Index to Advertisers.

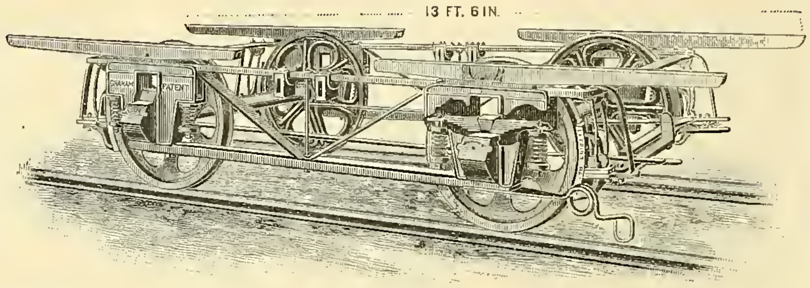
GRAHAM TRUCK.

TESTIMONIALS

General Manager Potter, Union Railroad, Providence: "I am well pleased with the truck."

Superintendent Wentworth, Haverhill & Amesbury Street Railway: "It is the truck that street railway people are looking for."

Superintendent Pond, Winchester Avenue Railroad, New Haven: "I consider it is the best truck in the market."



TESTIMONIALS

Boston *Herald*, September 17, 1893:—One thing is certain, Bath has the finest riding electric trucks in Maine, if not in New England. There is none of that oscillation which troubles so many cars. Though they have to make a round trip of nine miles every hour, the motion is perfectly steady.

Bath *Times*, August 24, 1893:—The Graham rucks have proved all that was claimed for hem. President Shaw and the Directors are enthusiastic over the way they work, and call them the best and easiest riding trucks in the state of Maine. No matter how many people are crowded into the car there is no oscillation whatever, and they ride as steadily as a sleeper.

OUR TRUCK IS A REVELATION TO ALL WHO RIDE ON IT.

GRAHAM EQUIPMENT CO., - 258 WASHINGTON ST., BOSTON

WESTINGHOUSE ELECTRIC AND MFG. CO.

PITTSBURG, PA.

We Manufacture Complete Installations of
Electrical Apparatus for Electric Railways.

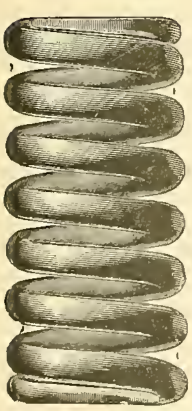
CENTRAL STATION ELECTRIC LIGHTING. LONG DISTANCE POWER TRANSMISSION AND ISOLATED PLANTS.

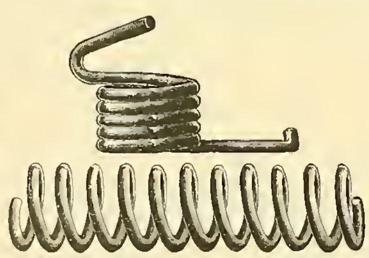
BRANCH OFFICES IN ALL LARGE CITIES.

Charles Scott Spring Co.,

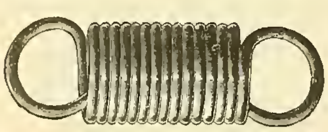
1028-1038 New Market Street,
PHILADELPHIA.

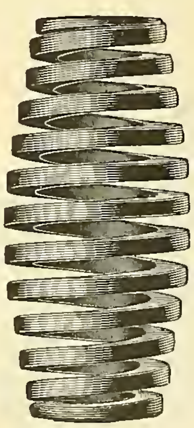
Springs for all Standard Trucks kept in stock.



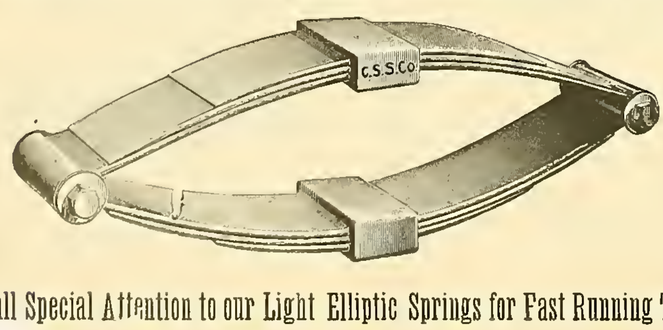


SEND US A SAMPLE SPRING AND WE WILL BE PLEASED TO QUOTE YOU......





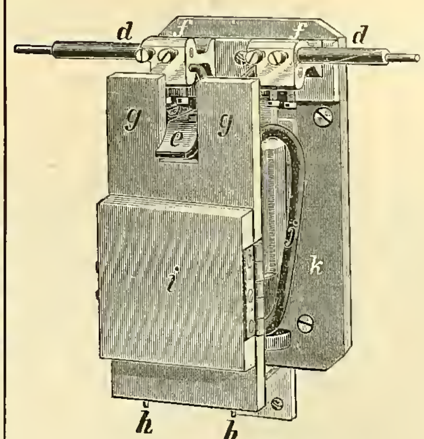
SPRINGS OF ALL DESCRIPTIONS.



We Call Special Attention to our Light Elliptic Springs for Fast Running Trucks.

SOLVED!!!

A Problem in Electric Railway Economy.



C–S AUTOMATIC MAGNETIC CUTOUT.

The C=S Automatic Magnetic Cutout

1. Locates a ground or short circuit to the car in which it occurs, and *stops that car only*, without disturbing the cutout at the power station.
2. It is easily adjusted and set to open at any desired percentage of overload. Once set there is nothing to be displaced or disarranged by any possible jolting or jarring of the car, and it requires no further attention.
3. It is compact and simple in construction, and is calculated to withstand indefinitely the roughest usage.
4. It is supplied at a price that is actually nominal for the service rendered.
5. It has been in practical and successful operation for the past two years.

C=S Quadruple Break Switch.

The only "Snap" Knife-blade Switch in existence competent to contro. incandescent lights on a

500-VOLT CIRCUIT.

In practice it has been proven adequate to control 20 lights on a 500-volt circuit For circular describing these devices, write to

The Cutter Electrical and Manufacturing Company,

27 South Eleventh Street, PHILADELPHIA, PA.

CENTRAL ELECTRIC CO.

CHICAGO.

STREET RAILWAY SUPPLIES.

Construction Tools, Hangers, Line Materials, Pins, Brackets, Porcelain and Glass Insulators, Etc.

OKONITE FEED WIRES,

CAR WIRES,

OKONITE and MANSON TAPES,

ARE THE LEADERS.

THE FERRIS WHEEL, WIRED WITH OKONITE.

INCANDESCENT LAMPS, TIED AND FREE FILAMENTS.

LUNDELL MOTORS FOR STREET RAILWAY CIRCUITS.

INTERIOR CONDUIT SYSTEM OF ELECTRIC WIRING,

THE ONLY PERFECT AND COMPLETE SYSTEM FOR INTERIOR WIRING.

STANDARD PAINT COMPANY'S Celebrated P. & B. Electrical Paints and Compounds Carried in Stock.

ELECTRIC LIGHT CARBONS FOR ALL SYSTEMS.

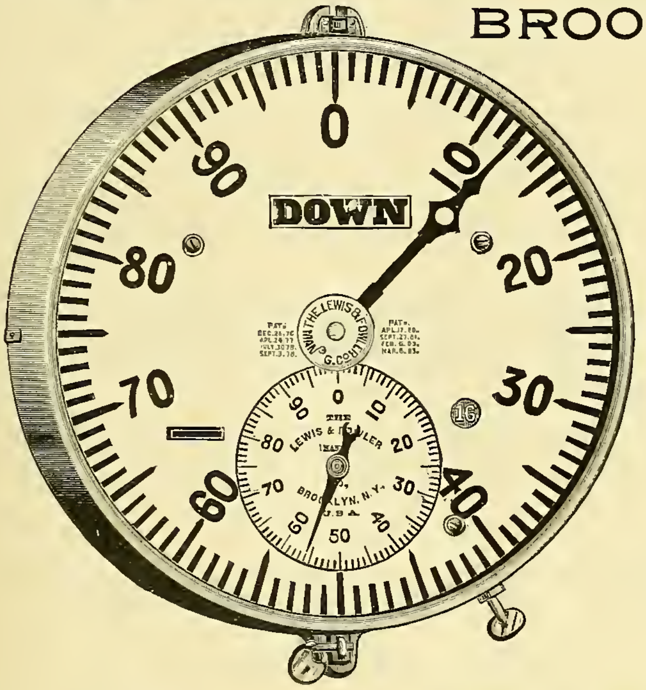
CENTRAL ELECTRIC CO.

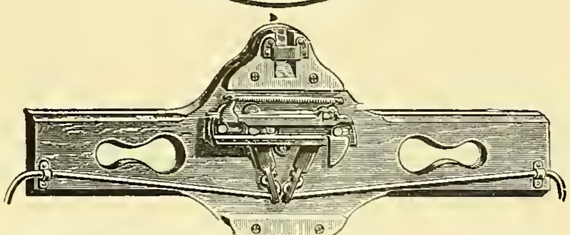
CHICAGO.

SPECIAL AGENTS - - - - SOUTHERN ELECTRICAL SUPPLY CO., St. Louis. - GATE CITY ELECTRIC CO., Kansas City, Mo.

THE LEWIS & FOWLER MFG. CO.

BROOKLYN, N. Y.

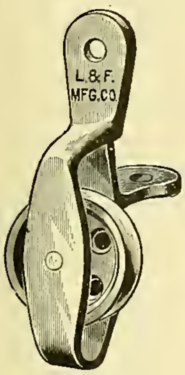


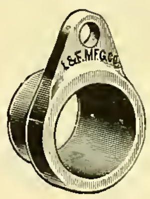


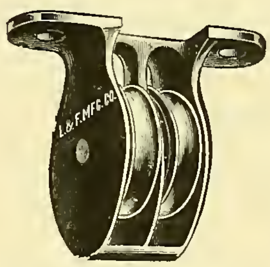
REGISTER BLOCK FOR OPEN CAR WITH CLOSED ENDS.

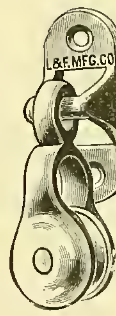
PATENTEES AND SOLE MANUFACTURERS OF

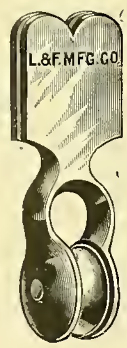
THE IMPROVED "ALARM" PASSENGER REGISTER





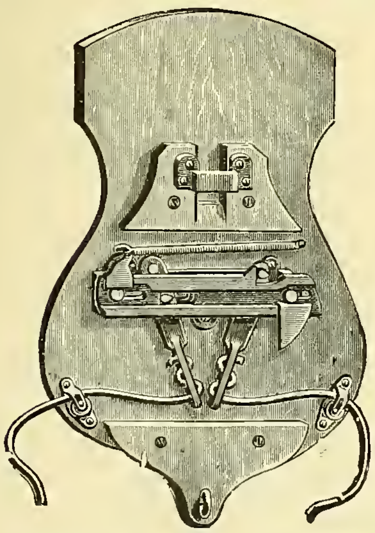




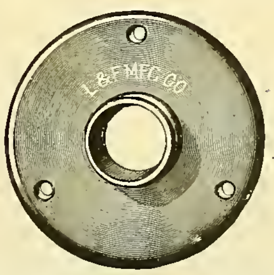


Acknowledged to be the Safest and Most Complete Register in the World.

HAS BEEN ADOPTED BY 500 RAILROAD COMPANIES.

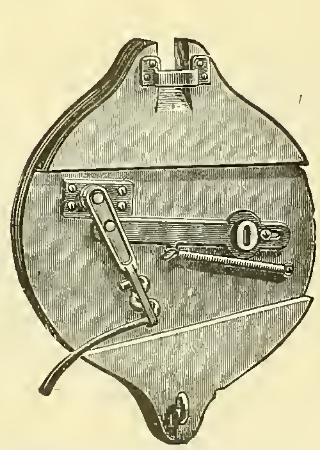


REGISTER BLOCK FOR OPEN CARS WITH OPEN ENDS.



Send for list of Railroad Companies that have Purchased our REGISTER.

Descriptive Circular Mailed on Application.



REGISTER BLOCK FOR CLOSED CARS.

OUR PATENT RECORD

IS WELL WORTH

A Year's Subscription.

TURN TO OUR LAST READING PAGE AND EXAMINE IT.

STREET RAILWAY GAZETTE

PUBLISHED EVERY SATURDAY BY THE

STREET RAILWAY GAZETTE COMPANY,

Monadnock Block, Chicago.

CLARENCE E. STUMP, General Manager.

EDITORS:

EDWARD CALDWELL. J. W. DICKERSON.

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We invite correspondence upon all subjects of interest to street railway men. Information regarding changes of officers, new equipment, extensions, etc., will be greatly appreciated for our news columns. Communications for the attention of the editor, new advertisements and hanges should reach this office not later than Thursday morning of each week.

Address all communications and remittances, and make drafts, checks, and money orders payable to STREET RAILWAY GAZETTE COMPANY, Monadnock Block, Chicago.

VOL. X. CHICAGO, JANUARY 6, 1894. NO. 1.

CONTENTS.

Fly Wheel Accidents. Within the last few weeks several power plants have been badly shattered by bursting fly wheels, and certainly during the last year three or four accidents of this kind have caused no little damage in electric railway stations. In this issue is presented a report of the damage to a plant from this cause in Des Moines. Is it possible that engine builders are neglecting this important part of their product, or how does the trouble arise?

A Compact Time Card. A compact time card distributed among the patrons of a street railway system will oftentimes prove of convenience to them, and indirectly serve to stimulate travel. An excellent form is that which is shown elsewhere in this issue. It has proved acceptable to the patrons of the line to which it refers, and as it costs the company nothing its distribution has proved satisfactory to all parties concerned.

West End Agreement. We give elsewhere a very important agreement of the West End Street Railway Company of Boston with its motormen, conductors, and drivers. This new agreement was made necessary by the enactment of a new law in the State of Massachusetts that so far as the West End Company was concerned became operative on January 1 of this year. It has already been complained of as working to the detriment of men who had been accustomed, by service on extra cars, to secure a day's wages for work extending over 15 hours. The new law makes it impossible for the company to employ the same man on its morning and evening extra cars as that would extend his service over more than 12 consecutive hours, and would therefore violate the new law. It is stated that the men themselves are the sufferers and that they formerly were glad enough of the opportunity to perform the required service even though it had to be spread out over such long hours. The company on its part claims, as will be seen from its letter replying to certain criticisms, to be doing all it can for its men under the requirements of the law. The agreement is in favor of the regular men but operates disadvantageously to the "regular extras," as the men are called who run the extra cars morning and evening.

Death of William Richardson. The first day of the new year brought the news of the death of William Richardson, one of the veterans in the street railway field, and the announcement was received with genuine sorrow. Mr. Richardson had an interesting and a striking personality, and he will be greatly missed in street railway circles. The conventions of the American Street Railway Association will scarcely seem the same without the familiar figure of the president of the Atlantic Avenue Railroad Company of Brooklyn, Mr. Richardson was a self-made man, and he possessed the strongest traits of character. He was determined and aggressive, and these qualities were necessary to his success, for his path to prominence was by no means an easy one. When he entered into a contest he was prepared to give and receive hard knocks. His aggressiveness made him the target for much criticism, but even before the death of this strong man all ill-feeling had passed away. Mr. Richardson was a firm, even enthusiastic believer in surface transportation, and Brooklyn, where he was known, at least by sight, to almost every resident, owes not a little to his confident belief in its possibilities, and street railway men generally may thank him for victories that he won that have made their work easier.

Arrests for Jumping on Cars. Early last month the city council of Chicago passed an ordinance making it an offense for boys to jump on or off moving street cars, and a few days ago policemen were instructed to enforce the regulation. Quite a contingent of boys ranging from eight to sixteen years of age was gathered in, and further arrests are to be made from time to time. If snch a measure could be so severely enforced that the common practice of boys jumping on street cars would be eradicated, superintendents and managers would live longer and far more happily. The habit seems to be so deeply seated and its indulgence appears to be productive of so much reckless enjoyment that few managers, we fancy, expect to live long enough to see the desire uprooted in the nature of the average boy. We know at least one superintendent whose eldest son, de spite repeated warnings, has been detected in the very act of surreptitiously boarding cars. It is a difficult matter to deal with. We have little confidence that the ordinance will be productive of much good; in fact by adding a new danger it may make the pastime even more fascinating. It is sickening to read of the accidents to these little chaps mangled or perhaps even killed because of their foolhardiness. We would be glad to know of an effective solution of the problem, we have heard of none.

No Strike in Brooklyn. It is now announced that the motormen and conductors of the Brooklyn City Railroad Company have determined not to strike at the present time for the obvious reason that they could see no probability of victory if they engaged in a fight with the company. The decision is a wise one; in fact it was the only one that could have been reached if ordinary intelligence was to be exercised. This assertion is true regardless of the merits of the existing controversy. Every street railway company is overwhelmed at the present time with applications for work, and no great difficulty would be experienced in finding men abundantly able to man cars in any of the great cities. The Brooklyn company, had its men struck for higher pay, might have been subjected to considerable inconvenience, but it was morally certain to win in a fight, especially as employes would not be supported by public opinion if they abandoned voluntarily their positions at such a time as the present. Everyone likes to have his pay increased, but he cannot reasonably expect an advance in seasons of financial depression. The street railway employe at the present time enjoys rare good fortune if his pay is not decreased. The present is an excellent time for rejoicing in the possession of means of support and for forgetting that such a plan of compulsion as a strike exists.

Our Practical Articles. Elsewhere in our columns this week we begin the publication of Nelson W. Perry's series of articles on "Electric Railway Motors; their Construction and Operation," which will extend over several months, and, as we have already outlined, will deal broadly with the fundamental principles of the construction of motors and generators, the details of their operation, the troubles with which motormen are likely to be confronted when running their cars in regular service, and the best methods of overcoming these difficulties. Mr. Perry's first article is necessarily somewhat introductory in its character and is intended to arouse among practical street railway men a desire for further study of the apparatus under their charge as well as for more accurate and detailed information regarding its construction and operation. The author will take up at once in the next and succeeding articles the elementary principles and the details about which practical men are so anxious to learn, but are too often unable to obtain the desired information even by asking questions of their superiors. There can be no doubt about the advantages that will accrue to any street railway company from placing within reach of its men the opportunity to secure the valuable instruction that this series of articles will contain. Any company can well afford to pay for a sufficient number of subscriptions to the STREET RAILWAY GAZETTE to supply its shops, car-houses, power-stations, and conductors' and motormen's waiting rooms with all the copies needed, since the more efficient staff of men thus obtained would take better care and exercise a more intelligent supervision over the apparatus entrusted to their care. Besides Mr. Perry's articles, much valuable information intended for the same class of employes will be presented in this department of the STREET RAILWAY GAZETTE. In this issue one article is given detailing a motorman's method of obtaining the exact speed of his car in miles per hour, and another pointing out how a motorman may save considerable current and at the same time prevent overheating his motor. Similar material may be expected from week to week. No motorman can make a mistake in sending his subscription to begin with this number and thus obtain all of the series of articles, as well as the supplementary matter similar to that presented in this issue.

WASTEFUL USE OF EXHAUST STEAM.

Economy from the use of exhaust steam from an engine for heating purposes has become so generally looked upon as a matter of course that it would seem to many almost like rank heresy to question the advisability, in any case, of utilizing so obviously valuable a waste product—in fact to actually recommend throwing it away and substituting in its place live steam from a boiler.

Every engineer knows that after steam has performed its legitimate function in a non-condensing engine and has there reached its limit of usefulness as a propelling agent behind the piston, it still possesses a very considerable amount of heat which can be profitably extracted in a variety of ways. For years, in fact, sermons were preached and are still being preached, on the advantages to be derived from the several methods of turning this steam to some account, until, at last, owners of boilers and engines became educated up to that point where they recognized that by passing the exhaust through heating systems and feed-water heaters, instead of allowing it to escape directly into the open air, they could virtually get something for nothing.

That in laying out such systems, however, there are qualifications to be observed which may make all the difference between gain and loss seems to have been overlooked in many instances, and, as a consequence, suggestive results can be found in numbers, strikingly showing that exhaust steam may sometimes be profitably allowed to go to waste.

Brief mention of one of several cases, as mentioned by a writer in *Cassier's Magazine*, may be of interest. The facts in the one here selected were ascertained in indicating an engine with the view of obtaining a proper basis for steam charges. The back pressure observed amounted to about 15 pounds per square inch, and was due to the fact that the exhaust steam was passed through a series of coils of 2-inch pipe, placed in a tank which served as a feedwater heater. It was, of course, a question of some interest to the users whether this way of heating the feed-water was a good one, or whether better results could be obtained by pumping water into the boiler at its normal temperature and allowing the engine to exhaust freely into the open air through a larger pipe, thus bringing the back pressure down to the atmosphere or, at least, near it. A few simple calculations showed that, when working against the back pressure, the engine used about 1,100 pounds of steam, equivalent to about 120 pounds of coal, more per hour than when exhausting freely into the open air, and this steam did work in heating which would have been easily accomplished by about 22 pounds of coal if burnt directly under the boilers. It seems almost needless to say that the heater was removed and that its owner had learned something about exhaust steam using that was in the nature of a revelation.

FORT WAYNE RAILWAY'S DONATION TO CHARITY.

On Christmas day all the money collected on the various street car lines of Fort Wayne was generously donated to the poor fund by the street car company. During the day 12,584 passengers were carried and 10,129 cash fares were collected amounting to $514 33. This is $110 more than was collected a year ago. One hundred and ninety-seven tickets were used and twenty-seven employes rode on passes.

The Metropolitan Electric Company of Chicago has opened a new and commodious store and salesroom at 186 Fifth avenue, where customers will find a great variety of supplies and a full line of the specialties which the Metropolitan Company is placing upon the market.

PROBLEMS FOR STREET RAILWAY ENGINEERS.

[Under this heading we will present each week during 1894 some practical street railway problem, the solution of which will call for the exercise of the same kind of engineering ability that is necessary in the every day practice of the consulting or designing engineer. Solutions to these problems are solicited and will be published when considered sufficiently accurate or when they contain valuable information.—Eds.]

PROBLEM I.—Given a double track line of electric railway located so as to connect two towns, one of 8,000 population and the other of 20,000, nine miles apart over a practically straight line nearly free from grades. Cars are to be run at 15 minute intervals from 5 A. M. to 10 P. M., except morning and evening, when for about an hour this interval is reduced to 7½ minutes. The schedule time from one end of the line to the other is fixed at 45 minutes. Both towns are manufacturing centers and there is a good prospect that the traffic may increase to double that originally planned for. At the larger town, owing to the existence of an abundant supply of water power, electricity for the operation of the road can be produced at about two-thirds the expense required for its production at the smaller town by a steam plant, interest charges on the original outlay (except for real estate), and depreciation of plant being taken into consideration. In the larger town real estate is valuable and a site for a power house would cost about $10,000, while in the smaller town a site would not cost over $2,000, and taxes and insurance rates vary correspondingly. At the center of the line a free site for power and car houses could be obtained, but owing to the increased cost of fuel power produced by steam plant would cost about 10 per cent. more than at the smaller town. Required the most economical location for the power house and the amount and distribution of the copper wire necessary for the operation of the line from the site selected. State in detail the factors that determine the location of the plant.

BURSTING OF A FLYWHEEL IN THE DES MOINES POWER STATION.

Brief mention was made in the last number of the STREET RAILWAY GAZETTE of an accident in the power station of the Des Moines (Ia.) Street Railroad Company on December 23. On that date the flywheel of a 500 horse power engine suddenly burst, and the pieces tore through the roof and demolished the flooring about the engine. The flywheel, which was 24 feet in diameter and weighed 125 000 pounds, was making 60 revolutions per minute at the time. It had been in use for three years and had given no signs of weakness. General Manager George B. Hippee writes as follows to the STREET RAILWAY GAZETTE regarding the accident:

"The trouble occurred at about 10 o'clock in the morning, when everything was seemingly running very smoothly and nicely. The engine was a 30 inch by 60 inch Lane & Bodley engine. The flywheel seemed to go to pieces all at once. An examination of the various pieces of the broken flywheel readily showed the cause of the accident; the metal used in the casting was very poor and rotten; in some places the face of the wheel was two inches thick and in others only half an inch thick. In our engine room there are three engines; one to the extreme east, one to the extreme west, and this large engine, to which the accident occurred, was in the center of the room. The engineer and dynamo tender were in the engine room at the time of the accident.

"The greater part of the wheel seemed to be in the bottom of the pit, although some of it was thrown upward through the roof and out into the yard, and some straight ahead through the door and wall south into the yard; the rim and spokes were mostly broken in small pieces. It seems almost a miracle to us that this wheel could break and the pieces fly through the roof, through the wall and all through the room, without in some manner injuring some of the dynamos or some person.

"Our force at once went to work clearing up the wreck and putting our other engines on to the lines shaft, and in just an hour and a half after the accident happened, we had our cars running. Our large engine was only partially damaged by the accident. The cylinder was not injured in the least. We anticipate that it will take us about two months to get the damage repaired and the engine fixed up in working order again."

Compact Street Railway Time Card.

The accompanying time schedule, which went into effect on November 1st on the Beaver Valley Traction Company of Beaver Falls, Pa., is the work of Hartford P. Brown, General Manager of the company. The form was evolved from the cumbersome sheet of old after much thought and experimenting, and it has proved extremely useful in service. The form was first prepared for the use of the employes of the company, but the patrons of the line clamored for them in such numbers that Mr. Brown found it necessary to print them in large quantities. The fact that the

Schedule Beaver Valley Traction Co.

Eastern Standard Time. CARS 10 MINUTES APART.

	5 Minute Departure.	15 Minute Departure.	25 Minute Departure.		35 Minute Departure	45 Minute Departure	55 Minute Departure
DOWN.				DOWN.			
Geneva Park	.05	.15	.25	Geneva Park	.35	.45	.55
17th Street	.10	.20	.30	17th Street	.40	.50	.00
Postoffice	.15	.25	.35	Postoffice	.45	.55	.05
Bridge	.20	.30	.40	Bridge	.50	.00	.10
Broadway	.25	.35	.45	Broadway	.55	.05	.15
Elverson	.30	.40	.50	Elverson	.00	.10	.20
Junction	.32½	.42½	.52½	Junction	.02½	.12½	.22½
Sharon	.35	.45	.55	Sharon	.05	.15	.25
Bridgewater	.40	.50	.00	Bridgewater	.10	.20	.30
Beaver	.45	.55	.05	Beaver	.15	.25	.35
Groveland	.50	.00	.10	Groveland	.20	.30	.40
UP.				UP.			
Groveland	.50	.00	.10	Groveland	.20	.30	.40
Beaver	.55	.05	.15	Beaver	.25	.35	.45
Bridgewater	.00	.10	.20	Bridgewater	.30	.40	.50
Sharon	.05	.15	.25	Sharon	.35	.45	.55
Junction	.07½	.17½	.27½	Junction	.37½	.47½	.57½
Elverson	.10	.20	.30	Elverson	.40	.50	.00
Broadway	.15	.25	.35	Broadway	.45	.55	.05
Bridge	.20	.30	.40	Bridge	.50	.00	.10
Postoffice	.25	.35	.45	Postoffice	.55	.05	.15
17th Street	.30	.40	.50	17th Street	.00	.10	.20
Geneva Park	.35	.45	.55	Geneva Park	.05	.15	.25

The minute divisions of time are used in above schedule, and the proper hour numeral may be assumed to make complete schedule for any hour of the day.

Cars must be run in accordance with Block Signal Rules.

All Conductors and Motormen must provide themselves with time pieces, and keep them set with regulator in Dispatcher's office.

HARTFORD P. BROWN, GENERAL MANAGER.

NOVEMBER 1, 1893.

time table was novel and compact caused it to be so popular that a prominent local merchant saw at once that it would prove a valuable advertising medium. He agreed to pay for the printing in return for the privilege of using the reverse side for advertising his goods. The card can be folded in the middle so that it can be readily slipped into the vest pocket. It is doubtless the fact that a time card like that of Mr. Brown's could be adopted with advantage by a great many railway companies.

The New Motor Man.

An observer in the Philadelphia *Times* has been watching the process of breaking in new motormen on the electric lines. His statement of the progress and experiences of the latter are accurate and are given herewith:

The new motorman on the trolley cars is put on a car with an experienced man. For two days he stands on the front platform and watches the driver manipulate the brake and turn the current on and off. After he has learned this and become familiar with all the curves and switches he is allowed to try his hand at running the car. The first thing he does after the car starts is to get nervous and wonder how long it will take him to bring it to a standstill after a passenger has signaled that he wants to get off. He begins to sweat, and before a car has gone half a mile he is played out and is glad to give up to his teacher. This goes on for about a day, or until the new man gets a little confidence, and then he gradually learns the trick of stopping the car so quickly that it will bring the passengers to their feet. He is obliged to gain a knowledge of the construction of the motor to be able to repair slight breaks and put in burned out fuses. It is usually about two weeks before he is competent to take charge of a car alone, and even then he can learn something more about running one every day.

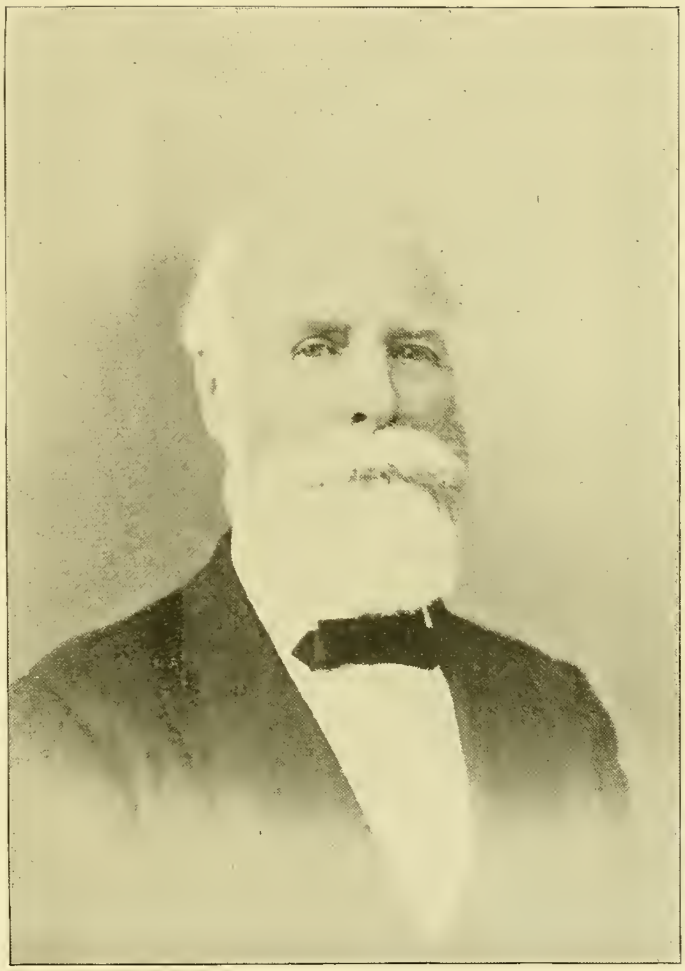
DEATH OF WILLIAM RICHARDSON.

With the death of William Richardson in Brooklyn on the last day of 1893, one of the most interesting and strongest figures in the street railway world passes away. For over a quarter of a century he was identified with street railway interests, and his connection was of such a character that his name was brought prominently before the public. He was enterprising, independent and aggressive, and these traits often made him the mark for criticism not always of the most friendly order. Early in the present year · Mr. Richardson retired from the presidency of the Atlantic Avenue road of Brooklyn after twenty-five years of service, and did not subsequently actively engage in business. He was taken ill with grip in the latter part of December; the disease rapidly developed into pneumonia, and on December 27 a consultation of physicians was held. They found that the patient was beyond human skill, and he sank gradually until December 31 when he passed away. Mr. Richardson leaves a wife, three sons, W. J. Richardson secretary of the Atlantic Avenue Railroad Company of Brooklyn and secretary of the American Street Railway Association, Dr. John E. Richardson of Brooklyn and Charles A. Richardson of New York and one daughter, Miss Louise Richardson.

Mr. Richardson was born in Berkhampstead, England in 1822. His father was a farmer. The son went to school until he was ten years old, but he did not enjoy a farmer's life, and his father apprenticed him to John B. Garman, who was then an eminent barrister, with offices in Lincoln's Inn, London. He had been there only a year when his mother died, and his father decided to come to America. They sailed on the clipper ship Sovereign, September 22, 1834. They went to Gambier, O. It took a week in those days to make the journey from New York. Mr. Richardson's first work was in a newspaper office in Mount Vernon, O., where he was employed two years. He was 18 years old when the Harrison and Tyler campaign was in progress, but he became intensely interested in the political fight. His liking for politics dated from that time. Although a mere boy he entered into the discussion of the interests at stake and proved to be quite an effective speaker on the stump. After the campaign he removed to Albany where he resided for nearly twenty-five years. Here he became greatly interested in the temperance movement, and was one of the most active organizers of the Grand Division of Templars of Western New York, of which he was electedthe first grand worthy associate. He took part,too in the "Anti-Nebraska" and "Free Soil" movements, which led to the formation of the Republican party. He was always an enthusiastic member of that party. He was a member of the first Republican State Committee of New York. In 1857 he was elected Clerk of the State Assembly. The year following, when there was a tie in the Assembly, he acted both as Clerk and Speaker. He was reëlected in 1859 and 1860.

Subsequently he was employed for some little time in the office of the Albany *Evening Journal*. In 1861 he was appointed by President Lincoln an additional paymaster in the United States army. Four years after, when he had resigned his position, Thurlow Weed, who had been his political sponsor, asked him one day what he expcted to do for his living. Mr. Richardson answered, "Any honest business except holding office." Mr. Weed offered him the place of superintendent of the Dry Dock, East Broadway and the Battery Railroad Company. This was November 15, 1864, and from that day to the day of his death he prospered as a street railroad man. Two months after entering the service of the company he was made its president. His management increased the business of the road from $600 to $2,000 a day. He continued with the company for two years and a half, when he secured a forty-year lease of the old Brooklyn and Jamaica Railroad Company. The line was in a dilapidated condition and he improved it materially. In 1872 an old mortgage on the property became due, and Mr. Richardson secured the road at the foreclosure sale and organized the Atlantic Avenue Raiload Company. The railroad was extended until it now comprises ten independent lines. Mr. Richardson's interest in the property was acquired last year by the Brooklyn Traction Company.

Mr. Richardson was familiarly known as the "Deacon," although he never held this office in the Baptist Church, of which he was a member. The title was applied in newspaper reports of a controversy growing out of Sunday track laying in Brooklyn.



WILLIAM RICHARDSON.

In 1870 Mr. Richardson was elected to the Brooklyn Board of Aldermen and ware elected the following year. In 1878 he was nominated for the State Senate on the Republican ticket and was defeated by a small majority. He asserted then that he was not cut out for a politician and said that he proposed hereafter to stick to railroading, and he did not break his word.

Perhaps no railroad manager in the country passed through more excitement than Mr. Richardson. He had a number of interesting experiences in strikes. In 1886 he undertook to quell a strike on the Dry Dock road in New York, in which he owned a large interest, and all his men in Brooklyn also struck. But he successfully managed both strikes and did not grant the demands of the men. He had Superintendent Murray and 600 policemen take a car through Grand Street, New York, and Police Commissioner Carroll rode on the front of a car to awe the strikers in Brooklyn.

In 1889 the Atlantic avenue road was tied up for six days and New York lines so far as they could be controlled by the Knights of Labor, were also stopped. On the first car that was run Mr. Richardson rode on the front platform a conspicuous figure, with his snow white hair and full white beard. It was three weeks before the company was wholly victorious and the last line was put in operation. The outcome of the strike settled negatively the claim that it was necessary for a railroad company to run a car at least once a day to retain its charter rights. The following year there was organized among the employes the Atlantic Aid Association that has been instrumental in promoting frendly relations between the management and the employes. Mr. Richardson resigned his office of president early in 1893 at the end of a period of twenty-eight years of active work in the street railway field.

Mr. Richardson belonged to various organizations. He was a Free Mason, an Odd Fellow, a member of the Masonic Veteran Association, and many civic societies. He was a director of the Baptist Home and one of its most prominent supporters.

Reports of Two New York City Street Railroads.

The annual report of the Metropolitan Crosstown Railroad Company, for the year ending June 30, 1893, as made to the Railroad Commissioners of New York State shows the following:

EARNINGS EXPENSES AND CHARGES.

Receipts.	1891-2.	1892-3.
Gross earnings	$159,539	$847,883
Operating expenses and taxes	119,178	611,458
Net earnings	49,361	236,425
DISBURSEMENTS.		
Interest on bonds	30,000	30,000
Rents and guaranteed interest	3,140	179,441
Total	33,140	209,441
Surplus	7,221	26,984

The report of the Houston Street & Pavonia Ferry Company, which leases the Broadway & Seventh Avenue, the Sixth Avenue, the Ninth Avenue, the Twenty-Third Street and the Chambers Street & Grand Street Ferry roads, for the same period, the year ending June 30, 1893, makesthe following showing: Comparisons are also given for the two previous years operation so that the difference between the present earning capacity of the road and that formerly existing can readily be seen.

EARNINGS, EXPENSES AND CHARGES.

	1890-1.	1891-2.	1892-3.
Gross earnings	$2,005,561	$2,261,983	$3,170,703
Operating expenses and taxes	1,453,218	1,747,657	2,383,013
Net earnings	$ 552,343	$ 514,326	$ 787,690
Other income	923	14,383	4,137
Total	$ 553,266	$ 528,709	$ 791,827
Deduct—			
Interest on bonds	$ 33,495	$ 33,495	$ 33,495
Rentals	529,248	453,083	667,521
Total	$ 562,743	$ 486,578	$ 701,016
Surplus	def.$ 9,477	$ 42,131	$ 90,811

Assignee Appointed.—On Wednesday, January 3, the Railway Equipment Company of Chicago made an assignment to Geo. O. Fairbanks. The reason assigned for this step is the inability of the company to meet its accruing obligations. As soon as the statement of the company's affairs can be prepared it will be submitted to the creditors. It is claimed that the goods in stock and other assets will considerably exceed the liabilities.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

Some years ago I became acquainted as a boarder, with a bright young man who introduced himself to me as an electrician. It happened that we were placed at the same table, and as he was of an affable disposition we soon became very well acquainted. Whenever the subject of electricity came up, he was accustomed to speak in such a way as to impress all his hearers with the idea that he was an authority on all such subjects whose opinions were not to be questioned, and as he was generally correct in his statements I also became somewhat impressed with his knowledge, and would often ask questions—sometimes for information and sometimes to see how nearly his opinions coincided with my own.

I found that he had been sent out by the then leading company engaged in electrical railway construction and his business in that city (a Western one) was the construction of its first electric railway. We soon became quite good friends and when the power-house was nearing completion I was a privileged character within its walls, for visitors were rigidly excluded as a rule; and later when the first tests of the operation of the road were made, I was one of the fortunate few invited guests.

The first car over the line started out from the barns at 10 o'clock at night and carried as passengers besides myself and the gentleman referred to, but three others—all officials of the road. Everything went smoothly until the further terminus—about three miles distant—was reached—when something gave way and we were stalled.

I must add here that my friend had not yet discovered that I was myself an electrician. I had had no other object in concealing the fact than that as I had not been asked my business, it had never been necessary for me to declare it, and I felt that he would talk with me more freely if he did not know it. He knew that I was an engineer, however, and he attributed my ability to solve certain questions which arose, to that fact—to that combined with what he took to be a smattering of electricity which he supposed I had acquired in some way or other.

As a matter of fact, however, I considered myself a full-fledged electrical engineer, and was, as electrical engineers went in those days, for besides having had a pretty thorough training on the purely theoretical side of electricity, I had worked in two of the largest shops in the country in all the departments of electrical manufacture. I had wound armatures and fields, and assisted in making and dressing down all the other parts of machines, both large and small; had assembled these various parts, connected them up, soldered the connections and finally tested the completed machines. I had also assisted in installing one road myself, and had inspected every road but one that was at that time in operation in the country, so that I was pretty familiar with electric railroad construction as then developed. I knew that my friend's experience had not been nearly as wide as my own, and I was glad to be with him on the occasion of the opening test of this, which I suspected, was the first road over whose construction he had been completely in charge.

Well, as I say, something had happened, which was only really discovered when the attempt was made to run the car back. There was a considerable grade at starting and this the car failed to ascend. We backed down to the level and tried it again. The car worked all right until the grade was reached when she stopped again. This was repeated a number of times and always with the same result. My own experience made me suspect at once the true trouble but it would not do for me to suggest. My friend had been playing the role of a great authority on electric railroad matters for the special benefit of his invited guests on the car. He was in very high feather, and not without reason, that night, because the work of his hands was finished, and now he was showing his admiring guests how immeasurably better it worked than even his own anticipations had led him to hope.

For me to have suggested the cause would have been considered a piece of impertinence of the highest order, not only by him but by the other guests, who looked upon my friend as a wonderful man; so I kept quiet.

My friend was a man of great self-confidence and equal to the emergency. In reply to inquiring glances, he said it was due to "something or other"—using a term not down either in Webster's or Houston's dictionaries—that it was a very trivial matter and could easily be fixed; he would back down to the level again and fix it. He did so—that is, he backed down, and, after making an examination, said: "Yes, that's it, just as I thought; the 'something or other' was just what caused the trouble;" and he straightway proceeded to correct the thing. In the meantime I had had an opportunity of verifying my suspicions, but of course kept my counsel. When all was declared ready we entered the car again and my friend, who really had done nothing, as far as I had been able to see—he certainly hadn't touched the root of the trouble—turning on the current to the last notch, said, "now we go;" and we did, until we had gotten even a little way beyond the point on the grade where we had always stalled before, and then we stalled again. We had gained a few feet over previous attempts simply because we had gained a little more momentum on the level. I think my friend understood this as well as I, but he pointed to the small gain with apparent pride, and with unblushing assurance stated that that proved that he knew he was right in locating the trouble, and that now he would run back and fix the thing for good. We went back and he got under the car again. I watched him closely this time, and after doing absolutely nothing more than fumble around a little he came out and announced that "now I've fixed her for good, and I'll show you how we can mount that grade."

I have often heard it claimed by horsemen, and have seen several instances myself where good results seemed to follow the plan, that to start a balky horse, the best way is to simply jump out of the wagon and pretend to fix the horse's bridle, then get in and on giving the signal, the horse which neither whip nor oaths could budge before, would start right off as though nothing had happened. This was exactly what my friend seemed to have done and nothing more, and when, after we had all followed the injunction to get "aboard" he commenced to turn on the current I could not but be astounded at the cheek or rather the assurance which enabled him to keep up the appearance of entire confidence in the success another attempt which he *knew* must fail for *exactly* the same reasons the other had. It is needless to state what the result was, further than to say that we did not get quite as far this time as we had before, and it is also needless for me to state how with equal composure he gave some excuse for going back again to the starting point. I think he said he had forgotten his monkey-wrench or something else.

I determined this time to speak and when we stopped at the bottom I got off and commenced looking around as if hunting for something and stooping down, some distance from the car so as to get him alone, cried out "I've found it," and as I expected, he rushed over, leaving the others behind and I whispered "look at your positive brush on the front motor." He heard me and understood. He stooped down, though, as if to examine what I pretended to have found and then in tones loud enough to be heard by the others said "No that's not it, but I've got something that will do as well," and lost no time in getting under the car and repairing the broken connection which had rendered useless one of our motors.

When we got onto the car again and he grasped the controlling switch, I know I had more confidence that we could ascend the grade, but his appearance betrayed not one whit more than it had on the two previous attempts. As for the other parties, I am sure there was never a suspicion. We completed the return trip in great shape, and the trial trip was pronounced a success, and my friend was the hero of the hour. We returned to the car barns, and after he had seen everything safe for the night we walked home together. He seemed buried in deep thought for some distance, but finally broke the silence by, "you played me a darned mean trick." I was very much surprised at his attitude, thinking that he should rather have thanked me for helping him out of his difficulty. I knew that he would have found the difficulty after awhile if left to his own resources, but thought I had saved him some embarrassment which further delay might have caused him, so I laughingly asked, "how?" to which he replied: "By not letting me know before that you were an electrician."

The above anecdote is related merely to show how a little bravado judiciously used may save a reputation where entire candor would be fatal, However reprehensible this practice may be in the abstract, it is one that pervades all walks in life and is nowhere more prevalent, perhaps, than in the medical profession. It is in fact often used there to advantage, for if the physician should fail to inspire his patient with confidence in the beginning, it would be almost impossible for him to succeed later, and it is conceded that confidence in one's physician as well as in the remedies one takes is of the greatest help in curing disease.

If we find this practice so general in such an honorable profession as medicine, it is not surprising if we find it in the motorman, nor can we disparage it there while we uphold it elsewhere. In fact I believe the motorman or electrical artisan is really less to blame than many others, by the circumstances of his position. Most often the electric motorman has obtained his position as a reward for faithful services as a driver or conductor of a horse car. In his previous occupation his hours have been long and his work exhausting both to mind and body, and when his day's work is done he is in no condition for study or more work. Besides, as a driver, he has probably mastered his business and there has been no incentive to further study.

With this habit of mind he is transferred without any special preparation to the responsibilities of the care of the electrical equipment of his car. He is broken-in by some one who has had a little more experience than he has had and after having been shown the various parts of his apparatus and how they are intended to operate, is given a set of rules which tell him that he must do this and must not do that, and is allowed then to shift for himself. He is expected to talk about a current which he can't see and to guard against results which he knows only by name. A new language is placed in his mouth which he does not understand, but which he understands somehow is intimately connected with his business. His hours are no shorter than before and books which would explain matters are too expensive even if he had time to read them, or entirely inaccessible. His companion motormen are using this new language familiarly and he soon acquires that habit almost unconsciously, and as soon as he is thus initiated into the charmed circle which speaks this foreign language he becomes with his brother motormen a class distinct from that class from which they have all sprung. If he knows little of electricity, he still knows more than his former companions and they treat him with a respect due to his superior knowledge. It will not do for him to admit ignorance and he has an answer ready for every question. Nor does he care to show his ignorance among his companions by asking them questions or by asking questions of others in their presence and in this way too often stands in his own light.

That the average motorman is anxious to inform himself where he can do so under circumstances which are not embarassing, I know well from personal experience, for I have had individuals ply me with questions when they could get me alone who would rather have died, almost, than to have asked the same questions in the presence of fellow workmen.

No one blames them for this. It is human nature, and as I have stated before, they have shining examples in the same practice in members of professions considered more dignified than theirs.

It was in the firm belief that the motorman would gladly inform himself, and therefore improve his position, if the opportunity were but offered, that the editors of the Street Railway Gazette have asked the writer to contribute a series of articles on electrical subjects which should gradually lead up to the street car motor and its management.

I feel sure that if the readers of the Street Railway Gazette will follow these articles conscientiously from week to week, they will be able to gain an intelligent knowledge of the theory of the electric motor which will often stand them in good stead and enable them to master situations not usually provided for in the rules and instructions with which they are furnished. With this added knowledge they will not only be more self-respecting, but be more respected, and as their usefulness is increased to their employer so will their services to him become the more indispensable and preferment be more certain.

Overworking a Street Car Motor.

Probably every motorman has noticed that street car motors get quite warm when running in regular service and that the heavier the loads carried the hotter the motors become. This latter fact is due to the greater quantity of current that passes through the motor when heavy loads are carried,—in other words it works harder and like the car horse shows the results of its overwork in this way. It is a characteristic of the iron horse, however, that it will endure an immense amount of moderate abuse at the hands of its driver without displaying any symptoms of permanent injury. To be sure it will, like the mule motor, become excessively hot if persistently and continually overworked, but even then if properly cared for rapidly recovers its normal condition and when properly "rested" will be as fresh as ever for a new day's work. There is one kind of abuse however, to which motormen are very likely to subject an electric motor which is sure to result in a waste of current even if its effects are not noticeable on the apparatus itself. We refer to the tendency when starting a car to throw the full strength of the current through the motor as soon as possible after the wheels begin to turn. This is a topic to which we have already called attention but the subject is well worth careful consideration.

To be sure the desire to put the car under full headway, after a stop has been made, without wasting time is commendable enough, but the method of doing this as often practiced results in an extravagant and unnecessary use of current. It is a well-established fact that while an armature is turning very slowly, the current, if given an opportunity by the man who handles the switch, will rush through it at an enormous rate, As soon, however, as the armature acquires even a fair rate of speed, although this may be much below the normal rate, the current flow will decrease very rapidly. The simple experiment of placing an ammeter in the circuit of any car, and watching the violent throw of its pointer as the car is started suddenly, will show how enormous this flow of current can actually become at the instant after or even before the armature begins to turn. If the car is heavily loaded or the brakes happen to be set the effect will be all the more noticeable. The writer recalls an instance in which the trolley wire was burned completely off by an excessive flow of current due to a hot box that prevented the wheels from turning.

Now an experienced horse car driver knows well enough that he can actually get more service out of his horses and make better time if he starts his car slowly and applies the surplus strength of his horses after the car has acquired a fair amount of momentum. The case is not very different from that of the electric motor that has taken the horse's place. Since the heating effect of the current increases with the current, the excessive flow at the moment of starting heats the motor unnecessarily, and renders it a less efficient machine, or, in other words, less work can be got out of it for a given amount of current put in. Of course it is understood that very much more current must be used in starting a car than after it has acquired its maximum speed; but we merely wish to direct attention to the fact that the prevailing custom of opening the car switch too suddenly is an unwarranted and uneconomical abuse of what has proved to be a long-suffering piece of machinery. Like the car horse, however, its best service is secured by giving it good treatment when doing its hardest work.

A Motorman's Method of Determining the Speed of His Car.

In many of the cities where electric cars have been introduced the municipal authorities have fixed the maximum speed of the cars at a fixed rate. In some cases this is six miles per hour, in others eight and in still others ten or more. Whatever this may be it is desirable that the motorman should be able to ascertain with some degree of certainty at about what speed his car is running. In case of accident this is often a disputed point, since the company may be obliged to prove that its car was not running at a higher rate of speed than that prescribed by law. The method of judging the speed of the car by the time required to pass a certain number of poles as may be done on a steam railroad is not applicable, because street railway poles are not set at any uniform distance apart and this is especially true in business streets, where the question of speed is of the most importance. For a similar reason it is not possible to estimate the speed by the time required to run one or more blocks.

A very simple method however is applicable to almost every road upon which electric cars are operated and can easily be used by any conductor or motorman. This method makes use of the length of one of the track rails as a unit of distance and all that it is necessary for the motorman to do is to count the number of rail joints passed over in a certain number of seconds. This can be very easily done on all ordinary roads, as the cases where the joints are so perfect that the "bump" of the wheels in passing over them cannot be either heard or felt, or both, are much more rare than than they ought to be. Assuming then that it is an easy matter for a motorman to count the rail joints as the car passes over them and that the rails are 30 feet long, as is usually the case, the speed may be determined by counting the rail joints passed over in 20 seconds. This will be the speed in miles per hour. If the joints are "staggered," instead of "matched," only half this number must be taken or the time of counting limited to 10 seconds instead of 20. This result comes about in this way. In one mile of track there are 180 thirty foot rails, very nearly. The exact number is 176, but for the sake of even figures we may take 180 as the number on which to base our calculations. Now if this number were all passed over in one minute or 60 seconds the speed would be of course one mile per minute or 60 miles per hour. But it is evident that 60 is the number of rail joints passed over in one-third of the run or in 20 seconds, so that if the number of joints passed in 20 seconds had been counted we would have had the speed in miles per hour. Suppose now that the speed is much below this and that only 10 joints were passed in 20 seconds. To run one mile at this speed, or what is the same thing to cross 180 joints, would require 18 times as long—360 seconds, or six minutes. In one hour, then, the car could run 10 times as far or 10 miles, so that we see our calculation based upon the number of joints crossed in 20 seconds was correct. Again, suppose only 6 joints are counted in 20 seconds, how does this indicate a speed of six miles per hour? To run one mile or cross 180 joints would require 30 times as long—600 seconds or 10 minutes, and at this speed a car would run of course six miles in 60 minutes or one hour.

But what if the rails are 32 feet long instead of 30? The only difference this will make is that we must then count the joints for 22 seconds instead of 20. For instance, suppose we find that 10 joints are crossed in 22 seconds. This is a distance of 320 feet. To run one mile or 5,280 feet at this speed would require $16\frac{1}{2}$ times as long, or 363 seconds. Without appreciable error we may disregard the three seconds, which is only about one per cent. of the whole time, and call this result 360 seconds or six minutes, and we see at once that a car running a mile in six minutes is running at a speed of 10 miles an hour.

At there is usually no difficulty in counting the joints for 10 or 20 seconds this forms a very convenient method of ascertaining exactly the speed of the car.

In this connection it may be of interest to refer briefly to another method of determining the speed when for any purpose speed trials are made. This method is also applicable to bicycle speed tests or even to the testing of the speed of runners. The rule is this:

Take any convenient distance in yards, and take the time required to traverse that distance in seconds; then twice the distance in yards divided by the number of seconds will equal the number of miles per hour, nearly. To be more exact add one-fortieth.

Thus, 440 yards traversed in 15 seconds $=440\times2\div15=58.66$ miles per hour; then adding one-fortieth, or 1.46, we have 60.12, the true value being 60.

Again, say 20 yards traversed in 5 seconds; then $20\times2\div5=8$ miles per hour approximately. In most cases it is unnecessary to add the one-fortieth, because the error of observation would probably exceed that amount.

The Edson Gauge Wins the John Scott Legacy Medal and Premium.

The John Scott Legacy Medal and Premium, held in trust by the city of Philadelphia, under the legacy of John Scott, of Edinburgh, to be used for the encouragement of "ingenious men and women who make useful inventions" provides for the distribution of a medal inscribed "To the Most Deserving," and a money premium in the sum of $20. Both have just been awarded to Jarvis B. Edson, of New York, for a pressure recording gauge, by the Franklin Institute, which has been delegated by the Board of City Trusts, of Philadelphia, to make investigations and awards.

The general adoption of these instruments proves their indispensable nature, for in no other way can a proprietor place himself in a position to know how the steam pressure is carried during night and day, or how much inattention accompanies the firing. It is a well established fact that carelessness and indifference at the furnace door waste coal in an amount often sufficient to pay an extra dividend to say nothing of loss in the cylinder from lack of initial pressure and proper economy from expansion of the steam, for the fireman little understands the necessity for maintaining high initial pressure. "Following" too far or "cutting off" too short are both wasteful of steam, and can only be controlled by the fireman carrying, uniformly, such a pressure on the boilers as the engine requires for the work it has to perform.

DECISIONS REGARDING THE MUTILATION AND REFUSAL OF COUPON TICKETS.

BY R. D. FISHER.

The Supreme Court of Michigan has recently rendered an important and interesting decision in the case of Rouser *vs.* North Park Street Railway Company, of Grand Rapids. The following statement and synopsis of the cause and decision, together with a note bearing on the subject of contractural relations of carrier and passenger, it is hoped, may prove interesting and profitable to the readers of the STREET RAILWAY GAZETTE.

The defendant street railway is operated in connection with another line. The plaintiff boarded a car upon the Valley City Street and Cable Railway Company's road, and paid the conductor the regular fare which under existing contracts between such connecting lines entitled him to a continuous ride over both lines. The conductor took two coupon tickets, and putting them together, tore them in two, retaining the lower portions, and handing the upper parts to plaintiff and a companion. In tearing these tickets, through carelessness, the conductor took not only the coupon belonging to his road, but with it about one-third of the upper coupon, which constituted the only evidence of plaintiff's right to ide over the defendant's road. Upon transferring to defendant's line the conductor thereof refused to accept these mutilated coupons, and required the plaintiff to get off the car, which he did, although he had money and might have paid his fare, had he been so disposed. He recovered judgment for nominal sums in the lower courts and the company thereupon appealed to the higher tribunal.

Upon review the higher court discovered that the record contains a sample of the tickets as printed; also the mutilated coupon in question. The complete ticket consisted of two coupons printed upon a single sheet, and separated by a perforated line, each coupon designed to be taken by the conductor of the proper road. The upper coupon was designed for use upon defendant's road. The ticket was a token, merely, rather than a contract. Each coupon had the following printed upon it: "V. C. St. and C. Ry. Co., A. J. Brown, Pres't." Upon the lower part were the words: "City Hall to North Park Railway Depot." Upon the upper were the words: "North Park Railway Depot to North Park." This was torn off by the conductor of the cable road, and it is maintained by the defendant road that the ticket contained nothing to apprise the conductor upon defendant's road of the right of the plaintiff to ride. These tickets were good for a ride the whole length of both lines. They were not used for any other purpose. They were of peculiar color and print, and susceptible of easy recognition. It was difficult to see how a conductor could have trouble in identifying a fragment as a portion of such ticket, with the office and use of which he must be supposed to be familiar. After inspecting the tickets, the court ruled as a matter of law, that the conductor was bound to know that the fragment was a portion of a genuine ticket used upon his line, which, if whole, would have entitled the plaintiff to a ride. It was evident that some one had paid a fare. But it was contended that the conductor was not obliged to take this, because it was mutilated; that it did not show the destination; and that to require it would subject the defendant company to the danger of having fractions of tickets used frauduently. The court, however, in this case expressed the opinion that when the plaintiff presented the upper half of his coupon, there was no reason for the belief that the other part had been, or could be, used illegally.

It was in evidence that the tearing of these tickets was an everyday occurrence, and that mutilations were not uncommon. When the upper portion of the coupon was produced by a passenger, the natural inference would be that the mutilation was the result of carelessness. The absence of the upper half would be a different matter, and could be accounted for in no such way. Nor is there any reason to apprehend the danger feared by defendant company that more than one ride could be obtained upon one ticket. Hence, the court, without attempting to lay down a rule upon the subject that shall cover all cases, did not hesitate to say that the fragment in question was such as to make its reception safe and prudent. The lower portion, or a fragment from an end, if presented, would stand upon a different footing. Neither could there be any uncertainty about the destination, as such tickets covered the whole length of the road between the points named. Therefore a ticket for a continuous ride over the whole length of a street railway and a connecting line was of a peculiar color and print, composed of two coupons, the upper of which was for use on the connecting line, and gave the names of its termini below, and the names of both lines above and a conductor of a connecting line was bound to accept for passage an upper fragment of an upper coupon, which gave the names of the lines, on the assumption that the conductor of the other line carelessly tore off the part giving the termini, in taking the lower coupon. In his refusal to so accept said fragment and the consequent ejection of plaintiff by reason of such refusal he rendered the company liable in damages.

CONTRACTURAL RELATION.

Where there is a legally enforcible contract between a street railway company and a passenger, the terms of that contract must, if they so far extend, determine the liability of the company for personal injuries, indignities or inconveniences suffered by the passenger. So if the stipulation be of such a character as to be against the the policy of the law to enforce it, the liability of the carrier will be dependent solely on the duty raised by the law.

CONNECTING LINES.

A street railway company is liable to one with whom it has contracted to carry to a point beyond the terminus of its own line and over the line of a connecting street railway, for any injuries, indignities, or inconveniences suffered on such connecting line.

REGULATION AND CUSTOM AS TO TRANSFERS AND COUPON TICKETS.

Where passengers are entitled, upon the payment of a single fare, to be transferred from one car to another, or carried over connecting lines, a company may enforce reasonable regulations to prevent imposition and to facilitate its business, and such regulations are valid, whether the transfer is made in obedience to statute or ordinance, or voluntarily. Where it is the custom of a street railway company to use transfer checks of different colors for different lines, a passenger who accepts a wrong ticket from a conductor without reading it is not entitled, upon presenting it to a conductor of a second line, to continue his trip without the payment of fare on the second line; and upon refusal may be rightfully ejected from the car. In such cases the conductor is not required to take the word of passenger in lieu of the presentation of a proper transfer check. (*Bradshaw vs. St. Ry. Co.*, 135 Mass. 407.) But if a company by virtue of its contract with the city must carry passengers over two sections of its line for one fare, a rule established by it requiring a passenger to keep and show, undetached by him, a coupon ticket, as a voucher of his right to continue on the car beyond a given point, is reasonable in law, and any passenger refusing to comply with the rule may be ejected from such car. (*De Lucas vs. St. Ry. Co*, 38 La Ann 930.)

MUTILATED OR IRREGULAR TICKETS.

In an action to recover for an alleged unlawful ejection the conductor of the original line tore the coupon ticket apart and handed plaintiff the wrong part, which she accepted without examination. When presented to the conductor of the connecting line it was refused as being irregular, and plaintiff was compelled to leave the car for non-payment of fare. The court held that the expulsion resulted from the wrongful act of the defendant's conductor and affirmed a decree for damages. (*R. R. Co. vs. Conrad*, Ind. S. C. 30 N. E. R. 406.)

When a coupon ticket issued to a passenger provided that it would be void if detached, and was detached accidentally and both ends presented, the conductor by mistake taking the wrong end, it was held that this was a waiver of the condition on the coupon in regard to detachment. (*R. R. Co. vs. Bray.* 25 N. E. 439.)

A company is bound to honor a ticket when duly presented, notwithstanding any mistake or omission by their agents in signing or stamping it, or of the passenger in signing by the direction of the agent. (*Heald vs. R. R. Co.* Ga. S. C. 7 S. E. R. 217.) A common carrier, such as a commercial or a street railway company, cannot refuse to accept a defective ticket for passage, where the defect is due to the carelessness of its agents or conductors. (See *R. R. Co. vs. Cope.* 36 Ill. App. 97.)

EXPLANATIONS ADMISSIBLE.

Conductors in charge of a car or train are legally bound to give some thought and consideration to explanations made by passengers. Where a passenger purchases a ticket of one authorized to sell, believing in good faith that it is genuine, upon presentation to a conductor and states such facts to him, such conductor is bound to take such facts as true until the contrary is proven, without regard to any words, figures or other marks upon the ticket, and a refusal to pay fare upon demand, a touching for the purpose of removal was held to constitute an assault and battery for which the company was held liable in damages. (*Hufferd vs. R. R. Co.* 31. N. W. R. 544.)

A conductor renders his company liable for ejecting a passenger who presented a ticket slightly mutilated by the conductor who punched it erroneously refusing to accept any explanation by the passenger. (*Johnson vs. R. R. Co.* 46 Fed. R. 347.) Notwithstanding that the residents of a city are presumed to know the provisions of ordinances of the city regulating the management of street cars, and the rules and regulations prescribed by such companies, and that the servants in charge may act on the presumption of such knowledge upon the part of patrons, it appears that courts have held each case to have an individuality governed by circumstances. Hence it will appear that in the light of present authority, no general rule can safely be followed in the disposition of these cases.

IS THE BURNING OF COAL DUST ECONOMICAL?

The subject of utilizing the immense heaps of coal dust, or slack, with which everyone who has been in the anthracite mining regions is familiar, has been harped upon for years, and every possible evidence has been given of the prevalence of the idea that these coal dumps are veritable mines of good fuel and that all that is necessary is to shovel it onto cars and haul it to the ready market which the low price of the material would so easily command. It may not be amiss under the circumstances, says a writer in *Cassier's Magazine*, to direct attention to a few points which have been persistently overlooked by the enthusiastic advocates of this class of fuel. One of these is that a general use of the slack would most probably cause a decided increase in its price, and it would be an easy enough thing for this price to rise quite beyond a paying figure. All experience tends to show that as soon as a real and substantial opening for the fuel would appear in the market, either in its original dust form, mixed with bituminous coal, or in the shape of molded lumps or briquettes in which it has been and is still used to quite an extent, the price would go up, so that one of its chief advantages would be much diminished.

Another point is to be found in the quality of the slack. It is doubtful whether the great heaps as they now lie in the coal districts would be found as useful or as well worth buying at any price as some have thought them to be, largely made up, as they are, of slate refuse. No care was taken in past years to keep the purer coal separate from the strictly waste material, and the consequence is that the stuff not only burns poorly, but in some cases does not burn at all. Mr. Eckley P. Coxe, who can speak with a better knowledge of this whole subject than probably anybody else in the United States, in fact, remarked last month, in his presidential address before the American Society of Mechanical Engineers, that the fuel value of the dust alone was *nil*, and that the slack must be mixed with a certain proportion of good coal before it can be put to a satisfactory use as a steam-raiser. Mr. Coxe also emphasized the very important fact that in the considerations of cheap coal the prospective user should try to ascertain not how many pounds of water will be evaporated by one pound of any coal in a given boiler, but how many pounds of water will be evaporated for $1; that is the vital point. Particulars of an actual case which recently came to hand illustrate its significance in a very striking manner, though the figures of cost would have to be somewhat modified to correctly reflect present conditions. Relatively speaking, however, they fairly represent what may be expected in other instances. It appears that a certain company burned coal screenings under their boilers, because they could get them for about $2 per ton, and an important saving was confidently looked forward to, because previously $5 per ton had been paid for coal, though the latter was of the best Lehigh lump variety. When the coal bills, however, were gone over after a short trial period it was found that something like three tons of the screenings were being burned under the boilers in order to raise the same amount of steam formerly obtained from one ton of the $5 Lehigh coal. Evidently there was no economy in this, and the use of the cheap coal was disappointedly abandoned.

STREET CAR TRACTION BY ACCUMULATORS IN PARIS.

It is several years since the first trial of electric accumulators for street car purposes was made in Paris. The attempt to use them for this purpose was not successful, but the problem has quite recently been taken up by Messrs. Laurent, Cèly and Sarclat, using accumulators of the modified Planté type. The number of cells used on each car is 108. The battery boxes are in groups of three in series, and the connections are so arranged that the voltage available may be either 50, 100 or 200 as desired. The motors are placed directly upon the car axle and are of the gearless type and weigh 7,010 pounds. They are of the 4-pole Gramme type, with hollow shaft, through which the car axle passes. The rated capacity of each motor is 10 kilowatts. The method of loading and unloading the cells is shown in the accompanying figure: Fig. 2 shows the construction of the truck and truck frame. The axle, A, is connected by two pieces a, a', parallel to the

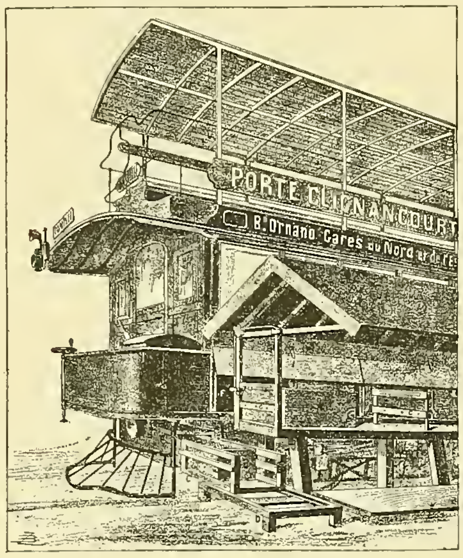


FIG. 1. PARIS ACCUMULATOR CAR AND METHOD OF LOADING.

car-body, and by a transverse piece C to a central piece T movable about a pivot resting upon an intermediate axle, F. In the same way the axle, B, is joined to the intermediate axle at the same point. The purpose of this arrangement is similar to that kept in view by the designers of the Robinson radial truck used on a number of roads in this country. It is, in fact, a sort of radial truck, the three axles of which take the position of radii of the curve around which the truck passes. The car-body is carried upon the two outside trucks.

FIG. 2. RADIAL TRUCK USED ON A PARIS ACCUMULATOR CAR.

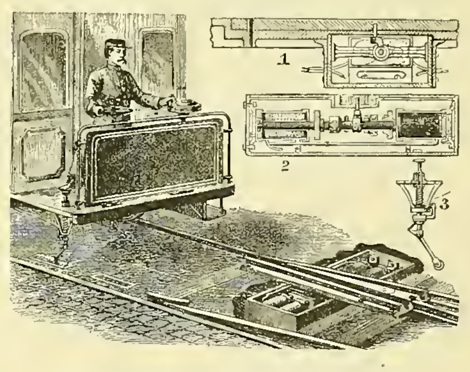
An Electrically Operated Track Switch.

The improvement shown in the illustration is designed principally for application to electric cars. It has been patented by Mr. Henry L. Falco, of No. 643 Carlton Avenue, Brooklyn, N. Y. The view in perspective shows the operation of the improved switch, Fig. 1 being a longitudinal and Fig. 2 a transverse section, while Fig. 3 shows the contact-making device. The car may be supplied with the current in the usual way, the wire carrying such current leading to the contact maker just under the car platform, and carrying at its upper end a foot piece to be pressed by the motorman. The contact maker adapts itself to any distance between the car and contact plates. The switch tongue turns on a pivot, and is mounted in a casting in the usual way. A pin projects from the tongue through a slot in the casting, and enters an arm on a sliding rod in the switch pit, there being on opposite ends of the rod cross bars carrying armatures which enter the coils of electromagnets. These magnets have short cores and are inclosed in lead to prevent their being acted on by water entering the pit, and the mechanism is inclosed in an iron box with cross bars through which the rod slides. Buffers are provided on the rod to prevent shock when the armatures are drawn in either direction. There are two insulated contact plates in the roadbed near the track rail, a wire from one plate extending to one of the magnets, while the other plate is connected by a wire with the other magnet. When, therefore, a car approaches the switch, the driver can swing the switch tongue in either direction, to open or close the switch to the main or the side track, by simply pressing on the foot piece to bring the roller on the lower end of the contact maker down upon one of the contact plates in the roadbed, the current then being made to energize one or the other of the magnets to move the sliding rod connected with the switch tongue. The box containing the magnets is closed at the top by serrated covers in the usual way. For our illustration we are indebted to the *Scientific American*.

Prof. Elihu Thomson's Opinion of the Intramural Railway Plant.

In a general review of the electrical exhibits at the World's Fair published in the January number of the *Engineering Magazine*, Prof. Elihu Thomson has this to say of the Intramural railway:

"The largest single exhibit of an electrical nature was, without doubt, the Intramural railway



ELECTRICALLY OPERATED TRACK SWITCH.

and its power house—together a grand practical exemplification of electricity applied to traction. It was remarkable in many ways as a piece of engineering and operated with the greatest success. It emphasized the fact that the days of steam locomotives on elevated roads in cities are numbered, and that just as surely as the horse-car has given place to the trolley-car, so must the electric motor supply steam propulsion on the roads in question. Yet in 1876 there was no hint or suggestion of such extended use of electricity on railways—and, in fact, no such application had been made. On the Intramural road a conductor rail with the ordinary rails for return circuit was used, the current being taken up by sliding shoes bearing on the conductor rail. The motor car at the head of each train, besides the ordinary seats, was supplied with four electric motors, one geared to each axle individually, while the controlling mechanism was arranged so as to connect the motors in simple series for starting and to make successive changes passing through intermediate connections until the one having all the motors in parallel was reached, the condition for maximum speed.

"This arrangement, with refinements of detail especially designed for this work, and first put into full operation at the World's Fair, gave great economy as well as flexibility in the handling of the trains. One of the best illustrations of the progress in the art of electrical engineering in the past few years was the building in the station of the Intramural road of the great direct coupled continuous current dynamo of 2,000 horse-power capacity. This machine—by far the largest continuous current dynamo ever made—was lately described by its designer, Horace F. Parshall.* It is a comparatively simple undertaking to design and construct very large alternating current generators, since in many respects they are like duplications or enlargements, simply, of the elements of smaller similar machines. This is not so with continuous current types, as the problems of armature reaction, air gap, and self-induction as affecting the working of the commutator at various loads have to be carefully estimated, while the relation of turns on the armature to number of segments in the commutator, the proper proportions and construction of the commutator itself, and the other proportions have to be studied with great care and adjusted within limits. All this makes the production of so large a machine, built as it was without previous experiment, and its parts put together even to the assembling of the sheet iron pieces of the armature, in the station itself, a veritable triumph of engineering skill."

ENGINEERING THE ESTABLISHMENT OF COMPETITIVE ENTERPRISES.†

BY THOMAS D. WEST.

In days of sharp competition, the starting of new enterprises soon places upon the shoulders of its managers and investors a weight they had not figured on carrying, and all sentimental ideas of self importance and there is "millions in it" vanish long before dividends are declared.

Could the struggles of late enterprises to get a foothold be fully outlined, we could not fail to have volume after volume giving recitals of trials, that could the principals in them have foreseen what they had to go through and the chances to be taken ere they could establish a paying business, there would have been much hesitancy before starting in and a great probability of their not having done so.

The writer having fought through two such undertakings within the past five years, the first being lost by fire, should be in a position to know from experience some of the difficulties attending the establishment of a business open to free competition, an element most all new enterprises have to figure on combatting.

Of the many struggles to be met and mastered there is none more serious than that of getting a works filled with competent and faithful employes having qualifications such as are necessary to fill the many different characteristic lines of work called for in their business

I know there are those which would not believe it, but nevertheless such is true; there are industries which it may take from one to three years to procure the character of employes they would like to see filling all posts of duty, and one factor most all new enterprises should specially figure on at the start is that of not being compelled to rush out work to the full capacity of the plant.

The endeavor to do this will often entail serious loss financially. There are few whose character of manufacture will admit of such proceedings without loss, but with most all it is much the better plan to go easy for the first year and be under as few obligations as possible in matters of manufaturing their product.

In first starting business the quality and quantity of an employe's daily output is to be considered and a new firm will by having new appliances, etc., have their own customs and standards they will desire to see adopted and achieved, and no matter if the mechanic or employe did do the same character of work in his last place, their standard is not yours and you want the benefit of modern arrangement and tools and the work done to your ideas.

If your plant is rushed your men will know it, and in nine cases out of ten you will find yourself placed in the position to shut up shop or let the employes establish their own notions of the customs and standards to be adopted. No one but an experienced manager knows how difficult and expensive it is to undertake to change the customs and standards in a workshop after they are once established.

If in first starting up, a firm could be assured of filling all its positions with men having the character and qualifications they would like them to have, and not before they can procure one such, have to discharge in some cases a dozen, business could be figured differently and the rushing of the plant to its full capacity, turning out the quality and quantity desired profitably, could be much more satisfactorily relied upon.

Taking the employe's side of the subject, it is also better for them that the starting off of a new plant should go slow, for it gives all more room to work, a better chance for the overseer to assist them in systematizing and becoming accustomed to their labors, and should the employe at first not manifest the ability required, business not being rushing, the overseer can permit the man hanging on a little longer to see if he can make any success of him and often eventually thereby making a good reliable man that can stay as long as he may desire, otherwise he might be walking the streets looking for work.

A factor to also be considered by the employer and the employe in starting a new plant is the much less risk taken of persons being injured where there is much new machinery with green hands to run it.

It is much better for the overseer to have ample time to watch and educate employes in the use of tools and machinery than have them all crowded together with a "go as you can" principle, injuring themselves and breaking machinery.

Another good reason why it is advisable for new firms to figure on going slow the first year, is to test its machinery. The plant is yet to be built that for the first year did not discover many weak points in its appliances and machinery that required shut downs and time to strengthen and repair, and if rushed with work things will often be found to go wrong that would not have given any trouble could there only have been time spared to humor and nurse them, for new machinery often requires such treatmant in order to have it run and act well just as much as a sick child.

In nine cases out of ten a plant will be more sure of making money by going slow the first year than by attempting to drive the plant to its utmost capacity, and, it is pretty sure to be the case that more money is laid out to put up buildings and place machinery ready to start than was figured on, and the establishment often finds itself left with a very small working capital; if with such it is attempted to rush business the first year, the chances are very favorable for the plant sinking or getting in a hole it will require several years of profitable work to get it out of, if at all, for when financial matters start going down hill they often go as if on a greased plank. In business matters the margin for profit these days is very small.

A firm cannot survive many blunders and the attempt to rush business the first year is generally to try a risk. "Be sure you are right then go ahead."

*See the Street Railway Gazette for Sept. 9, 1893.
†Read before the Civil Engineer Club of Cleveland.

Toronto, Ont.—An application has been made to the Legislature to amalgamate the City and Suburban Electric Railway Company and the Davenport Street Railway Company, under the name of "The Toronto Suburban Railway Company," with a capital of $250,000.

NEW AGREEMENT BETWEEN THE WEST END STREET RAILWAY COMPANY AND ITS EMPLOYES.

Upon January 1 the new Massachusetts law went into effect compelling the West End Street Railway Company of Boston to limit the work of its employes on cars to 10 hours per day to be done in 12 consecutive hours, This necessitated a new agreement between the company and its employes as it had been the custom of the company to employ men on the "regular extra cars" whose 10 hours, service extended over a period of 15 hours. The agreement which went into effect last Monday is here given in full together with an explanatory letter of the company in reply to certain criticisms:

Agreement, made this twenty-seventh day of December, 1893, by and between the West End Street Railway Company and the Conductors, Drivers, and Motormen in its employ, as follows:

Article 1. All revenue work in car service shall be described as regular cars, extra cars, and special (or chartered) cars.

Art. 2. No more than ten (10) hours' platform work, to be performed within twelve (12) consecutive hours, will be exacted from conductors, motormen, and drivers in any one day, except as provided by law. Time to be calculated from the time they pull out, or swing on, until relieved or the car put up.

Art 3. The time elapsing at the end of routes between schedule time and allowed time, commonly called "lay offs," and also the time consumed in running from the car house to the starting point of line, commonly called "pull outs," and vice versa, shall be considered as platform work, to be paid for at regular rates. This applies to both regular and extra men. All lay offs of thirty (30) minutes or less to be considered platform work.

Art. 4. All work done by regular men shall be laid out on the basis of ten (10) hours' work, to be done in not more than twelve (12) consecutive hours, and men shall be paid at the rate of two dollars and twenty-five ($2.25) cents per day for all platform work, as described in Art. 2.

In all cases wherein the work of regular men, owing to accident or unavoidable delay, exceeds ten (10) hours, such over-time shall be paid at the rate of twenty-four (24) cents per hour, in addition to the amounts above provided, as follows;

For ten (10) minutes or less.... ... ... 4 cents.
For over ten (10) minutes, and less than twenty-one (21) ....8 cents.

Men doing the full schedule work,—which shall not exceed seven and one-half ($7\frac{1}{2}$) hours,—on regular night cars, shall receive two dollars and twenty-five ($2.25) cents.

Extra cars shall be paid at the rate of twenty-seven and one-half ($27\frac{1}{2}$) cents per hour, except in cases where the total work in twelve (12) consecutive hours amounts to five (5) hours, or more, in which case the rate shall be twenty-two and one-half ($22\frac{1}{2}$) cents per hour.

Art. 5. All special (chartered) cars, starting previous to ten (10) P. M. to be paid at the rate of thirty (30) cents per hour. Conductors, drivers, and motormen of such cars, starting between ten (10) P. M., and five (5) A. M., shall be paid one dollar ($1.00) for the first two (2) hours, or fraction thereof, and at the rate of fifty (50) cents per hour thereafter.

Art. 6. Men shall report ten (10) minutes before the starting time, with the exception of trips after meal hours, when five (5) minutes will be required, but if from any cause a conductor, driver, or motorman does not report as above specified, to take out his car on time, and has not previously notified the foreman or starter of the station of his inability to do so, he shall be charged with one miss, for which he shall be placed at the foot of the extra list for three (3) days.

But all men on cars starting before three (3) o'clock P. M., who report within one hour after their car has gone out, shall be placed at the foot of the extra list for that day only.

On cars starting after these (3) o'clock, P. M., such men shall be placed at the foot of the extra list for the balance of that day, and also for the following day, and in either case shall be charged with a tardy report, and for the fourth tardy report they shall be charged with a miss.

Three (3) subsequent misses shall be treated in like manner, but for the fifth within one year he shall have the standing only of a new man employed by the Company, beginning at the bottom of the extra list. A Division Superintendent may, within his discretion, accept an excuse from an employe for the first or any subsequent miss.

When conductors, drivers, or motormen are placed at the foot of the extra list for missing, as provided in this article, they shall report (at the station to which they have been ordered) each day while so rated at seven (7) A. M. roll-call, and remain until six (6) o'clock, P. M., unless detailed or excused. Each failure to do so will be called a miss, and will entail an additional day at the foot of the list.

Art. 7. All extra conductors, drivers and motormen shall report each day at seven (7) A. M. roll-call at the station to which they are regularly assigned for work, and remain there until six (6) o'clock P. M., unless detailed or excused. Failure to do so will place the offender at the foot of the extra list for one day. All subsequent misses will be dealt with at the discretion of the Division Superintendent.

Extra men will find it to their advantage to report before seven (7) A. M. roll-call, and men so reporting after five (5) o'clock, A. M., shall be listed and receive work in rotation as they report, holding such position only until seven (7) A. M., after which time each man will take his regular position on the list.

The Division Superintendent may detail in rotation extra men to report at any station prior to seven (7) A. M. Men especially detailed for early work shall have precedence for work given out before seven (7) o'clock A. M. Failure to report on time will subject the offender to the same penalty as provided for extra men missing at seven (7) A. M. roll-call.

Work to be given out to the extra men on the following plan:

When there is but one central station or headquarters for the assignment of extra men in a Division, the man longest in service on that Division shall be the first man on the list, and shall be assigned to the first vacancy occurring each day, unless already detailed or excused.

When there is more than one central station or headquarters for the assignment of extra men in a Division, men shall be rated by stations, at each of which the man longest in service on that Division shall be the first man on the list, and shall be assigned to the first vacancy occurring each day at that station, unless already detailed or excused.

Extra men shall retain their position or rating on the list when returning from any forenoon detail, said position or rating to cease if also assigned to work on the afternoon list or detail. With this exception work given out to extra men at any time of day shall be according to rating.

Sunday work shall be given out by beginning at the bottom of the extra list.

Art. 8. Conductors, drivers and motormen of all cars starting at or before five thirty (5:30) A. M., to have one half hour for breakfast, which shall not be considered as platform work, and these, and all other conductors, drivers, and motormen to have at least one hour, and as far as practicable, one hour and thirty minutes for dinner, said time to be fixed as near the middle of the day's work as practicable.

Art. 9. Regular men, having no Sunday time, when compelled to report, shall be paid for the time they are held at the station.

Art. 10. When in any Division there is a regular car to be given away, arising, directly or indirectly, from resignation or discharge, the regular man who has been longest in the service of the Company in that Division shall have the preference in making application for such car. All cars shall be advertised on the list at least three days before they are given away.

When necessary to re-rate the men at one or more stations, they shall be re-rated at those stations only, the car getting through first according to schedule to be given the man at those stations who has been longest in service on that Division.

Regular cars to be given away, arising from change of time-tables, shall be given to the extra men, beginning at the head of list, but when regular cars are lost by change of time, the men displaced shall have the place on the extra list to which they are entitled by their rating.

If a line of cars is transferred from one Division to another, the men running those cars shall, if they desire, also be transferred, and shall retain their cars until a change of time, or new rating, when they shall be rated from the last time they hired with the Company.

This article is subject to the provision that no man shall be assigned to service upon an electric car, unless, in the judgment of the Division Superintendent, he is competent for such service.

Art. 11. If possible, no man shall be compelled to work more than two (2) weeks without having a day off if he desires it. Regular men, or extra men when assigned for work, desiring to be excused, must notify the official in charge of the station from which they run, or at the office of the Superintendent (as he may direct), on or before two (2) o'clock P. M., on the day preceding the day they desire to be excused. Men asking to be off, having failed to give notice on the previous day, shall, if excused, forfeit to the men taking their places all pay for the trips they have run, when the same do not constitute half of the platform work on that car for the day.

Art. 12. If, under pressure of necessity, a Division Superintendent decides it to be expedient to run extra trips, he may call upon regular men for such duty; but a record of such extra work shall be kept, and such work shall be distributed as nearly as possible, from time to time, among all the regular men on that Division, so that no man may be called upon to do more than his fair share of extra work of this nature.

Regular men, when called upon to do such extra work, shall be paid at the rate of thirty (30) cents per hour, no single trip of this kind to be run at less than fifty (50) cents. Regular men so reporting shall receive not less than fifty (50) cents, whether the trip be run or not.

When necessary to loan men from one Division to another, they shall be taken from the bottom of the extra list, and shall receive for each day so detailed not less than one dollar ($1.00), but shall not take precedence over the extra men in the Division to which they have been loaned.

Art. 13. On all lines where the running time is less than one (1) hour and forty (40) minutes per round trip, Sunday regular work will be laid out on a basis of nine (9) hours in eleven (11), not to exceed nine and one-half (9½) in eleven and one-half (11½) consecutive hours.

Regular men having no Sunday time shall have the preference over extra men for Sunday work, if they desire it.

All Sunday work on regular cars shall be paid for at the rate of two dollars and twenty-five ($2.25) cents per day.

Art. 14. No employe's position as conductor, driver or motorman will be kept for him longer than thirty (30) days, provided, however, that if he is sick, the conductors, drivers, or motormen rating below him on that line shall be advanced one car, the final vacancy thus created to be filled from the head of the extra list, and the original rating shall be restored upon his return to car service. If he is otherwise employed by the Company, the car shall be advertised after the expiration of thirty (30) days and given away, subject to being restored to the man upon his return to car service.

Art. 15. When working on snow-plows or levelers, the rates of pay shall be as follows:

Drivers of six (6) horse teams shall receive 40 cents per hour.

Drivers of four (4) horse teams shall receive 35 cents per hour.

Motormen on electric plows shall receive 35 cents per hour.

Conductors, drivers, and motermen not working on cars shall have the preference in snow work, other than above named, and shall be paid thirty (30) cents per hour; counting from the time they report at the station until they are excused.

Art. 16. Men shall be furnished, where necessary, to carry the pole in four (4) horse time.

Art. 17. Conductors, drivers, and motormen shall at all times while on duty wear a full regulation suit and cap, as follows:

The regulation uniform shall consist of a double-breasted sack coat of navy blue cloth, with vest and trousers of the same material.

The uniform overcoat shall be double-breasted and of navy blue cloth, but wearing it shall not be compulsory upon drivers and motormen.

The regulation cap shall be of black serge. From November 1 to April 15, a navy blue Scotch Havelock cap may be worn, and during June, July and August, a regulation straight-brimmed brown straw hat may be worn by motormen and drivers.

The cap of the conductor must have a one-quarter inch gilt stripe on the upper side of the band or lapel, and the cap or hat of the motorman or driver, with the exception of the rubber hat, must have a quarter-inch silver stripe on the upper side of the band or lapel.

During extremely hot weather, a black alpaca coat or vest, with the Company's regulation buttons, may be worn by either conductors, motormen or drivers.

From November 1 to April 15, motormen and drivers, when wearing overcoats, need not wear the uniform suit. During wet weather they may wear a rubber coat, and during cold weather they may wear a fur coat.

All uniform garments, except the rubber and fur overcoats, must be equipped with the Company's regulation buttons, which will be furnished by the Company upon receiving a deposit therefor. Upon the termination of service of an employe, the buttons must be returned to the Company, and the deposit will be repaid.

Suits, overcoats and caps may be purchased by the men where they choose, but must be of good quality, will be inspected from time to time, and must be kept in good condition and renewed when necessary.

Regulation badges shall at all times be worn upon the cap or hat, plainly exposed to view.

Conductors, motormen and drivers may ride upon the cars without payment of fare *only when in full uniform* as above provided for.

Art. 18. All employes who deposit five (5) dollars or over with the Company shall receive four (4) per cent. per annum interest on such deposit after thirty (30) days.

Art. 19. Charges for damages occurring by the carelessness of a motorman, driver or conductor shall be based upon the actual cost of repairs necessary to make good such damages after fair investigation.

Art. 20. No official in the employ of the Company shall be allowed to keep boarders, lodgers, or engage in any business in which he may receive compensation from a driver, motorman or conductor when attention has been called to it.

Art. 21. The company will recognize a committee of eight (8) (with or without a stenographer), to consist of one employe from each Division, who shall have full powers to adjust grievances arising under this agreement with the management upon conference. All grievances shall be thoroughly investigated by the committee before any conference, and any request for a conference shall be accompanied by a written statement of the grievances to be acted upon.

Art. 22. All service upon the cars of this Company shall be governed by such rules and regulations not conflicting with the terms of this agreement as the management may from time to time establish.

Art. 23. Complaints shall be fairly investigated, and employes exonerated shall be paid for any lost time.

Art. 24. A copy of these regulations shall be framed and posted in the lobbies of the several stations.

This agreement shall go into effect January 1, 1895, and shall remain in force for a term of one year thereafter. Executed of the date first above written.

West End Street Railway Company.
By.....................General Manager.
Approved. ....President.

Committee of Conductors, Motormen and Drivers duly authorized to execute said agreement.

After the issue of the above agreement between the West End Street Railway Company and its employes some of the Boston papers took up the question on behalf of the employes, representing that the agreement was an unfair one for certain classes of the men. In reply to these criticisms the company issued early this week the following statement:

Certain statements have appeared in the press in reference to labor difficulties on the West End Street Railway, and that there is great dissatisfaction among the men, who believed that the company had not done what it could for them under the law, and was violating an agreement which was signed on Saturday last to cover the relations between the company and its employes for the ensuing year.

It is but fair to state that the best efforts of the management of the West End Street Railway are always put forth to carry out strictly every agreement made with its employes, and that the employes and their committee are well aware that such is the case,

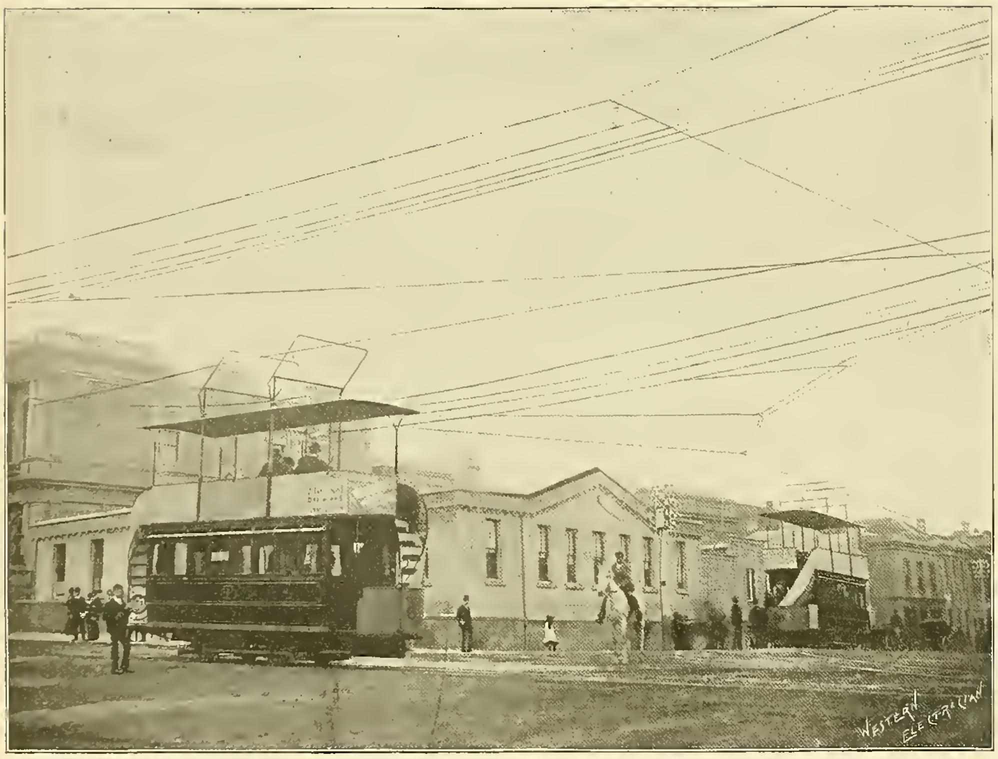
That the enforcement of the new law, which for the West End Street Railway Company became operative on the first day of January, would cause great dissatisfaction among the extra men, and hardship to them, was something which the railway company anticipated and deplored. The new law works a particular hardship in the case of the extra men, and one which is not fully understood by the men generally. Heretofore it has been the practice to give extra men a full day's work by grouping together extra morning trips and extra afternoon or evening trips with one less trip than a regular car as a day's work, making considerably less than 10 hours' platform work, but a total length of day of approximately fifteen hours. This has never been considered a hardship by the extra men, but on the contrary the demand has always been for a greater number of these day's works, which have been known by the name of "regular extra cars." Under the new law the company cannot exact from any of its employes on cars more than ten hours' work, to be done in twelve consecutive hours, and the extra man, therefore, who has certain work in the morning, cannot have assigned to him work in the afternoon which would overrun twelve hours as a total length of day. In arranging the time tables for extra men, every effort has been made to group the trips so as to favor the men as far as possible, but notwithstanding this, there remain some men who do not draw under this law adequate pay.

Owing to absence of regular men from various causes, the work of extra men varies from day to day, and the man who has a small day's work one day, may have a full day another. the work being given out strictly according to the agreement, which gives precedence to the man longest in the service.

So radical a change in the method of paying employes on street cars could not, of course, be made without some difficulties and friction arising on its first introduction, but these difficulties will doubtless be overcome in some way by concerted action between the employes and the company.

An Australian Electric Railway.

In all the colonies of Australia there are but two electric railways in operation, and but one of these—that located at Sydney—is Australian if the word be strictly employed, as the other, which is the one illustrated herewith, is found in Hobart, the capital of the outlying island of Tasmania, which is a city of some 30,000 inhabitants. Unlike the Sydney power plant, which is almost entirely made up of American machinery, the Hobart line is equipped with a steam and electrical plant furnished by Siemens Bros., of London. The rolling stock was also furnished by the same company, although the contract was sublet to the Lancaster Wagon company. As the illustration shows, the cars are double-decked, and they are designed for 24 inside and 24 outside passengers. They were built of teak, ash and mahogany, and are doubtless strongly constructed, although lacking the elegance of appearance which characterizes American cars. The trolley arrangement also seems crude and clumsy when compared with the pole and rolling contact of the American system.



AN AUSTRALIAN ELECTRIC RAILWAY.

The operating company is the Hobart Electrical Tramway company, an English corporation, which has secured a perpetual lease of the necessary rights-of-way by purchase from a local syndicate. The line is of single track and is about ten miles long, the point selected for illustration being at the corner of Macquarie and Elizabeth streets. The steepest grade is on the Newtown line, where for about 350 yards there is a 6 per cent. rise. In other places there are some rather severe curves and grades. The rails are 40 pound Vignoles rails, with guard rails throughout, the joints being spanned by copper strap riveted to the rails. The trolley wire is supported from poles on either side of the street, galvanized steel wires being used for suspension. It has been found necessary in some places, in order to clear the telegraph and telephone wires, to cover the tops of the poles, which are mostly iron.

The power house and car shed are situated at the lower end of Marquarie street, near the Hobart river, and built on cement concrete set on piles. The power house consists of a galvanized iron shell with wrought iron girders and columns, with brick and wooden partition walls. It was designed in England, and sent out ready to erect. The chimney stack, 90 feet high and five feet in diameter, is of wrought iron, riveted throughout and stayed with stranded steel stays. There are four of Marshall's multitubular locomotive boilers, giving steam at 160 pounds pressure to three Willans central valve high speed compound engines running at 350 revolutions. Two No. 5 Worthington steam pumps pump the feed water through two Marshall's feed water heaters of 100 horse power each. There are three compound wound Siemens dynamos, giving 250 amperes each at 500 volts, coupled directly to the engines, on one bed-plate. The shaft of each carries a fly-wheel 4 feet 2 inches in diameter. Two Siemens 15 horse power motors are used for each car, geared to the car axles with single reduction spur gearing working in oil.

Much delay has been caused by the telephone people, who claim that the working of the railway seriously interferes with the efficiency of their system. As the telephone system of Tasmania is under government control, the railway company has thus far had rather the worst of the contention, For the accompanying illustration we are indebted to the *Western Electrician.*

ANNUAL MEETING OF THE SOUTH SIDE RAPID TRANSIT COMPANY, CHICAGO.

The annual meeting of the Chicago and South Side Rapid Transit Company, or as it is more familiarly called the Alley "L," was held on Thursday last. W. W. Gurley and M. Hopkins, representing the Chicago City Railway Company's holdings and Edward L. Lobdell, representing the opposition were elected directors. Out of a total of 75,000 shares of stock, 68,000 were represented at the meeting. President Wheeler in his annual report made the following reference to the necessity of down-town terminal facilities and of extensions.

"It has become apparent to every one at all acquainted with the experiences of the past that the extension of your road to the north by means of a loop or otherwise is an imperative necessity. It is apparent that an extension to Englewood is also desirable. No definite steps have been taken in regard to either of these extensions, but both matters have been carefully and thoroughly canvassed by the management of your company, and they are a unit in recommending the immediate accomplishment, if possible, of these undertakings."

General Manager Hopkins in his annual report defended the present train service. Since the close of the World's Fair the time intervals between trains have been increased and the number of cars has been decreased. This action has subjected the management to no little criticism. Mr. Hopkins, said it would be necessary for the company to make extensive repairs of its rolling stock at a cost of $27,750, and eventually it would need more cars. The report said after paying interest due January 1 on the $3,000,000 of second section bonds, there would be left in the treasury about $400,000. These bonds were negotiated at about 75 cents on the dollar. The General Manager's experience as to the cost of operating trains was summed up as follows: The cost of running a five car train for eight hours is $25; a four car train, $21.65; a three car train, $18.30; a two car train, $12.45; a one car train, $11. The general manager's report concluded with the statement that further extensions of the road were positively essential to its well being and prosperity.

In the following statement is shown the operations of the road since the company took possession December 16, 1892. The returns are given for the fifteen days of December, 1892, and for each month of 1893. The number of passengers carried, income, and expenses were as follows:

	Receipts.	Expenses.	Passengers.
December 16, 1892........$	32,684	$ 29 863	653,000
January, 1893............	52,556	49,705	1,051,000
February................	52,822	48,810	1,056,000
March.........	63,716	53,969	1,274,000
April....................	78,049	53,393	1,560,000
May.............	165,224	90,814	3,306,000
June.....................	171,733	84,964	3,474,000
July.....................	152,130	77,524	3,042,000
August.......	162,047	67,327	3,241,000
September....	196,592	82,004	3,931,000
October........	268,811	93 961	5,376,000
November................	72,883	56,509	1,457,000
December................	64,168	57,647	1,283,000
	$1,535,471	$846,495	30,709,000

COST OF CARRYING PASSENGERS

The following table shows the percentage of earnings to operating expenses each month, and the actual cost of carrying passengers each month:

	Percentage.	Cost per passenger.
December 16 1892........................	91.2	.0457
January 1893............................	94 5	.0473
February................................	92.5	.0462
March...................................	85.0	.0424
April...................................	68.5	.0349
May.....................................	54.5	.0274
June....................................	48.5	.0242
July....................................	50.9	.0255
August..................................	41 6	.0208
September...............................	41.7	.0209
October.................................	35 0	.0175
November................................	77.6	.0388
December................................	89.9	.0443
Average.................................	55.9	.0276

E. L. Lobdell representing the opposition to the existing management presented a statement in which he criticized the policy of the company and changes in the train service as follows:

The Chicago and South Side Rapid Transit railroad company has labored under great disadvantage from the time of its inception. It bought the real estate for its right of way on a rising market, and commenced at the wrong end of the road to make purchases. By commencing toward the down-town end and buying south the cost of the real estate needed for the right of way was put up on themselves until the actual outlay below Thirty-ninth street amounted to probably double what it would have been if the purchases had begun at the south end. The company had serious financial trouble; frequently did not know where the money was coming from to pay judgments rendered for right of way and other expenses; bonds had to be sold for what they would bring. The par value of bonds now outstanding amounts to $10,500,000. Nobody familiar with the methods employed in building this road believes any such amount as this ever went into the property; owing to one unfortunate circumstance after another, the cost of the road was increased very much beyond what it should have been.

A merchant starting in business usually figures that it will take a number of years at least to build up a business which will be profitable and pay any return on the capital invested. Stockholders in railroad corporations, however, seem to think a business is not progressive which does not earn enough to pay not only interest on the bonds (which usually represent the entire cash outlay), but also on the stock, which is largely as a rule what is known as promoters' profit. What the stockholders of this road should desire more than anything else is to have the road so operated as to make it earn its way and make the stock profitable at the earliest possible moment. What are the means necessary to accomplish this end?

The public has an idea this road is run directly or indirectly in the interest of the Chicago City railway company. This may be true or may not. The best interest of the stockholders of this road, however, demand that this idea should be removed from the public mind at the earliest possible moment. The quickest means of removing this idea, mistake or otherwise, held by the public, is to elect an independent ticket pledged to manage the affairs of the road for what they consider to be the best interest of all the stockholders and not for any particular class of stockholders.

It is stated by our General Manager that during the month of October the trains on this road were run on a three-minute schedule; during the first five days of November it was also operated on the three-minute schedule; during the second five days of November operated on a three and one-half minute schedule; from November 10 to the 15th on a four-minute schedule, and from November 15 on a four and one-half minute schedule. I do not know what the schedule is at the present moment, but I have frequently waited for trains at the Twenty-ninth Street station six minutes and sometimes seven at from 9 to 9:30 A. M. I presume that this experience is the experience of many other persons. For my own part, if I miss a train my inclination is to go a little further and take the State street cable cars rather than run the risk of wasting five to seven minutes. These different schedules referred to were made directly after the close of the Exposition, at a time when traffic from day to day was showing a gradual decrease no matter how good service could be rendered by this company. For this reason I do not think it a fair test.

The fixed charges of this company consist of interest, administration expenses, ticket sellers, and ticket takers. These charges are the same whether the company operates one train or one hundred. Then the company is amply supplied with rolling stock which at present is standing idle. Is this rolling stock more apt to run down by being in active service or by standing idle? It has been stated to me on good authority that by the economy now being practiced the road is earning above operating expenses about $500 per day. By a little figuring the total profit after paying expenses of operating this road per annum on this basis would amount to $182,500. The fixed charges with interest on the bonds of the road amount to $525,000 per year. This leaves a deficit of $342,500 per annum. Your surplus at present I understand to be about $400,000. While the company probably is amply provided with funds for the next twelve months, yet what will it do during the twelve months which are to follow, unless something is done to foster a much larger traffic than appears to be in sight at the present moment?

One of the most desirable things to do first, it seems to me, is to build an extension to Englewood and endeavor to secure the right of way down-town as far north as possible. And it seems to me it would be policy for this company to select some first-class experienced man who is informed as to ownership, etc., on down-town districts and say to him that we will give him $100,000 or whatever sum as would seem advisable if he would secure for us the right to run our trains as far north as South Water street. Should the road succeed in acquiring these two extensions the number of passengers carried by the road ought to be at least double what they are to-day from the moment such extensions are put in operation.

Nothing was said at the meeting concerning a change of motive power on the road from steam to electricity, although it has been repeatedly stated that the matter might be considered and recommendations made. The following statement which General Manager Hopkins made a few days ago, probably gives all that can be said on this score at the present time:

"We have been told again and again that we must discard steam and use electricity. Well, we probably will; but whether we will do it this year, next year, or the year after I cannot say. We have held several interesting conferences with electrical concerns, and we have given a great deal of attention to the third-rail system which was used at the World's Fair. Now, we have been advised by the very same people who told us we must make a change to go a little slow. They tell us that they are working on the three-phase system, which they say is more economical than the three-rail or other systems. They cannot tell us when the three-phase system will be perfected, yet they tell us to wait."

Rapid Transit Developments in Five Cities in 1893.

Col. F. K. Hain has made the following statement regarding improvements on the elevated roads of New York City during 1893:

The elevated railroads of this city carried eight million more people during the fiscal year ending September 30, 1893, than during the previous year. The figures for the fiscal year ending September 30, 1892, were 213,000,000 passengers carried, while 221,000,000 passengers were carried during this year. During October, November and December the daily volume of business on the elevated roads was fully up to this standard. The business has been steadily increasing for several years past, and there is no reason to doubt that it will so continue to increase in the future.

At One Hundred and Thirtieth street, on the Ninth avenue road, a new station was built on one side of the track. It is on the downtown side, and passengers coming uptown have to alight at either one of the two nearest stations. The Manhattan Company would build a station on the uptown side if allowed to do so, but for some reason the property-owners object.

Twenty new engines have been ordered during the year, and are now being built. The number of passenger coaches at present employed in the service amounts to 1,116, and 75 new ones were added during the last four months.

Improvements in the structure continue to be made all the time. At present we are putting down ninety-pound rails instead of fifty, sixty and sixty-three-pound steel rails. These new ninety-pound rails, a great number of which have been put in place during the year 1893, add strength to the elevated structure, besides having other advantages.

Now that the subject of hard and soft coal is being discussed, it will interest the public to know that the best coal in the world is that used in the engines of the elevated roads. It is the best hard white ash anthracite. The elevated roads consume more than 200,000 tons of this coal per year. The coal makes no smoke whatever.

Another new feature of the year 1893 is the block-signal system now in operation on the Ninth avenue elevated line. This block-signal system is in operation the entire distance from the Battery to Harlem, and has only recently been finished. The blocks are about eight hundred feet in length. In the entire system of the Manhattan Company twenty-one switch-towers are now employed, having 438 levers, including all the switches, there are 111,845 movements made in twenty-four hours. Three men are employed in each tower, the men working eight hours a day each, in addition to which they are given a leave of absence each month with pay. In connection with the switches there are 598 signals in operation on the system.

Over three thousand trains per day are run, the exact number being 3,300. The employes number 5,000, and are all paid by the hour. Twelve hours is the longest time any man is required to work per day on the roads. The maximum pay is $3.50 per day. Engineers earn $100 per month. Just at present the applications for employment are unusually numerous.

A great many people wonder why the trolley system or some other electrical system is not employed instead of the independent steam engines. The question has been very carefully looked into, but up to the present time no system has been devised which seems to have so many advantages as the steam engines. So far as the trolley is concerned, it is doubtful if the electrical power could be transmitted. Take the Third avenue road, for instance, where seventy trains are in motion at one time. These have five cars each, making a total of 350 cars. A car weighs fifteen tons, and when full of passengers about one-half as much again. Adding the weight of the engine, we thus have a total of 134 tons for a single train. This train must be moved at the rate of fifteen miles per hour, and there is a grade of 105 feet to the mile.

When this problem has been put to electricians, they say that a trolley wire, to convey the power necessary to move so great a weight, would have to be of copper about three inches in diameter, and that there would have to be many of such wires, as there are seventy such trains on the Third avenue road during the busy hours of the day.

During 1893 there have been no notable experiments on the elevated roads with electricity as a motive power, but our telegraph system has been extended and improved. We now operate 160 miles of wire of our own in this telegraph system, with 500 telegraph instruments and 2,000 batteries.

President Vreeland writes as follows concerning the work of the Metropolitan Traction Co. during last year:

The past year has been a busy one for the Metropolitan Street Railway Company. Despite the hard times many radical changes in street transportation have been made to the advantage, we know, of the company, and, we think, of the public. The most important incident in the year's record was the inauguration of the cable system on Broadway. This was put into complete operation on July 1, and since that time the traffic on this great thoroughfare has increased daily from week to week. During July, when the cable cars were first used, the total number of cars employed was seventy-eight, running on a headway of one and one-quarter minutes. The increase in traffic has made constant additions necessary. At the present time we are running 143 cars on the Broadway line on thirty seconds' headway. Last Saturday, Dec. 23, was the banner day in the history of the line. The total number of passengers carried on that day was more than 132,000. This is undoubtedly the largest number of passengers ever carried in a single day by any street car line less than six miles long in the world.

Besides the improvement in transportation facilities directly, we are now putting in an electric signaling system on Broadway, which will be of very great advantage in case of accident or any other difficulty interrupting traffic.

The company also during the past year has completed and is now occupying the eight-story power-house and office building at Broadway and Houston street and the power-house at Fiftieth street.

Summing it all up, while, as has been stated, 1893 has produced more than its share of changes for the better, we confidently expect that the revival of general business anticipated during the next six months will pave the way for yet greater progress during 1894.

The following statement regarding street railway extensions in Omaha is reproduced from the Omaha *World*.

The Omaha Street Railway Company, during 1893, spent $100,000 in round figures in improvements and extensions. The East Omaha Street Railway company, during the first six months of 1893, built two miles of road at an expense of $30,000. A prominent street railway official, in speaking of the year's business, said, in substance: "When the financial stringency came on, of course it affected the income of the company and the question of cutting down the train service was discussed. But no change was made, and with the exception of ten or twelve extra men around the power house no one was discharged. Every train was run regularly and not one of the over 500 employes was discharged on account of the hard times."

The following reference to street railway affairs appeared in a recent issue of the Kansas City *Journal:*

The condition of affairs in the street railway business at the close of the year is not so good as the early months indicated, and yet all the lines are doing a large business. Up to June 1 every road in the city showed an increase over the business of the preceding year. The average increase was 10 per cent, From June 1, or about the time of the financial disturbances, people began to save their nickels and dimes, and there was less travel by street car and more walking. The large gains which the roads had hoped for are, therefore, not realized by all. There has been no street railway extension during the year, nor have there been any important changes in the general system of street railway business. Kansas City still ranks as among the very first cities in the country in the matter of cable and electrical transportation, and, considering her size, is the first in the land.

The noticeable features in the rapid transit system of St. Louis are noted as follows by the *Post-Dispatch* of that city:

The most noticeable feature in the development of the local street car system during the year 1893, is the fact that all the improvements that have been made are in the shape of electric roads. Four complete new electric lines were built, three new branches and two extensions were added to electric roads already in operation, and one cable line changed its motive power to electricity. The four new systems are the Compton Heights, Union Depot & Merchants' Terminal road, the Cass Avenue line, Northern Central road and Union line.

The Cass Avenue, Union and Northern Central lines, which are owned by the National Railroad Syndicate of Chicago, became electric lines in June. They had previously been horse cars, but had been granted franchises to change their motive power early in 1892. The work of metamorphosing this system took over a year and cost over a million dollars. Four million one hundred thousand dollars are now invested in these three roads.

The two new branch electric roads that have been built this year are the Taylor avenue division of the Lindell, and the Virginia avenue branch of the Union Depot line.

The Taylor avenue road branches out from the main line at Taylor and Finney avenues and runs as far north as Farlin avenue, which is two blocks beyond Natural Bridge road. It will subsequently be extended to the cemeteries. The road has been in operation six months.

The Virginia avenue branch of the Union Depot is that company's new line to Carondelet. It leaves the main line at Twelfth and Clark avenue, goes to Eighteenth street, past the new Union Depot, over the Eighteenth street bridge and down Grattan street and then on to Virginia avenue.

The Grand avenue division of the Citizens' cable changed its motive power in May to electricity. The Cass Avenue Electric Line recently built an extension out Cass avenue to Prairie avenue to King's highway. The Laclede avenue line also extended its line from its west terminus at King's highway and Laclede avenue into Forest Park in loop form around their new depot. The Forest Park & Clayton Electric Road also laid the tracks for an electric line from Forsythe Junction on De Ballvere avenue and the Wabash tracks to Clayton. The Cass avenue line also built a branch which they have not yet attempted to operate along Seventh street, from Walnut to Cherokee.

In 1892 the street cars of the entire city made 5,361,973 trips and carried 91,685,555 people. This year it is safe to say they have carried over 100,000,000 as during the first three-quarters of this year the cars made 4,616,878 trips.

All in all about fifty new miles of track were added and about $5,000,000 more invested during the year.

The *News* of Baltimore refers to the development of the street railway system of that city during 1894 as follows:

Baltimore's street railways, which represent a total of nearly 225 miles of single track, and an investment of close to $25,000,000, have developed most remarkably during the year just ending. The Baltimore City Passenger Railway Company, with a system of 50 miles of track, have opened three cable lines, the blue, the red and the white, and are now rapidly converting their other lines to the electric system of motive power. The tracks have been laid for the new system on the Greene street and Canton, the yellow and the brown lines, and the power-house, which is to supply the wires with electricity, is fast being built in South Baltimore. The contract calls for its completion within 110 working days from the 1st of November last, when the award was made. A good supply of cars has been ordered and will be ready for running as soon as the power-house is finished. The stock of the Bowie lines amounts to $2,000,000, and the bonds to $2,000,000.

The Baltimore Traction, which has a system of nearly 75 miles of track, has opened its Carey street and Fort avenue and its Linden and Huntingdon avenue lines operated with electricity. Its road to Pikesville has been operated with electricity since the autumn of 1892, but during 1893 part of the line has been double-tracked and laid with heavy steel rails and stone ballast so as to allow greater speed in the suburbs. The stock of the Traction Company amounts to $5,700,000, and the bonds to $4 500,000.

The City and Suburban Company has also opened all its electric lines since the first of 1893, except the Frederick road line. Now the York road and Lombard street, the West North avenue, the Park avenue and Highlandtown, the John street and Columbia avenue and the Hampden lines are run by electricity. The system amounts to 63 miles of track, the stock is $3,000,000 and the bonds $3,000,000.

The Lake Roland Elevated Railway has 21 miles of track, of which 10½ miles are double. It has one line to Roland Park, with an extension to Lakeside, and another to Walbrook. The first opened was the Roland Park road on May 6, which put in operation the first elevated electric line in this country. On June 4 the Walbrook cars also began to use the elevated and run to the City Hall, and on July 4 the extension to Lakeside was opened to the public. The stock of the Lake Roland Elevated Railway Company is $1,000,000 and bonds $1,000,000.

The Central Railway, which has the cross-town line, opened its electric road in 1892, and during this month has added one-fourth to its power-house plant. Ten motor cars and ten trailers have also been added to the rolling stock. The Central has a line twelve miles in length; its stock amounts to $300,000, and its bonds to $700,000.

There are now eighteen rapid transit lines in operation in Baltimore, with others in preparation which will swell the number to over twenty. At the beginning of 1893 there were only the Traction's two cable roads and the Central, the Pikesville and the Curtis Bay electric lines running.

Comments and Views from Contemporaries.

Making Electric Traction Safe. Electric traction is undoubtedly the best system as well as the cheapest for the movement of cars on the city streets. It may be made as safe as any other method of surface propulsion where a like speed is attained. The public are entitled to the largest measure of safety within the compass of human invention.—*Philadelphia Record.*

Adjuncts of Metropolitanism.—The people of New York continue to complain of the danger to life caused by the trolley street cars. When they get a little more accustomed to these adjuncts of metropolitanism they will suffer no more inconvenience than is experienced in St. Paul.—*St. Paul Globe.*

Electric Lines Wanted in Florida.—The development of the electric railway for carrying passengers has been enormous during the past decade. The great volume of the business of selling apparatus for constructing such roads has already been done. This forces the manufacturers to develop avenues in which to dispose of their manufactures, and one of the most promising of these is the construction of interurban roads, designed primarily to do a freight and express business. Such a road can be built and equipped for a few thousand dollars a mile and can be operated at slight expense compared to ordinary methods of traffic. Such roads would be invaluable in developing regions sparsely supplied with steam roads. There are many sections of Florida that are now thinly inhabited because of a lack of facilities for sending products to market. At present there is not trade enough to warrant the construction of a steam road in these sections, but a single track electric road could be built and be made to pay under ordinary circumstances and be a valuable feeder to some steam road whose line it connected with.—*Jacksonville (Fla.) Citizen.*

Use of Platforms.—The superintendents of the Newark, N. J., street car companies have instructed the car conductors not to allow passengers on the rear platform when there is room inside the car, and when the car is so crowded that passengers have to be let stand on the rear platform, the conductors must "take particular pains to keep the passage open nearest the sidewalk for people getting on and off the cars." This is a commendable departure, and it should be made in every city. Nothing is more provoking than to see the rear platform of a car densely packed while half or two-thirds of the standing room in the car is vacant. It is a most disagreeable annoyance to women in getting into a car to have to force their way through a crowd of men.—*Philadelphia Press.*

Two-story Street. — Stated in the fewest words, the subway scheme looks to the construction of a two-story street along Tremont street from Pleasant street to Scollay square, and perhaps further northward. The upper story—the present surface of the street—will be used by pedestrians and vehicles, as now; in the lower story, beneath the surface, the street cars will run on four tracks. The street above will be open, free and pleasant. The street below, with the resources of electricity, can be made free from all objection on the score of light and pure air. The only question as to the availability of the plan relates to the cost of construction, and this, there is reason to believe, will come within the limit of expenditure authorized by the Legislature.—*Boston Post.*

Result of Brooklyn Rapid Transit.—Within the year the introduction of electricity as a motor power on the Brooklyn surface roads has revolutionized matters of transit. As a result the outlying wards, where building lots may be purchased for $500 to $700, are being rapidly populated by a class of people who own their own homes.—*New York World.*

Engineering Economics.—One does not now design a turbine wheel or a steam engine unless directly in that business, although one may thoroughly understand the subject; but, looking up the results of tests, one selects the engine best adapted to the work to be done, and goes to the manufacturer for the outfit complete. The question now asked is, not if a process can be devised for accomplishing certain results, but which of a number of methods is the best, and by the best is meant the most economical. Many an elaborate plan and many a well-laid scheme has fallen because of the commercial element having been entirely neglected or not thoroughly understood. —Prof. L. S. Randolph in *Cassier's Magazine* for January.

FINANCIAL DEPARTMENT.

Financial Notes.

The Northwestern Elevated, Chicago.—The Chicago *Tribune* has the following in its financial column. There is much speculation in regard to just what kind of a scheme is behind the Northwestern Elevated Railway ordinance. The financial sponsor of the company is John J. Mitchell, president of the Illinois Trust and Savings Bank. Mr. Mitchell does not claim to have any personal interest in the enterprise, but he does stand sponsor for the financial ability of the people who are behind it. The board of directors is chiefly made up of representatives of electrical interests. There is a coterie of capitalists here that has come to be known in financial parlance as the "Mitchell crowd." They are undoubtedly among the strongest financiers in the city. They have many common interests, and among others the Evanston electric line. These people, who include such men as Marshall Field, Charles Hutchinson, O. S. A. Sprague, the Buckinghams and other well-known and exceedingly conservative capitalists, are undoubtedly capable of raising $10,000,000 if they choose. In financial circles, however, it is considered quite another matter as to whether or not they would raise $10,000,000 for such a purpose as this.

New Albany Report.—The report of the receivers of the Kentucky & Indiana Bridge Company on the New Albany street car lines for the period extending from October 14 to December 22 shows that the gross earnings were $2,721.04, the gross expenses $2,530.06. The report states that this is not to be taken as a criterion of the earning capacity of the road. It is surprising under the inadequate facilities, the report states, that the report is not more discouraging, but the receivers are powerless to remedy these inadequate facilities. What are needed are track facilities, fully wired lines and equipment. The effect of this imperfect equipment is not only to paralyze the business of the lines, but that of the electric lines on the bridge, the passenger revenue of the bridge being greatly reduced by the poor street car service.

Utica Belt Line Report. The annual report of the Utica Belt Line has been filed by the receiver, Charles E. Benton. The gross earnings for 1893 were $148,607, 1892, $127,143; operating expenses 1893 $92,531, 1892, $95,593; net earnings 1893 $56,076, 1892 $31,550; fixed charges 1893, $2,315; 1892 $2,303; net income, 1893 $53,761, 1892, $29,247. Surplus 1892 $37,136, 1892 $14,210. During the year ended June 30, there was expended in betterments a total of $16,732, of which $10,090 went on the roadbed and $6,551 for equipments. For electrical appliances $4,854 was expended. For wages of conductors and motormen $34,699 was paid out, and for salaries of general officers and clerks $3,248.

Earnings of the New England Street Railway Company.—The directors of the New England Street Railway Company at their meeting (January 23,) declared a quarterly dividend of one per cent. from net earnings, payable January 15. Transfer books close January 12, and reopen January 16. This is a reduction from a 6 per cent. to a 4 per cent. yearly basis. The earnings of the company for 1893 showed increases for every week over those for the corresponding week of 1892 with but one exception. A floating debt has been contracted during the past seven or eight months, mostly on account of construction in New Haven, and the erection of a brick block there.

Hudson (N. Y.) Railway Report.—The following figures are taken from the report of the Hudson Electric Railway Company for the last quarter: Gross earnings from operation, $4,808.69; operating expenses, $2,477.30; net earnings from operation, $2,331.39; gross income, $2,331.39; fixed charges (including interest on funded debt, taxes, etc.), $851.51; net income, $1,479.88. For the corresponding quarter of last year the gross earnings were $5,425.52; net earnings from operation, $2,793.91; fixed charges, $306.34; net income, $2,487.57.

Receiver Appointed in Keokuk, Ia.—H. C. Reiner has been appointed receiver for the Gate City Electric Street Railway on application of the Central Trust Company, of New York. The trust company holds first mortgage securing bonds for $85,000 on which the street railway company has defaulted interest. The street railway company has a floating debt of about $12,000. The operation of the line ceased some weeks ago. This is a second time in three years that the railway has gone into the hands of a receiver.

East Harrisburg Dividend.—The East Harrisburg Electric Railway Company's directors have decided to declare a semi-annual dividend of five per cent.

A. M. Jackson has been appointed receiver of the Sioux City Rapid Transit Company to succeed his father, James A. Jackson, deceased.

NEWS OF THE WEEK.

Fairfield, O.—The *Reflector* in a recent issue says: An electric railroad from Norwalk to this place, with branches to New London and Chicago Junction, would do an immense business both in passenger and freight traffic. The distance from Norwalk to Chicago Junction over such a line would be about eighteen miles, and from Fairfield to New London the distance is eleven miles, making a total of about twenty-nine miles of road, which would traverse a section of country equal to the richest and best in Ohio, and through which no steam road passes. Five good towns would thus be placed in close connection with each other, which under existing circumstances are practically isolated from one another at least five months in each year. Such a road would add more value to the farming lands of this isolated section of Huron county than the entire cost of the road fully equipped for business, and the value of such an enterprise to the inland towns through which it would pass could not be computed in dollars and cents; but the comfort and convenience it would bring to the people should enter largely into the computation when estimating its value.

Chicago, Ill.—Mayor Hopkins has vetoed the ordinance passed by the council giving a franchise to the Northwestern Elevated Railroad Company, which contemplates the construction of an elevated road from Congress Street northwest to the city limits, with four branches. The mayor finds that the provisions for the construction of the road within a certain time are too indefinite and the compensation to the city is not sufficiently generous. The ordinance was amended in accordance with the mayor's suggestions, and was adopted in its new form. The ordinance provides that during the first ten years of the 50 years life of the ordinance the company is to pay $50 annually for each car, and thereafter in addition for ten years 1 per cent. of its gross receipts; for the next ten years 2 per cent. and for the last twenty years 3 per cent. of its gross earnings.

Brooklyn, N. Y. The Highway Commissioners of Flatlands, L. I., have granted an application for a franchise to the Brooklyn, Bergen Beach and Canarsie Railroad Company to build eighteen miles of railroad in the town. The latter is to be an electric trolley road, beginning at Flatbush.ave., at the terminus of the system of the Brooklyn City Railroad Company. The line will extend to Bergen Beach, with a branch across country to the Canarsie shore. An electric plant to cost $30,000 is to be erected at Flatbush-ave. and Kings Highway. By the terms of the contract work is to begin immediately, and it is expected that the road will be in operation early in the summer. The improvement will be of great benefit to the town, as building will be encouraged, with a consequent increase in the population. The company is incorporated, with a capital stock of $200,000; Perry G. Williams is president, and Thomas Adams, Jr., treasurer.

Trenton, N. J. The Trenton *Times* publishes a detailed account of the purposes of the New Jersey Railway, a trolley line, which is to connect Trenton with Newark, Paterson, Jersey City, and have many branches in Northern New Jersey. According to this account, Mr. Joseph H. Reall, well known in this city, has had surveys made, acquired the right of way and secured the co-operation of local lines of electric railway. The project includes connection with a projected trolley line between Philadelphia and Trenton, the two together forming a line between Philadelphia and New York. According to the estimates of the engineer, the cars will run at eight to ten miles an hour through towns and cities, and at 25 to 30 miles an hour in the open country.

Brooklyn, N. Y.—The Hempstead and Jamaica Turnpike Company's interests in the road which bears its name have been sold to the Long Island Traction Company. The sale includes only the franchise, roadbed, tollhouses and the plank road in actual use. The company purchasing these interests agrees on its part to lay the tracks and equip and complete a trolley railroad on the whole length of the road, from Jamaica to Hempstead, a distance of nine miles, and have it ready for travel before January 1,1895. The road will, therefore, be in reality an extension of the present trolley system from East New York to Jamaica, the purchasing company being the same that controls the last named trolley line. The construction and operation of such a road would open up a new avenue of travel to people in Hollis, Queens and other villages, besides throwing into market a section of farm lands as yet undeveloped.

Boiler Test.—The Cincinnati Edison Electric Illuminating Company has made a series of comparative evaporation tests at its Station E, in which the Jones underfeed mechanical stoker was used for firing one furnace, the other furnace being fired by hand in the usual manner. The tests extended through a period of ten days. The results of the first test showed

Percentage of gain in evaporation, stoker over hand firing........17.84
Percentage of gain in saving of fuel, stoker over hand firing........15.15

The second test showed

Percentage of gain in evaporation, stoker over hand firing........21.73
Percentage of gain in saving of fuel, stoker over hand firing........17.95

Indianapolis, Ind.—Because of the reduction in receipts the wages of the conductors and motormen on the electric cars have been reduced from 17 to 15 cents per hour and the wages of the drivers on the mule cars from 15 to 13 cents per hour. President Mason says that the reduction was a matter of necessity. He refers to the fact that street railroad traffic had fallen off in every city of the country. Economy, he said, had been practiced in every possible way, but that the work of construction which has been going on and the converting of the lines into electric lines had caused the company an enormous expense. Some policy of retrenchment had to be made, and the board thought the reduction of wages the best policy.

Omaha, Neb.—In view of the decision of Judge McGee which declared the Omaha and Council Bluffs Railway and Bridge Company to be without a franchise, and without rights to the streets, a motion was made for a stay and permission to file a supersedeas bond pending an appeal. The States Attorney urged the appointment of trustees to take charge of the property. The court appointed as trustees William Moore, C. E. H. Campbell and F. S. Pusey, with the understanding that they should not take possession until the court should decide the motion for a stay and the filing of the bond.

Toledo, O.—The Toledo & Maumee Valley Railroad Company has been incorporated with a capital stock of $300,000. The incorporators are: Wm. B. Taylor, Josiah D. Cook, Geo. G. Metzger, Parks Foster and Grant Williams. It is the purpose of the new company to build a railroad on private right-of-way from the terminal of the Consolidated street railroad line at Bellevue Park to Maumee, across the river to Perrysburg, and back on that side to East Toledo, and connect with the Consolidated at that point, thus completing a complete belt.

Brooklyn, N. Y.—It is now practically settled that there will be no strike of the Brooklyn trolley lines' employes next month. All was arranged by the men to enforce their demands by a strike, but their plan miscarried at the most vital point. The plan as arranged provided that the elevated roads' employes should also strike in support of the surface men, but at the last moment the elevated men backed down and determined to stick to the companies.

Traffic in Kansas City, in 1893.—The Elevated railway in Kansas City, Mo., collected 4,130,778 fares during 1893. The Ninth street line estimates that it carried 8½ million passengers, including transfers, and officials of the Grand avenue system say its conductors gathered five cent fares from 6,115,000 people. The "L" road was the only line which made improvements, changing its motive power from steam and cable to electricity. A better service and a big increase in business was the result.

Denver, Colo.—Two men attempted to hold up an electric car on the Eighth avenue line on New Year's night. One of them smashed the headlight and made a dash for the motorman, who drew a revolver and fired at him. The motorman then turned on the current and both robbers were left behind. There were only four passengers in the car.

Pittsburgh, Pa.—Mayor McKenna has vetoed the ordinance granting a franchise to the Pittsburgh & Mansfield Railroad Company from the corner of Ferry Street and Liberty Avenue to the south line of the city. The mayor bases his disapproval on the ground that the proposed elevated structure of the company would ruin the throughfare on which it was located.

La Salle, Ill.—The Interurban Electric Railway Company, has been incorporated; capital stock, $250,000; incorporators C. W. Palmer, R. Gardner and M. C. Vanfleet.

Pawtucket, R. I.—The electric power station of the Inter-State and Attleboro Street railway companies at Farmers, Mass., was burned last week. Loss, $75,000; partly insured.

Peoria, Ill.—The wages of the employes of the street railway company have been reduced from 4 to 7 per cent. The men voted to accept a cut in pay rather than to work longer hours.

PERSONALS.

F. Wayland Brown, who recently resigned the position of manager of the Youngstown (O.) Street Railway Company, was presented a gold watch by the employes of the company a few days ago. The presentation took place at the close of work at night, and 135 employes were present at the time. Mr. Brown thanked the men for their token of regard; expressed regret at leaving them and hoped their relations with the new manager, A. A. Anderson, would be as harmonious as they had been with him.

J. J. Nate, who has been connected with the telephone industry in this country for many years, severed his connections with the Chicago Telephone Company on January 1 to accept the position of manager of the Metropolitan Electric Company of this city. Mr. Nate's long connection with the telephone and electrical interests and the responsible positions he has filled during the past 15 years have brought him an extensive acquaintance that will be of great value to him in his new position.

Leslie W. Collins, well known to the street railway and electrical trade, has resigned his position as manager of the western office of the *Electrical Engineer* to accept a position on the business staff of the *Electrical World*. Mr. Collins is an industrious and capable newspaper man, and these qualities, together with his popularity, will make him a valuable addition to the *Electrical World* staff.

Newton Hall recently resigned his position with the W. J. Johnston Company, where for two years he has been connected with the editorial department of The *Electrical World* or engaged in the compilation of the electrical directory published by that company. Mr. Hall takes the position of assistant manager of the American Electrical Publishing Company, which, with offices at 136 Liberty street, New York City, will publish the *Electrical and Street Railway Reporter*. The first number will appear about March first.

E. L. Babcock, of the Falls Rivet & Machine Company, Cuyahoga Falls, Ohio, had a very narrow escape last week in New York City from what might have proved a serious accident. He was knocked down in the street by a careless truck driver and so seriously injured as to necessitate his removal to the New York hospital. He was able, however, to leave for his home the next afternoon.

Charles R. Henderson, president of the United States Trust Company, has been elected a director and president of the Metropolitan Traction Company of New York.

E. J. Cook, manager of the engine department of the Field Engineering Company, of New York, is in Chicago this week on a business trip.

TRADE NOTES.

The Complete Electric Construction Company, contractors for electrical construction of every kind, reports an excellent outlook for the ensuing year. The company takes contracts for electric railway construction in all its branches, including complete power plants. The company has the best of facilities and its corps of engineers includes men of wide experience, and high ability. The officers of the company are President and General Manager John A. Seely; vice-president, W. H. Baker; secretary and treasurer, C. O. Baker, Jr., and auditor, Mills H. Landon. The New York office is at 121 Liberty street. The western office is located at 1401 Monadnock Block, where Clift Wise is in charge as manager. Mr. Wise has had an extended experience in street railway work as an engineer, and has been in charge of work for several of the largest companies in the country.

The Altoona Manufacturing Company, of Altoona, Pa., builder of the M. A. Green automatic cut-off engines, has issued a very striking folder containing illustrations of these engines and brief descriptions. Upon the reverse side of the sheet, which is no less than four feet long, are given the names of numerous users and a few selected testimonial letters.

The Austin Engineering Works, of Pittsburg, Pa., have removed their offices from the Lewis Block to more commodious quarters in the Schmidt Building, 95 Fifth avenue, where Edward F. Austin will be found in charge.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued December 19, 1893.

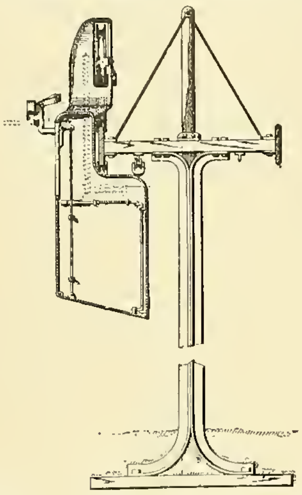
510,878. Elevated Railway System. Burr F. Barnes, Circleville, Ohio. Filed April 11, 1893.

The fourth claim of this patent reads as follows:

"In combination with the car having the receiving and delivery doors, the means for opening both, the bell-crank lever adapted to be engaged and moved by the former, and the rod connecting said lever and the delivery door." (See illustration).

510,922. Fender for Street Cars. William B. Miles, Holyoke, Mass. Filed June 5, 1893.

This fender comprises a frame which is connected to the car to swivel horizontally; the fender proper is pivotally connected to this swivel frame so that it may have an up and down swinging movement. A spring is provided for



NO. 510,878. BARNES' ELEVATED RAILWAY SYSTEM.

pressing the fender downward, and flanged rollers are placed at the forward lateral extremities of the fender for engaging and running on the car track. (See illustration).

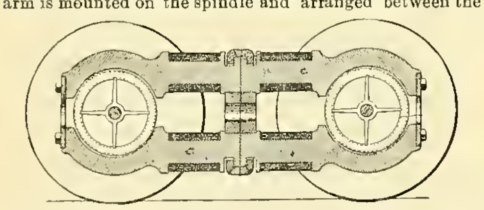
510,947. Electric Locomotive. Charles F. Winkler, Troy, N. Y., assignor to the United Columbian Electric Company, of New Jersey. Filed March 11, 1893.

The first claim of this patent reads as follows:

"A single electric motor provided with two rotary armatures geared respectively with two car axles and with a single field-magnet acting upon both of said armatures, said field-magnet being formed in two parts flexibly connected together, in combination with said car axles." (See illustration).

510,952. Brush Holder for Dynamo Electric Machines. Frank E. Averill, Syracuse, N. Y. Filed February 13, 1893.

This comprises the combination of a supporting spindle, a brush holder frame loosely mounted on the spindle and having one extremity adapted to support the brush; a fixed arm is mounted on the spindle and arranged between the



NO. 510,947. WINKLER'S ELECTRIC LOCOMOTIVE.

two extremities of the holder frame, and a spring is provided having one end connected to the arm and the other to the opposite extremity of the holder frame. (See illustration.)

511,010. Horseshoe. Josef Eckart, Munich, Germany. Filed April 15, 1893.

This horseshoe has a prismatic calk fitted into a socket provided for the purpose, and the calk has a cross-bar extending along its hollow side.

511,017. Electric Railway Switch and Crossing. William W. Hendrix, Bowling Green, Ky. Filed August 5, 1892.

This is a switch or crossing consisting of stationary blocks connected with the ends of the wire, sliding blocks abutting against the stationary blocks and adapted to be moved by the jaws of the trolley, a coil spring having one end attached to the sliding block and the other to another part of the switch or crossing, the spring being adapted to pull the sliding block back in place when the block is disengaged from the jaws. (See illustration.)

511,018. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky. Filed August 5, 1892.

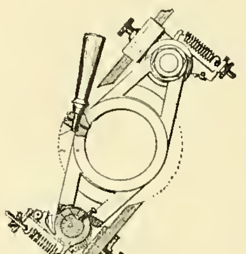
This is an attachment for trolleys consisting of two jaws hinged one on each side of the trolley, the upper ends of the jaws having their front edges beveled to the rear, while these upper ends are adapted to overlap the wire; suitable springs are provided for connecting the jaws above their hinged point.

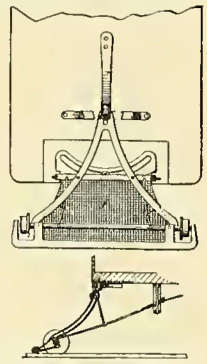
511,019. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky. Filed October 7, 1892.

This is an overhead trolley having its lower end pivoted in a swiveled boot, the trolley pole having bearing against its underside one end of the coiled spring, the coils of the spring passing around the pivot and the other end of the spring bearing against the bottom of the boot.

511,020. Horseshoe. John W. Johnson, Harrodsburg, Ky. Filed March 14, 1893.

The plain-faced underside of this shoe is provided with a tapering recess having its side walls undercut and also having its under or transverse wall provided with a hole, in combination with a calk provided on one side with a





NO. 510,922. MILES' FENDER FOR STREET CARS.

NO. 510,952. AVERILL'S BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES.

lug adapted to fit snugly in the recess and also provided with a threaded stem and a nut for securing the calk in the recess of the shoe.

511,068. Street Railway Track. William C. Wood, Brooklyn, N. Y., assignor to the Lewis & Fowler Girder Rail Company, same place. Filed April 6, 1893.

The first claim of this patent reads as follows:

"In street railway track comprising box rails and clamp chairs, a tongue switch composed principally of a casting approximately H-shaped in general cross-section, and provided at top with a laterally swinging tongue, and at bottom with an internal boss integral with its horizontal web to coact with the pivot of said tongue, and with external clamp-engaging flanges."

511,072. Metal Railway Tie. Hippolyte A. De Raismes, Elizabeth, N. J. Filed January 26, 1891.

This invention consists of the combination with a metallic railway tie formed with endloops and provided with slots, of a chair formed with rail engaging flanges and with other flanges adapted to enter the slots in the metallic tie; locking keys are also provided.

511,093. Horseshoe. Arthur E. Ogden, Ashley, N. D. Filed June 15, 1893.

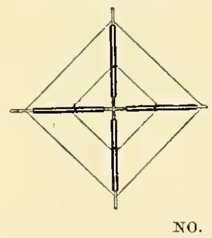
This horseshoe comprises two sections of unequal length and pivoted together, each section being provided with an inwardly and upwardly extending flange, the longer section being provided with a recess at its pivoted end and the shorter section with a latch head entering said recess, and a rod passing through apertures in the ends of the sections.

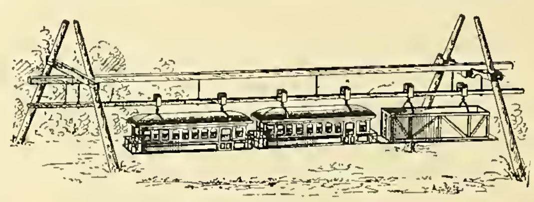
511,163. Signal for Cable Railways. Joseph Sachs, New York, N. Y. Filed August 4, 1893.

The last claim of this patent reads as follows: "The combination with a vehicle and a cable for moving the same, of signal boxes adjacent to the cable, an electric circuit connecting the signal boxes with the central station and devices that can be actuated from either end of the car for operating the signal boxes by the movement of the cable and car."

511,170. Rail Shoe and Brace. Andrew B. Snider and William H. Roberts, Bartholow's, Md. Filed August 26, 1893.

This consists of a plate having on one side a simple hook-shaped flange on the rail base and having on the





NO. 511,017. HENDRIX'S ELECTRIC RAILWAY SWITCH AND CROSSING.

NO. 511,179. VALLEY'S ELEVATED RAILWAY.

other side a shoulder, forming between them a rail-seat; spike-holes are provided at the edge of the shoulder which open into the rail-seat.

511,173. Electrically Operated Railway Switch. Chas. A. Stone, Newton, and Edwin S. Webster, Boston, Mass. Filed August 30, 1892.

This invention comprises a main current conductor which has sections insulated from direct electrical connection therewith, a connecting loop between the main conductor and each of the sections with a plurality of electromagnets in circuit; differentially adjusted armatures for the magnets; two or more shunt lines from the connecting loops, each having in circuit a circuit-closer which is operated by one of the armatures, and a magnet of a railway switch, and a rheostat upon the car adapted to be switched into an electric circuit, in parallel with the motor circuit, for the purpose of operating the railway switch. (See illustration.)

511,179. Elevated Railway. John N. Valley, Jersey City, N. J. Filed September 13, 1892.

The supporting posts of this roadway are arranged in pairs inclined toward each other; the girders are adjustable vertically and project beyond the posts to form clamp sections; these clamp sections are attached to the girders both at the outside and the inside of the post. (See illustration.)

511,199. Sanding Device for Cars. James R. Dougherty, St. Joseph, Mo. Filed May 4, 1891.

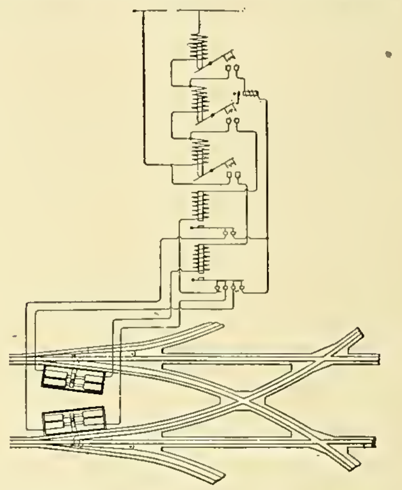
This is a sand-box adapted to revolve independently of its bottom and has bevel gears and shafting and frictional gearing which when operated by the bell crank lever provided for that purpose is brought into continuous contact with the car axle. By this means the sand box is operated so as to keep the sand in working order.

511,214. Brush Holder for Electric Motors. James J. Robison and Fred B. Perkins, Toledo, Ohio. Filed February 6, 1893.

This brush holder has a practically rectangular shell, and an arm connected therewith having flanged sides; a lever is pivoted to the end of the arm, and a spiral spring connects the lever with the base of the arm; a transverse bearing is carried at the free end of the lever to bear upon the brush within the shell.

511,226. Fastening for Railroad Rails. Leander E. Whipple, New York, N. Y. Filed March 17, 1893.

This is the combination of a plate adapted to be seated and secured upon the tie and provided with a flange, and



NO. 511,173. STONE & WEBSTER'S ELECTRICALLY OPERATED RAILWAY SYSTEM.

clamping plates secured upon the first named plate beneath the flange with their edges in position to engage the foot of the rail.

511,227. Railroad Tie. Leander E. Whipple, New York, N. Y. Filed March 17, 1893.

The last claim of this patent reads as follows:

"In a railroad tie, the combination with the body portion, the two curved plates united at their edges, of a vertical plate applied to the end of the body portion and extending below the same and provided with lips embracing the outer sides of the curved plates."

511,254. Closed Conduit Electric Railway. William S. Smith, Berkeley, Cal. Filed February 29, 1892.

This consists of the combination of an insulated main conductor extending along the roadway, a secondary or working conductor, a branch conductor between the main and secondary conductors, a sealed box surrounding the branching point of the main and branching conductors and a switch or cutout at both ends of the branch conductor, one inside of the box and one outside thereof.

511,317. Metallic Tie and Fastener. Thomas M. Brintnall, Medina, Ohio, assignor of three-fourths to Blake Hendrickson, same place, Rollin S. Giffin, Cleveland, and Howard C. Bradley, Warren, Ohio. Filed August 3, 1893.

This comprises a railroad rail fastener for securing one flange of a rail comprising a channel block, dog spike and a key, the channel block being provided with an upper and a lower gripping jaw and side lugs, and across its back with a lug or head near its lower end and a groove near its upper end to receive the key; and the dog spike provided with an outwardly extending shoulder and having its lower end reduced in thickness to give it a spring action and formed across its back with a recess near its lower end and a groove near its upper end to receive the key.

STREET RAILWAY GAZETTE

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CONTENTS.

REMOVAL NOTICE.

The New York office of the STREET RAILWAY GAZETTE has been removed from 171 Broadway to more commodious quarters on the twelfth floor of the Havemeyer Building, located on the corner of Dey and Cortlandt streets, in the centre of the industrial interests of the city. All who are interested in the street railway business are invited to call as often as they find it convenient.

Franchises Were Refused. Quite a number of cities are now paying the penalty for refusing to grant applications for reasonable street railway franchises made last summer. Had the desired ordinances been granted the numbers of the unemployed in these places would now be materially less. A Cleveland paper is responsible for the statement that the unreasonable attitude of the city authorities toward the local companies, had deprived 1,000 men of employment; as a result the city is now seeking the right to issue bonds for $50,000 to aid the poor.

Electric Railway Freight Service. A Montreal street railway company whose cars run into the suburbs has concluded, upon investigation, that its receipts could be materially increased if it opened its lines to freight. Its plan is to operate its road from midnight until 5 A. M. as a freight line. During these hours all the necessary freight business can be transacted, and the regular passenger traffic will in no wise be interfered with. It is possible that the example of the Montreal company could be profitably followed in a considerable number of localities where lines are so laid out that coal and produce could be carried. Considerable difficulty, however, might be experienced in securing the changes in charters and franchises necessary before engaging in the new branch of transportation.

Reports from Motormen. It is often a difficult matter to arouse in the motorman an interest in the proper care of his motor. One way of doing this is mentioned in one of the addresses before the Massachusetts Street Railway Association printed elsewhere in our columns. In this instance a part of the motorman's training is a careful study of the price list of repair parts for the purpose of teaching him the value of the machinery entrusted to his care. Prizes are also offered and other inducements held out to persuade the motorman to watch carefully the operation of his motors and to lead him to report any indication of approaching trouble that he may notice. On one road in Illinois a rule exists that requires the conductor to run the car for 100 feet up and down the track at the end of each trip, while the motorman watches the operation of the motors both through the traps and from a position at the side of the track, and any faults noticed must be reported. Managers have fully realized the importance of having the motorman take a lively interest in his car and its equipment but it is often difficult to get the motorman himself to realize that his oversight will make any difference with the operation of the car.

One Way to Economize. Experience has proved that one of the best ways to keep the repairs account of an electric road at a moderate figure is to maintain only a single type of motors for the operation of the cars. On some roads this is impossible owing to the necessity for motors of the larger sizes for drawing one and two trailers, while for cars operated without trailers a smaller size motor is sufficient. But the maintenance of motors of two or more different makes and each of these of two or three sizes is an expensive experiment. In a repair shop recently visited we found no less than five different styles of motor although the entire equipment of the road consisted of only 30 cars. The result was evident upon visiting the store room where extra parts, from screws to armatures, were kept in stock for each of these five machines. Hundreds of these parts would have been uncalled for had a single style of motor been selected and adhered to for all cars. It would probably prove more economical in the end, if it had been decided to purchase for some cars a new type of motor, to dispose of all former equipments and adopt this new type, if it should prove economical, as the standard for all equipments. Much money is literally thrown away upon the constant repair of worthless motors.

Preserving Good Order on Cars. The maintenance of good order in a street car is one of the important duties of a conductor and he should be impressed with the fact. If he does not squelch the loafers that sometimes become offensive his car is likely to become an exceedingly unfit vehicle for ladies to occupy. Conductors hesitate too often to act in the fear that they may find themselves in difficulty, because of their activity. We confess to a feeling of entire approval in the case of conductors applying judicious physical measures in the treatment of "persons who are intoxicated or otherwise violating public decency." A case of this class recently came before a court in Massachusetts. The plaintiff, a Thomaston man sued, a street railway company because he was ejected from a car for alleged profanity. He won his case, and was awarded a verdict of over $1,100. It is to be hoped that this result will not establish the principle that a man may swear to his heart's content on a street car, and that while doing so he is acting well within his rights. It is rather to be hoped that too much force was exercised for it would be unfortunate to have the impression become general that foul language is permissible on a car. The fact is there is too much laxity in the enforcement of the rule providing for decency on cars, and we would be glad to have read of a different termination of the suit.

Elevated and Surface Transportion. The fact is frequently commented upon that the construction of the elevated roads in New York and Brooklyn did not affect the surface roads disastrously, as many of those interested in the latter had anticipated. There seemed to be plenty of business for both elevated and street lines, and so far from the elevated railways injuring the street roads, the reverse has appeared to be the fact. The same result was apparent in Chicago when the Alley elevated road was built. No diminution in the patronage of the parallel cable road was noticeable. Generally speaking, elevated railway companies have felt heretofore that they had nothing to fear from the competition of surface lines; they inclined to the belief that they were engaged in a somewhat higher order of transportation and they did not consider the surface companies as in any sense rivals; the horse car companies on the other hand were supposed to experience a fear from the mighty competition of the rapid transit lines running overhead. If we may judge from the annual report of the Brooklyn Elevated Railroad these conditions have been reversed, and the elevated companies may become fearful of the competition of their rivals on the street. The report shows that during last year the company not only has not made money, but it has encroached on its surplus. The decrease in earnings is partially due to the financial conditions beyond a doubt, but the president in his report attributes the retrogression in part to the competition of the surface cars, and the explanation is made with manifestations of no little bitterness. The competition is made possible because of the introduction of electricity, and it is alleged that the speeds attained are "reckless." It is true beyond a doubt that a road on the surface because of that very fact has a great advantage over an elevated railway. If by patronizing the latter considerable time cannot be gained people will not be inclined to climb up a steep stairway. That assertion has been abundantly proved by the experience of the Alley elevated road in Chicago. At the close of the Fair the intervals between trains was materially increased. At once there were deserters in the army of the patrons of this line. It was evidently their belief that it did not pay to clamber up the stairways if they were not bound to catch a train within a minute or two; they preferred to take a cable car at once and start the trip townward without delay. The means of regaining the lost patronage must necessarily be an improvement in the service, and this plan is unquestionably the one which the Brooklyn company must follow. If the electric cars run far more rapidly than the horse cars the elevated trains must make some corresponding improvement or necessarily the companies must suffer. They must operate their trains faster and make the coaches far more comfortable. As a matter of fact elevated roads have not done much in the way of improvement during the last five years, while the operation of surface lines has been fairly revolutionized. In these days of competition the company that is not progressive must pay the penalty. If the elevated service is improved as materially as the scheme of surface transportation, then as soon as good times return there will be no further encroachments on the surplus.

CONSPIRACY AMONG DISCHARGED STREET RAILWAY EMPLOYES IN INDIANAPOLIS.

Reports of a decidedly sensational description have recently came from Indianapolis relating to alleged plots among the discharged employes of the Citizens Street Railway Company to destroy property of the company. There is a basis for the reports, although the truth is not as startling as the stories contained in the dispatches. In a recent issue of an Indianapolis paper General Manager McLean made a statement affirming the existence of a conspiracy among the employes. The principal part of the statement is presented herewith:

"There are a good many of the ex-employes in the plot, and their malicious schemes might have been successful had it not been that one of their number gave the whole thing away. We now have the names of all of the conspirators in our possession and the police are keeping a strict surveillance of their actions. All of them were discharged for adequate cause. In one or two cases men who were deep in the plot called here and wanted their places back, making pitiful appeals, and at the same time they were aiding and abetting their fellows in every possible way,

"The least harmful of the plans was a scheme to doctor our insulators and by creating short circuits to injure our lines in every possible way. The men congregated and formulated their plans at Peter Moon's saloon, 159 W. Washington street. Meetings have been held there for a good while, and it was arranged to simultaneously ground the wires on the N. Illinois street, Pennsylvania street, Alabama street, Central avenue, Columbia avenue, Clifford avenue, W. Washington street and the Stock Yards lines. To this end some of the conspirators pried into the tower wagons in the Tennessee street stables and stole the insulators, which were tampered with in such a manner as to cause the current to run from the wires to the ground. The dynamite part of the plot did not advance far enough to reveal the scheme, but I have learned that an ex-official of the road threatened more than once in Moon's saloon to use the deadly explosive, and there can be little doubt as to the outcome had not their plans been frustrated."

West End Company's Agreement.

The West End Street Railway Company of Boston has held several conferences with its employes in reference to the recent agreement published in the last issue of the STREET RAILWAY GAZETTE. The men took exception to certain of the provisions concerning extra men. The following notice was posted up in the stations explanatory of the agreement:

1—Regular extra cars shall consist of one trip less that a regular car of the same line on all lines where the running time is less than one hour forty minutes, and shall not exceed nine hours' platform work in fifteen hours, outside limit, unless requested by the men who ask to run it.

2—Men running the full hours of regular extra cars shall be credited on the pay-rolls with having earned $2.25.

3—All regular extra cars will be advertised and applications must be made on printed form, to be procured from the foremen, cars to be given men according to rating of those who apply, unless otherwise agreed upon between the several applicants.

4—Such applications may be withdrawn after two days' notice to the superintendent.

5—Extra men may make a general written application to the superintendent for work outside of the 12-hour limit.

6—No political use whatever will be made by the company of these applications. They are solely in the interest of the men if they desire the work, and must be voluntary on their part.

7—Trippers shall be paid at the rate of 27½ cents per hour for one or more trips, and fractions of one half hour to be called one hour, and any work done in five consecutive hours either in the morning or afternoon to be paid $1.13.

8—No employe will be discriminated against for failure to request work outside of 12 hours, except that he will not be eligible for such work.

9—The company wishes to have as many extra cars as possible.

10—The company will meet the views of the extra men in the request for giving out extra work, if it can be ascertained definitely what those views are.

MAYOR GILROY AND RAPID TRANSIT IN NEW YORK.

In his annual message to the board of aldermen Mayor Gilroy of New York makes the following reference to the rapid transit situation:

"The difficult problems involved, and the fact that capital is even more than usually timid and conservative in these times, have prevented any progress in this direction. It may be that an underground road, capable of the highest speed, to be built by private capital or public funds, will furnish the ultimate solution. Thus far no capitalists have shown a sufficient interest in such a plan, nor has public sentiment declared in favor of such an investment by the city. In the mean time, and even though work on that line was begun, more immediate relief is necesssary. The Rapid Transit Commissioners were not met in a proper spirit by the Manhattan Elevated Railroad managers in the effort to improve the facilities of that system. A new line of elevated railroads has, therefore, been planned, and the franchise will be shortly offered for sale. It is sincerely to be hoped that the additional transit service that is so urgently needed may in this way be acquired. Immediate relief, however, can only be afforded through the Manhattan system, by the construction of third tracks and additional terminal facilities."

Philadelphia Companies Annual Meeting.

Over a score of Philadelphia street railway companies held annual meetings on Tuesday last but as all of these with one exception are controlled or leased by the traction companies they merely met to keep alive their organizations. The only operating company to hold a meeting was the Hestonville, Mantua and Fairmount Railway Co. The annual report stated that 6,546,437 passengers were carried during the past year, an increase of 58,600 over the preceding year. The receipts for the past year were $325,126; showing a net increase of $9,000. During the year $42,000 was expended for betterments.

The report stated that the company will have arranged its financial plans for trolleying the road within a short time, but it is probable that no outside work will begin before the 1st of April, except, perhaps, in the construction of the power house on the site of the Race and Ravine Streets Depot at the Callowhill street bridge. It is thought that the entire system will be trolleyed and in operation by the close of this year.

The cost, including the cars, will not, it is estimated, exceed $1,500,000, and about 75 cars will be run over the route, the Race and Vine street cars running to West Philadelphia as well as those on the Hestonville Line.

Testing the Vestibule Law.

It has already been stated in the STREET RAILWAY GAZETTE that proceedings were recently instituted against Frank S. Hoskins, superintendent of the Twin City Rapid Transit Co., on the charge that cars under his control has not been vestibuled in accordance with the state law. The complaint was made by the labor commissioner, and the case came up before Judge Twohy in St. Paul on January 6th. The attorney for the defense admitted the truth of the statements alleged in the complaint, but raised the question of the constitutionality of the law, and made a motion to dismiss on the ground that the legislature had not the power to pass the act. The motion to dismiss was not argued at length, the attorneys agreeing that briefs on the motion should be submitted to the court Monday afternoon. The brief of the defense, as filed, alleged the unconstitutionality of the law on the grounds that it impairs the obligation of a contract, that it is class legislation and that it is taking property without due process of law.

Proceedings were also instituted against Dow S Smith general superintendent in Minneapolis on the same allegations. The same defense was made.

PROBLEMS FOR STREET RAILWAY ENGINEERS.

[Under this heading we will present each week during 1894 some practical street railway problem, the solution of which will call for the exercise of the same kind of engineering ability that is necessary in the every day practice of the consulting or designing engineer. Solutions to these problems are solicited and will be published when considered sufficiently accurate or when they contain valuable information.—EDS.]

PROBLEM II.—A street railway line is projected as follows: Beginning at the central station the line runs north 2,000 feet, east 4,500 feet, north 3,750 feet, east 2,500 feet, north again 800 feet, west 11,000 feet, south 1,250 feet, east 300 feet, south 1,500 feet, east 1,000 feet, south 3,800 feet and east 2,700 feet to the starting point. Assuming a certain size for trolley wire, design the network of feeders to give the most economical results of operation. Cars are run every five minutes in opposite directions and require one hour for the trip around the circuit and back to the power house. Coal costs $1.50 a ton at the furnace door. Ordinary rates of wages are paid. The line is double-tracked over its whole length and must be divided into about one-mile sections. The voltage to be used is 500 with a 10 per cent. drop allowed at distant points on the line. Provision must be made for heavy loads on the cars and for a possible addition of about 25 per cent. more cars at the morning and evening hours of heavy riding.

Street Railway Tracks on Paved Streets.

City Engineer Roberts, Saginaw, Mich., says that it has been demonstrated by the use of electric motor cars on the paved streets of that city that pavement can not be maintained in good condition for any length of time, while electric motor cars are run on a flat light rail laid on longitudinal timber or stringers resting on ties ballasted with an insufficient amount of sand and gravel, upon a sub-foundation poorly drained. The frequent loads on the tracks and their settling disturb the foundation under the pavement, causing the paving blocks to become loose and rise above the rails of the track. The greatest damage resulting from this, Mr. Roberts thinks, is the forcing of water under the rails and foundation of the track out under the pavement on either side so that it loosens the entire foundation, and the pavement soon begins to yield under ordinary travel. He believes that the premature destruction of pavements in streets where electric street car lines are operated is due largely to the poorly constructed track and foundation. He recommends that hereafter all street car tracks be laid on a foundation of six inches of concrete or eight inches of broken stone, with such surface and sub-drainage as will at all times conduct the water quickly and freely from the tracks and foundation.

Gas Motors for Street Railways.

President Boardman of the American Gas Light Association, in opening the recent annual meeting of that body made an address in which he referred to the use of gas engines on street cars as follows:

"The cost of building and equipping a street railway for the use of gas motors is considerably less than for electricity, even with the overhead trolley, which must soon be discarded for the more expensive system of underground wires. The running expense and repair account for a road operated by gas motors are far less than one operated by electricity; and the erection and maintenance of a power station is entirely unnecessary in a town having gas works. The gas company can compress the gas and deliver it so compressed at the street car stable; or a small room at the stable can be devoted to the compression machinery, and a gas engine to furnish the power to it. In either event the street railways could be made large gas consumers, to the mutual advantage of the shareholders in the street railway company and the gas company."

CARE OF STREET CAR MOTORS.

MONTHLY MEETING OF THE MASSACHUSETTS STREET RAILWAY ASSOCIATION.

Timely Discussion on the Care and Maintenance of Electric Motors During Winter and on the Heating of Street Cars.

Sketches of Prominent Members.

At the regular monthly dinner and meeting held at Young's Hotel in Boston on Thursday of last week, the Massachusetts Street Railway Association discussed one of the most important and timely subjects that could have been selected. Although it had been announced that the leading topic to be discussed would be the heating of street cars, the one actually considered was the care and maintenance of electric motors during winter. The principal speakers were Robert C. Brown of the West End Street Railway Company of Boston, E. C. Foster of the Lynn & Boston Road, P. F. Sullivan of the Lowell Street Railway Company and E. P. Shaw of the Haverhill and Amesbury Road, and their remarks are here given in full. Electric heating was also briefly discussed by Jas. F. Shaw of the Wakefield and Stoneham Road and others.

The important question of accident insurance and the refusal of existing accident companies to indemify street railways was presented and after dis-

COL. J. H. CUNNINGHAM.

cussion the matter was referred to the executive committee to consider and reportupon the advisibility of forming a mutual insurance company either for the state of Massachusetts or for New England.

President Cunningham referred to the death of the daughter of Chas. Odell of the Newburyport and Amesbury company and the secretary was authorized to forward resolutions of sympathy. Mr. Odell was the organizer of the Massachusetts Association, was its first president, and served in that capacity for three years. Mr. Sullivan of the Lowell Street Railway Company referred to the death of Deacon William Richardson of Brooklyn, and the secretary was authorized to transmit resolutions of sympathy.

Greeting was voted to the State of Maine Street Railway Association just organized, and it was voted that the secretary transmit regularly to it and to officials of other railway companies in New England all notices of meetings of the Association with a cordial invitation to attend.

The two subjects that will receive consideration at the next meeting will be "Bonding of Rails and the Return Circuit" and "Construction of Street Railways."

Before giving the full report of the discussion the accompanying sketches of officers and prominent members of the Association may prove of interest.

PRESIDENT J. H. CUNNINGHAM.

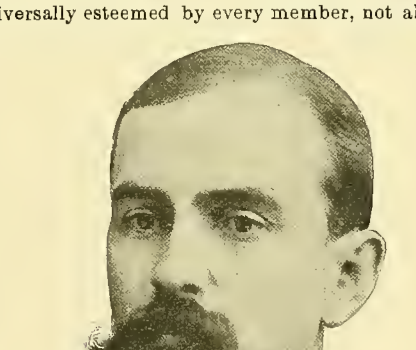
Col. J. H. Cunningham, president of the association, was born in Boston in 1851, and is presisident of the J. H. Cunningham Iron Co. of that city, a corporation representing a business founded by his father in 1852 and which he has honorably

A. E. BUTLER.

and successfully perpetuated until it ranks to-day as second to none among the leading iron manufacturing companies of this country. Wrought iron pipes and fittings for steam, gas and water are among its principal specialties, and it is but natural that in the early days of electricity as a competitor of gas, Col. Cunningham should have become financially and actively interested. As has heretofore been stated in our columns, Col. Cunningham has been more or less identified with electrical interests from the first introduction of electric lighting in Boston. His official connection with electric railway corporations is as follows: President of the Plymouth & Kingston road, vice-president of the Gloucester Street Railway Company, director of the Lynn & Boston, director of the Haverhill & Amesbury and director of the Worcester & Leicester and Worcester & Milbury roads. He is a thorough business man, a leader in social circles and was a member of Governor Russell's staff until the close of his term of office.

SECRETARY A. E. BUTLER.

A. E. Butler, secretary of the association, is universally esteemed by every member, not alone



C. S. SERGEANT.

because of the deep interest he manifests by his efforts for its welfare, but as well also for his many excellent social qualities. This is his second year as secretary. Mr. Butler is a resident of Lawrence, Mass. He became identified with the electric railway in its early days, formerly owning a controlling interest in the Merrimac Street Railway Company, of which he was treasurer and general manager for ten years. In 1892 the Industrial Improvement Company of Boston purchased the Lawrence and Haverhill roads, and Mr. Butler retired from active connection with the street railway business to give his entire attention to the business of the Arlington National Bank of Lawrence, of which institution he is cashier. He still retains an interest, however, in several street railway companies and contributes in great degree by his ability, energy and perseverance to their prosperity.

C. S. SERGEANT.

C. S. Sergeant was born in Northampton, Mass., in 1852, and was graduated from the Northampton high school in 1868. His first business connection was with the First National Bank of Easthampton, Mass., in the capacity of teller, resigning therefrom to engage in the railroad and iron business in the West, where he was located for several years. Returning to New England again he became identified with the Eastern Railroad in Boston as chief clerk, and afterward as general auditor for seven years. Later he became associated with Charles Merriman of Boston, who was treasurer of a number of western railroads for several years. His connection with the West End Street Railway Company of Boston dates almost from the consolidation of the Boston street railways in 1887. As general auditor he organized the accounts, and subsequently when the

E. C. FOSTER.

electric system was introduced he originated a system of accounts to meet the changed conditions. He was subsequently elected second vice-president and after operating the road under that title for nearly a year was elected general manager in November 1892. Mr. Sergeants long connection with steam railroads, having as he generally did, the supervision of the finances pertaining thereto, created for him the reputation of a high authority upon railroad finance. This knowledge he carried with him of course to the West End road, where it proved of great value at the time of the consolidation of the horse railroad system, and of still greater value when the operation of the road was changed from animal to electric power. It was a tremendous task to introduce a satisfactory accounting system during the early and experimental electric work, but Mr. Sergeant was finally successful, and very many of the electric roads in various parts of the country are indebted to him for an admirable system of accounting. Although an extremely busy man, Mr. Sergeant is always pleasant and agreeable, and enjoys the respect, confidence and esteem of the business community and a large circle of friends.

E. C. FOSTER.

E. C. Foster was born in Hancock, N. H., October 23, 1852. He received his early education in the country schools and later took a course at Appleton Academy, New Ipswich, N. H., and at the age of seventeen he took up his residence in the city of Lynn, Mass., and for a period of two years was engaged in mercantile business. At the age of nineteen he secured a situation under J. E. Rugg, then superintendent of the Lynn and Boston Railroad Company, as a conductor, acting in that capacity for two years. He then spent one year on the Pacific Coast in mercantile business, and returning again entered the employ of the company as a conductor, and from that time until the year 1882, he filled various positions as conductor, trackman, starter, foreman, etc. Finally he was appointed acting superintendent, and at the expiration of six months was appointed superintendent, in which capacity he was employed until August 25, 1892, when he was appointed general manager of the Lynn and Boston Railroad, the second largest system in New England. It will thus be seen that Mr. Foster, though comparatively young in years, is somewhat of a veteran in street railway service. He has been from the start a close student of electric traction and possesses valuable practical knowledge which he applies greatly to the profit of his road and shares generously with his street railway associates. There is no member of the Massachusetts Street Railway Association whose remarks receive greater attention or carry more weight.

The full discussion of the subjects under consideration at the meeting is here given:

ROBERT C. BROWN.

West End Street Railway Company, Boston.

Mr. Sergeant has delegated me to make a few remarks this evening in his stead, concerning our practices on the West End road in the care of motors during winter weather. I feel sure that you would much rather listen to Mr. Sergeant in dealing with such a subject, but however that may be, I will bring to your notice our methods, knowing that possibly a great deal will not be new to you. At the same time I trust that a little of it may be of benefit and interest.

Our winter practices differ but little from those of the summer, except that in summer we of course have a double equipment of cars, both open and box, the open being used a greater part of the time and receiving most of the attention. The box cars are seldom used and require but little labor to keep them in good running condition. In the winter our work follows a routine which is much the same throughout all kinds of weather. I will recite to you in a general way our methods for keeping our motors in good repair. Our motor equipment consists entirely of W. P. 50 motors. At one time we operated with F 30 motors, but these have been entirely done away with and now we use only waterproof motors.

We make it a practice to inspect to a certain degree—especially as regards brushes, leads, and other parts which are likely to get out of adjustment easily—every day. Every third day the car is "over the pit" and is thoroughly inspected from trolley wheel to rail. Every other third day the brush holders are removed at the same time this inspection goes on, and cleaned. Also the journal caps, and so far as possible, the motor, in general, receives a thorough wiping. Once every 30 days the motors are taken apart, the lower half of the shell being dropped into the pit. When this is done, all the parts of the motor are inspected and thoroughly cleaned. The brasses are removed, the oil wells cleaned out, the commutator and armature thoroughly cleaned, and the whole motor put in as cleanly a condition as possible. This is followed finally by a coat of asphaltum paint. We make use of this paint at all cleanings, using a little of it at each time. We find this an advantage as it gives a good surface to the iron and leaves it in a condition that allows of its being more easily cleaned. At the same time our axle gears and pinions, both of which are of steel, are closely examined for loose bolts, loose keys, wear and other depreciations.

You will perhaps be interested to know some of the details in connection with this "monthly cleaning," as we term it. In point of time, two men can do the above work in a thorough and satisfactory manner in two hours and a half. One of these two men is thoroughly experienced in motor work; the other man acts as a helper.

We make it a point that the foreman, at the time this work is performed, gives his personal attention to a thorough inspection of the car and all work that is being done at that time. Under these conditions and such inspection, we think that the cars receive attention which will cause them to run in the best possible manner.

The above classes of work are practiced continually, both winter and summer. During the stormy weather of the winter, we find it necessary to do but little different than in pleasant weather. The precautions we have taken to keep the water from getting into the motors so far guard us from any trouble from water that we consider the operation of the W. P. 50 motor through the streets, when they are fairly running with water, an entirely practical thing.

We cover the openings at each side of the motor with canvas shields, as snugly fitting it as is possible for us to apply. We also hang a canvas curtain on the commutator end, from the car body. These guards suffice very well to meet all the conditions of water which are likely to occur on the streets upon which we run. Of course grounded brush holders occur at times and are traceable to water lodging upon the brush holders, but this is by no means as serious a matter with us as it used to be with the old F 30 motors. In fact, we do not lay great stress upon the likelihood of the motor grounding at this point, provided the brush holder is kept perfectly clean.

In our plows the motors are on the floors of the plow body, and, of course, are away from the water, snow and salt which they would meet were they hung directly on the axles. These motors give us almost no trouble and require but a minimum of attention during their service.

I trust that these remarks have been of interest to you, and that there may be some little in what I have said that is new. I am laboring somewhat at a disadvantage in the position which I hold, as I never before have had the pleasure of attending one of your meetings, and may have repeated much that has been said before.

E. C. FOSTER,

Lynn and Boston Street Railway.

The subject before the meeting for discussion this evening is one of great importance to all managements, as it enters largely into the expense account. We have had quite a varied experience with motors and have found that the first step in the direction of economy is a very careful supervision, inspection and care. We have about 50 cars equipped with F 30 motors, which have been in service from three to five years, and we also have some No. 6 Sprague motors, 17 car equipments, which have been in service for about four years. We also have W. P. 30's, W. P. 50's and G. E. 800's of the General Election Company's make.

The F 30's require a great deal of care and attention, as the capacity of the armatures is somewhat limited, they become heated, and as a result, will short circuit and burn out. The intermediate shaft and gear are also a source of expense and the pans are a source of annoyance; in fact, they seem to be made up of delicate parts which seem to create trouble and annoyance to those having them in charge. Certainly, for the winter season, they are not adapted and cannot be operated with any profit in this northern climate. In the summer season it might be profitable to have a limited number of open cars equipped with them, to be run on special occasions, but for regular service, they are not as satisfactory as those of modern types. The cost of keeping them in repair is about three times as great as it is with the W. P's, that is for labor and the material necessary to keep them in running order, and then we are subject to annoyance, inconvenience and adverse criticism on having a car become disabled on the street and unreliable, to the extent that people will not patronize them. I think it works injury to the system, because, if a corporation once creates a bad reputation for regular service, it takes some little time to overcome it.

The W. P. 30 motors have given us very good service, yet, I do not consider them of sufficient capacity to do the work we require of them. We are operating over grades of 5 per cent. with trailers; the last season, during the summer months, we operated 10-seat cars with trailers, and with the type K controller and they did the work very nicely, but they were not of sufficient capacity to do it continuously without impairing the usefulness of the motors. The armatures are not of sufficient capacity to do the work.

The W. P. 50's, I think it goes without saying, are very profitable motors, and, of course, the cost of maintenance is less than with other types of motors. We have very little difficulty with the W. P. 50 motor. We have given them very hard service, as we have run them 16 miles from Boston to Marblehead, and the car runs there from one terminus of the track to the other, and frequently makes the return trip. It is a very long run and part of the way at a very high rate of speed. I do not undertake to say that the W. P. type of motor is a perfect one, as it is far from it. There are, possibly, some mechanical defects, but they certainly are far superior to the F. 30's.

The G. E. 800 seems to be the ideal motor, as it is very efficient, having a greater capacity than the W. P. 50; is a more "speedy" motor, and has about 1,000 lbs. less weight, which is something to be considered, as we experience great difficulty in maintaining perfect joints, and I think it is a step in the right direction to reduce the weight of the motor. When it is necessary to have the weight in order to obtain traction, that weight is created by the burden of passengers in the car. When the passengers are not there, the weight of the car is burden enough to give proper traction.

We have been highly pleased with the operation of the type K. controller, and were very fortunate in not having forced upon us controllers of other types as representatives of the company were very enthusiastic over some of the older types of controllers, especially the type J.

We run on the average a schedule of eight miles per hour. In the city of Lynn, we have several local lines over which the round trip is eight miles long, and we have no difficulty in making it. On some of our outside lines we run over eight miles, and in some remote localities, ten miles. I presume there are times when a car obtains the rate of twelve miles an hour. I do not believe it safe to run on the street at a higher rate of speed than twelve miles an hour, but in some very remote localities where the track is on one side of the street, it possibly would be safe to run fifteen or eighteen miles, but if there were much team travel, I would consider it unsafe, as I think the prolific source of accidents is quick running, and it adds greatly to the expense account. A car is subjected to a great strain every time the brake is applied and it weakens the parts of the motors; but there are various opinions on this subject.

Our F. 30's, S. R. G.'s, W. P. 30's, W. P. 50's, and G. E. 800's are wound to run twelve miles per hour with a maximum load on level track, and with the minimum load on level grade. I have no doubt a car would attain a speed of eighteen miles an hour if allowed to run any distance without having the brakes applied.

P. F. SULLIVAN.

Lowell and Suburban Street Railway Co.

The details of "care and maintenance of street railway motors" have been so clearly stated by Mr. Brown and Mr. Foster that any remarks I may make would be practically a repetition of their remarks, and would take up your time, yet inasmuch as our present methods are the result of experience I might state how we arrived at them.

In the last of the winter of 1888 and 1889 we looked into the subject of electricmotive power with a view of using such power on a proposed five-mile extension toward our present summer resort. Your experience will help you to imagine the rest. We were waited upon by and received some very interesting lectures from some eloquent young lecturers representing the various electrical companies, and so well did they do their work that we purchased what were known as Bentley-Knight motors, practically what we now call F. 30's.

From what the young man said we were almost tempted to purchase twice as many equipments as we did, like the man who upon being told that by purchasing a certain kind of stove he would save one half his coal, stated that he would purchase two and save all his coal. Their descriptions of the economy of electric over animal power were certainly beautiful romances.

We opened our line in August 1889 and for three months the electrical repairs did not exceed $8.00, and then we thought "Now we are fixed for Winter, bring along your snow storms, no more four horse time." You know the rest—the snow kept growing more and the motors less so that at the opening of spring our equipment looked very much as did the parrot and monkey, not nearly so good looking.

We then got our second wind, our sober second thought so to speak. Those young men had told us that anybody could take care of electric motors, but that better still, they required no care. We concluded to try our own, old fashoned methods, concluded that the greater part of the treatment of electric motors was mechanical, and that mechanics should have the care and maintenance of them, and that the good mechanical methods and practice should be the rule.

You all realize how you feel when you see a piece of machinery, whether engine or otherwise. We like to see it working smoothly and noiselessly, well oiled and clean kept, and you like to see the man in charge, an engineer, for instance, look fondly at his machine and speak to it and of it as an animate object. How differently we formerly looked at an electric motor, one of the most delicate pieces of machinery, subject to the severest tests, of loads, and temperatures, through extremes of dust and dirt, and operated by men relatively unskilled.

We assume those latter conditions to exist and have built from that basis, a system. In the car house skilled mechanics are in charge who are held responsible for results; subdivision of duties and labors in relation to parts of machinery as far as practicable, so as to more readily locate responsibility. The object is that when a car leaves the shop newly equipped, such equipment shall be thoroughly done, through the best material and workmanship, and after that time a thorough inspection. Motors, trucks and cars are numbered and an official record is then begun, and date and description of any repairs made are kept and comparisons formed, and causes sought. Our subdivision of labor, duties and times of inspection is practically the same as that, so very clearly described by Mr. Brown.

The work is only half done when a car leaves the shop and is passed into the hands of what I previously called relatively unskilled help. We assume that a man before taking charge of a car is absolutely ignorant, has no interest in the apparatus, and we aim to teach him, we endeavor to excite his interest and curiosity, so that he will look out for his motors, inquire for certain motors, create a rivalry so that a man will boast of his record; and we have such instances.

A green man is placed on the car in charge of a competent motorman, taught the names and methods incidental to car control, and is recommended as being competent to take charge of a car. He is then placed in the repair shop under the direction of the foreman and shown all the parts, their relations one to the other, and with one another, shown cause and effect, and in order that he may realize more fully what certain carelessness would amount to he is given the list price of the various parts, and shown how to get along and not get stuck particularly on a single track. Drivers of horse cars were put through the same course. When in the shops such men take the place of helpers in all branches, and are paid accordingly.

In addition to creating an interest among the men, and in fact to help to create such interest we have prizes for the motormen whose cars have had the best records in point of expense, delays, etc., and in this manner we are also enabled to find out from the regular men who the best reliefmen are. Motormen are given printed forms which enable them to call the attention of the night foreman to certain things which may appear wrong, and such form is countersigned by such foreman and forwarded to the superintendent. All loss of mileage or taking off of cars is reported directly to the manager's desk who exacts an accounting for the cause from the superintendent.

By following the above methods we have been enabled to adopt a standard of car mile expenses, and the different foremen are given to understand that if the expenses are kept below such a figure they may expect a present at the end of the fiscal year. Our equipment consists chiefly of W. P. 30 motors, Bemis standard trucks, 33-inch wheels. Nearly all cars are equipped with type K controllers, and all have gear cases. The cars were previously equipped with the former style of Bemis truck 30-inch wheels, but we found it was in the line of economy to change.

I have gone into the foregoing in detail, for while it is undoubtedly old to the older companies it may be of service to some of the newer companies, as it may enable them to steer clear from the rocks which some of the rest of us struck. I can assure them though that while the detail seems tedious and laborious they will find it directly in point of expenses and indirectly in less interruption to travel, the most economical method to maintain motors in summer as well as in winter.

N. E. MORTON.

Lowell, Lawrence & Haverhill Street Railway.

We have had considerable trouble during sleet storms by water getting on the commutator and brush holder, and grounding the brush holder to the motor frame, so that the current, instead of going to the controller, goes to the rail and ground. The current should go through the fuse box first, then from the lightning arrester to the controller, through the fields and armatures, as the trolley wire is the positive, and the rail the negative.

We have, also, had trouble in using salt on our tracks, by its being thrown on the wires by the wheels, and burning the insulation off, thus making a short circuit. Sometimes our men have thought an armature was disabled, or burned out, but on closer examination found that the insulation had been eaten from the wire by the action of the salt.

We have used every means to protect our motors from water as much as possible, and have found that a piece of No. I duck, painted with fireproof paint, attached to the motor and running along each side of it, between the motor and the wheels, so that no water can be thrown from the wheels into the motor, makes a very good protection.

Lightning arresters oftentimes cause trouble, by water getting on them and burning them out, or short-circuiting us at the station. I find the better way is to place them underneath, and in the center of the car as near as possible, in order to prevent water being thrown on them by the car wheels. They should also be covered with either a wooden or galvanized iron box, lined with asbestos as a protection to the car in case of being struck by lightning.

We have used the type K controllers for six months, and think they are far superior to any controller in use to-day and cause the least trouble. They are perfectly water-tight. One advantage is that in case of trouble with either armature the motorman can cut out the armature in trouble from the controller without disconnecting any wires or disturbing the passengers. Another good feature is that the reversing switch and controller are all together. This is a great improvement over the old style controller where the reversing switch was under the car body and was often burned out.

We use two kinds of motors—S. R. G. 15 and W. P. 25, two to each car. The S. R. G. requires a 70-ampere fuse, and the W. P. a 100-ampere fuse. Great care has to be exercised that the men do not use the larger fuse on the smaller motors, as they are liable to do if not watched closely. If this is done, and the small motors become overloaded, the fuse being too strong, it is apt to burn the motor out. The machines have to work a great deal harder in winter than in summer, on account of the ice and snow on the rails, which cause the wheels to slide more.

We have at our car barn three night men. One of them looks after the cleaning of the cars, sweeping the floors, washing the windows and taking care of the stoves; the other two go through all the cars, lift all traps, and make a thorough examination of every part,—lead wire, brushes, brush holders etc.,—and find all troubles that they possibly can. If they find a car that cannot be easily repaired, they put a sign on it—"Leave this car in," and the repairs are made during the day by the electricians. These men oil all bearings every night, using in all oil cups a motor compound which we buy from the Vacuum Oil Company, and which costs eight cents per pound; for the other bearings we use a cheap dark machine oil. All trucks, brakes, and brakeshoes are also examined every night.

Our car barn is so arranged that we have pit room enough to hold twelve cars. These pits are all heated by steam, and the men can walk under the cars easily, using a drop light, and making careful inspection of everything.

When an armature is burned out, the car is placed over the pit, and the armature is lowered down with chain falls and taken from under the car, through the pit, then to the armature room, and a new one put in its place.

The cause of one-half the trouble experienced during the winter months, is the location and condition of track. If the track is laid high (say, two inches above the street grade), and three or four track drops or grates used on all hills to catch the water as it comes down and carry it to a catch basin, also, a drop or grate used in very low places—there will be very little trouble experienced in winter more than in summer, any more than from the large fall of snow which might cause the motors to become heated.

On the other hand, if your track is low, and you have no track drops, and poor drainage, you will have a great deal of trouble, for nothing will interfere with electric appliances more than water thrown from the wheels or scrapers, if it can reach the armature and fields.

We have some places on our old track where water stands after a heavy thaw of snow or a rain storm. In the winter months we have to keep men in two or three places on our line, and keep a drain open and the water swept out. We also instruct all of our men to run slowly over such places with the current off. By doing this we have had little trouble thus far from water, which, I claim, is one of the worst features to overcome in the street railway business.

In regard to heating cars by electricity I would say we have used the Burton heater with very good results. We use six heaters to a car, and for rapid heating we run them in series of three, and it takes about 3 amperes to a car; for normal heating, we run them in series of six, and it takes $1\frac{1}{2}$ amperes.

We have had serious trouble with the switches, and have found them very nearly worthless, as they burn out in a very short time, and we do not consider them safe. We have a switch which has overcome all this difficulty. We have given it a trial for five weeks and it is pronounced by good judges to be a perfect working switch and safe in every respect.

JAMES F. SHAW.

Wakefield and Stoneham Street Railway.

I know no better way to interest you in the heating of cars by electricity than by giving you some of the facts that we have obtained from the superintendents of a few of our roads, but if you want to hear of the disadvantages of heating by stoves you will have to hear from some of the older railroad men.

On the Haverhill and Amesbury street railway we have used electric heaters of various makes for two winters. Among the different kinds are the Burton, Cochran and New England. Mr. Wentworth, the superintendent, informs me that he was able to keep his cars warm all last winter, even in the coldest days, with the Burton heater, but this winter he is using the New England electric heater. This is on a line where the cars make a run of eighteen miles, I think the longest run made without change on any road in New England.

The Wakefield & Stoneham street railway is now using the Cochran and New England heaters, and Col. Chas. F. Woodward, the president and general manager, says that the heaters are working well, and that during the few warm days we have had, only on one side of the car have the heaters been operated, thus saving one-half the expense; whereas, if we had been heating by stoves we would have been burning as much coal as on a cold day. The Burton heater is in use on the Worcester and Milbury, Natick and New Haven street railways, and they are all very well pleased with it. The Burton heaters, as you all probably know, are placed in the four corners of the car under the seats, and the panels in the risers are cut to allow the heat to circulate. The New England heater is continued the whole length of the car, outside the risers, thus diffusing the heat more equally, and giving each passenger his portion.

We find the Burton heater takes to heat moderately four amperes, but in extremely cold days it takes ten, more or less. The New England heater takes three amperes on each side of the car which you can run in either series or multiple, according to how much heat is desired. We think that while it costs a trifle more to heat our cars by electricity rather than stoves, that there are many advantages gained thereby. We save one seat surely, passengers are all receiving the same amount of heat, where with stoves two or three people are very warm and the rest nearly frozen, and sometimes all are nearly frozen as as there is no coal in the box.

Pass System Abandoned in New Jersey.

The passes issued by the New Jersey & Bergen Railroad Company, that expired at the end of 1893, were not renewed by the Consolidated Traction Company which controls the former company. Manager Loring was quoted as follows regarding the abolishment of passes. "Every pass will be called in, and new ones will not be issued. The board of directors has decided that everybody must pay his or her fare. I will have to pay when I ride on the cars. The only exceptions to the rule will be policemen and firemen who may only ride free when in uniform. Passes are held by police and city officials, politicians, railroad men and various other people, and special free and reduced rate tickets are also being used by others. All of these passes and tickets will be abolished after this week. A five cent piece or regulation full-fare ticket will be the only tenders allowable for the fares in the future."

GEORGE H. BABCOCK AND STEPHEN WILCOX.

George H. Babcock and Stephen Wilcox, whose deaths recently occurred within so short a time of each other, were intimate from boyhood and for the greater part of their lives were associated in business. By their ability, energy and perseverance they succeeded in establishing the largest boiler manufacturing company in the world, which will continue to be known by their names. The appended sketches are summarized from the *Iron Age:* Mr. Wilcox was born in Westerly, R. I., to which town Mr. Babcock removed when a boy from New York, and there they grew up together and formed that close friendship which continued through life. While a young man Mr. Wilcox became identified with the development of the steam engine, and his invention of a practical caloric engine really antedated that of Ericsson, both submitting their engines to the Light House Board, by whom they were to be used in operating a fog horn, about the same time. For several years Mr. Wilcox studied energetically the caloric, gas, and oil engines. As a result he became convinced that these methods of generating power were not practicable or economical except for small units, and that neither could hope to compete with the steam engine on even terms.

Mr. Babcock's early experience in business was in connection with woolen mills; he next started a newspaper at Westerly, which is now published, though under a different name. He was the first inventor of the polychromatic press for printing several colors at one impression, and upon this press as a foundation all the present machines for printing in colors are built up. The first printers' bronzing machine was also the result of his ingenuity. He next entered the office of Thomas D. Stetson of New York, who had a large practice as a patent lawyer. Afterward he was connected with the Mystic Iron Company and the Hope Iron Works of Providence as draftsman. It was while at the latter place that he invented the system of cut-off engine afterward known as the Babcock & Wilcox engine, the two men joining in business relations then for the first time. This engine was successful as long as the Corliss patents were in force, but as soon as they became public property competition reduced the price of engines, and as the Babcock & Wilcox engine was expensive to build the business was dropped. This was in the year 1866 or 1867.

Previous to this, in 1856, Mr. Wilcox invented the original of all the inclined water tube style of boilers, having a set of inclined water tubes connected with water tube spaces at their ends and to an overhead steam and water reservoir, through which there was a continuous circulation of water and in which a cross flow of the gases was established by means of diaphragms. This invention was perfected by both, and later by them and other engineers in their employ, and was the base upon which the business of the Babcock & Wilcox Company was built. In 1868 they came to New York to push their engine business, and arrangements were made by which they were built by the Hope Iron Works of Providence; by Morton, Poole & Co., Wilmington, Del.; Poole & Hunt, Baltimore, Md.; and the C. & G. Cooper Company of Mount Vernon, Ohio. As above mentioned, this business fell through on account of the competition due to the free building of Corliss engines, and they started the New York Safety Steam Power Company, building small engines with the safety boilers. This was continued for a number of years, during which the manufacture of the boiler based on Mr. Wilcox's invention was begun, and it gradually assumed such proportions that in 1878 both withdrew from the active management of the Safety Steam Power Company to give all their time to the development of their boiler business. This was continued as a firm up to 1881, when it was formed into a stock company. At that time Mr. Wilcox dropped out of active business life, but continued making experiments on compound, triple and quadruple expansion engines at high pressure in connection with marine boilers, While Mr. Babcock remained at the head of the business and was active for a number of years.

Mr. Babcock was of a quick, decisive disposition, able to bring to bear on any subject all the knowledge he possessed in relation to that subject. He could readily and rapidly take up a new subject, and master it thoroughly in all its details. When he was 58 years old he took up the study of French and acquired the language sufficiently for all practical purposes, for reading, writing and conversing, showing that his mental ability was strong at that time. He was like a mechanic with a modern set of tools, every one sharp and ready at hand for use.

GEO. H. BABCOCK.

STEPHEN WILCOX.

Mr. Wilcox on the other hand, was of a retiring disposition, well grounded and thoroughly equipped for reasoning out all mechanical problems, with a well balanced mind, and singularly adapted to all kinds of mechanical experimenting and able to size up the results and reduce them to practice; though much slower in argument until he had thought a problem out, when he had once mastered it his arguments were clear, to the point and very convincing.

Mr. Baboock was a past president of the American Society of Mechanical Engineers, and they were both among the earliest members of the society, of which both were life members. Mr. Babcock was of a literary turn of mind, and possessed a forcible and clear way of presenting facts. He lectured a number of times at Cornell University on scientific subjects.

Mr. Babcock was a prominent citizen of Plainfield, N. J., to which place he went to live in 1873, and he had been president of the Board of Education since 1885.

Mr. Wilcox was a valued citizen of Westerly, R. I.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Second Article.*)

Whenever we undertake the study of a new subject it becomes necessary to in a measure break away from old things—old thoughts, old names, old tools and oftentimes accustomed methods and to adopt in their place new ones which those who have had experience in the subject have found more suited to the new. It is this first breaking away from the old and accustoming ourselves to the new, that is the greatest stumbling block in the path of the student. We can best describe a phenomenon or a thing to a person unfamiliar with it by likening it to something with which he *is* familiar and then after conveying to his mind a clear idea of how the new resembles the old, impress upon his mind as well as we can that the resemblance is not complete and that the manner in which the familiar differs from the unfamiliar is really the essential difference between the two—we cannot at first explain this difference clearly, he must take that much in faith and assume at the outset that what is said is true. As the student becomes more and more familiar with the thing described, by handling it and seeing it used, he will begin to appreciate more fully the nature, not only the differences but of the new object itself. It is therefore well in the beginning to substitute for the new thing an entirely new name instead of continuing to describe it by the names of things which it partly resembles so that the mind may associate with the new name the actual qualities of the new thing rather than be misled by the name which the resemblance would indicate. This is true of all sciences and it is true of electricity. Each branch of science presents some phenomena peculiar to itself and therefore must have names for them and it is the names peculiar to this science that constitute its technical terms. If a branch of science which we are about to take up is full of phenomena new to us, it will be full of strange names and it is the mastery of these that is most formidable to us, for the meaning of each sentence is or may be obscured by their presence. It is frequently said that scientific men delight in obscuring their meaning behind technical terms, whereas the fact is they are using that language which is most intelligible to them and is only unintelligible to us because of our ignorance of the subject.

Technical Terms.

If the student could only appreciate the fact that technical language is really the simplest and most direct that can be used, much of the difficulty of the subject at the outset would be removed, and it is therefore, deemed wise to add a few words here with the hope of impressing upon his mind the truth of this statement.

In our everyday life we are constantly making use of technical terms as a matter of convenience —we do it unconsciously, it is true, but are impelled to it by the same necessities as is the electrician, the geologist or the astronomer. As an illustration: Suppose we were to try to describe a dog to a person who had never seen one or any animal of that family. We would have to describe it in some such vague terms as this—that it had four legs and a tail, was covered with hair, made a peculiar noise when angry or excited (imitating its bark) ate meat as its chief food, etc., etc., rehearsing many of its characteristics which, however well described would apply equally well to some other animal. Supposing after having failed to convey in this way any adequate idea of the animal, we should secure a specimen, and tell him that that was a dog; the story would be told a great deal better, and ever after the technical term "dog" would have a definite meaning to him—a much more definite meaning than any description that we could give. If his education stopped there—if he had seen but one breed of dog and perhaps but a single specimen, all dogs, to his mind would be about the same. If the one examined had been a great shaggy haired Newfoundland, he would not recognize in the hairless Mexican dog an animal of the same family at all, so that even after he had seen a dog of one breed, it would be almost as difficult to describe to him another of a different breed as it was in the first place to tell him what kind of an animal a dog of any kind was. On the other hand among dog fanciers how definite the phrase —"Irish Setter," is for instance. Those two words—that technical phrase—convey to the mind more definite information than could be imparted in pages of printed matter or perhaps more than in hours of discourse. To the person who was very familiar with dogs it would give an idea not only of the size and color, but of the general character, and yet how meaningless it would be to one who was not familiar with the term. To him it would not even convey the idea of a dog of any kind.

Thus it is that a technical term only has a meaning for us as we associate with it certain ideas. It seldom describes the thing itself, for it is impossible as we have shown, to fully describe to another something he has never seen. The best we can do is to liken it to something that he has seen and then caution him that the likeness is not exact. So that in describing electrical phenomena it must be understood that while our explanations and descriptions are the best we can give, they are not always exact but only approximately true.

Electrical Terms.

It will be apparent to everyone that there is more power available in a waterfall in which the volume or quantity of water flowing is great than in one where the quantity is small, and that the amount of power will be still greater if the water falls a great distance than if it falls but a short distance. In describing a waterfall therefore it is not sufficient to state either that it is of great height or that it is of great volume. We must state both the height and the volume. It is not sufficient to say that a waterfall is 500 feet high, or that the water flows at the rate of 1,000 gallons per second, but when it is said that a stream falls over a precipice 500 feet high at the rate of 1,000 gallons per second, we know exactly how large the fall is and can figure out just how many horse power can be developed. Electricity is most often likened to a stream of water falling over a precipice, and the energy of an electric current is described in exactly the same way, only instead of measuring the height of its fall in feet as we usually do water, electricians have decided to use the term "volt," and instead of measuring the flow in gallons they measure it in "amperes."

It is not necessary at this point to state just how much a volt or an ampere is—they are meaningless in themselves and are the names of men who early did much to advance the science of electricity, that is all; but we must now try to *give* them a meaning. Using these terms in the above example, the waterfall would be described as falling 500 volts at a rate of 1,000 amperes per second. Perhaps we would better represent the volt as the equivalent to a pound of pressure, and then we can say of the water in a water pipe that it flows at the rate of so many amperes at a pressure of so many volts.

Now, for our purposes, we may consider the trolley and feed wires as copper pipes conveying water from a pump at the power station to a turbine or other water wheel beneath the car. The pressure of the water in this pipe is kept by the pump at 500 pounds, and more or less gallons of it per second are used on the motor as we turn the controlling lever (faucet) on or off.

Everyone knows that if we twirl a wheel on an axle, be it ever so well greased, it will stop before long unless we continue applying power. It stops by reason of friction. Every car man also knows that if his journals are not kept well greased his car will pull harder and he will get a hot box. This is because there is *more* friction and the heat is generated faster than the rubbing parts can be cooled off, and therefore it accumulates to such an extent as to become not only apparent but oftentimes troublesome. Now water, in flowing through a pipe, be it ever so smooth, encounters friction against the inside of the pipes. Heat is not observed in the case of water friction, because the water carries it away so rapidly, but the main effect is to retard the flow of water. Thus under a given pressure a pipe of a given size, say 100 feet long, will deliver much more water per second than it will if the pipe be a mile or two long; and again, more water will be delivered through a smooth pipe than through an equal length of a rough or rusty pipe, for the same reason that in the former there is less friction.

Now in the electric current we have pretty much the same state of affairs. Every conductor however good, offers *some* resistance in the way of friction to the flow of current and of two wires of the same diameter that will offer the greatest resistances which is longest. If one wire be twice as long as another it will offer just twice the resistance, and that which is the smoothest inside, or in other words the best conductor will offer the least resistance. Copper is the best conductor of electricity we have (except silver) and therefore our copper feeder wires and trolley wires may be likened to polished metallic pipes carrying water from our pump to our waterwheel (motor) under the car, and the poorer conductors such as iron or brass or zinc may be likened to rusty pipes which produce more friction than the copper ones do. But the electric current cannot carry off heat in the same manner that water does, so as in the case of the car axle, if the conductor be overworked it will get hot. Electricians have a way of measuring the resistance to the flow of current in conductors and express this resistance in "ohms." The word "ohm" like volt and ampere has no meaning in itself and is also the name of an early investigator, but to the electrician who uses it to express the resistance due to friction it has a definite meaning. Thus we have the three fundamental units of electricity, the volt, equivalent to a water pressure of say a pound to the square inch or to a head of water of say one foot; the ampere, equivalent to a rate of flow of water of so many gallons per second or minute, and the ohm as the unit of resistance to a flow of water in a pipe, which for present purposes we may consider our conductors to be. We must bear in mind that as there are all sorts of pipes for conveying water—large ones, small ones, smooth and polished ones and rusty ones, all of which differ in the amount of water which they will deliver under a given pressure in a second or minute according as they offer more or less frictional resistance to its flow, so are there different kinds of electrical pipes or conductors which likewise differ in their carrying capacity of the electric current as they are large or small, smooth and polished (good conductors, silver, copper) or rusty ones (poor conductors, iron, brass, zinc, carbon, etc.) and although all of these units bear strange names—names of men who have distinguished themselves in scientific research, they are very closely equivalent to other units with which we have long been familiar.

Ohm's Law.

These three units bear a definite relation to each other too. Although common sense would seem to tell us that with a given pressure more water would be delivered through a short pipe in a given time than through a long one of the same diameter, that of two pipes of the same size and length, that which was smooth inside would deliver more water in a given time than that which was rough or rusty or partly obstructed, and that of two pipes of the same kind either smooth or rusty inside, that would deliver the greater quantity of water which was of the greater diameter—although, as I say, common sense would seem to tell us all this, electricians were a long time in finding out that it was true for electricity as well as for water.

It was George Simon Ohm who first discovered this simple relation of the flow of a current of electricity, but when he announced that the amount of current that would flow through any conductor was equal to the pressure (volts) divided by the frictional resistance (ohms), although he had really only stated that the electric current obeyed the same laws essentially as the flow of water through pipes, there were few who believed that it was true. Other investigators had imagined that the relation between the flow and the pressure and resistance was a much more complex one, and had gotten up long mathematical formulæ to express this supposed relation. Ohm's law, as it soon became called, was entirely too simple for them, and for a long time they would not accept it. Further experiment fortunately proved it to be strictly true, and this law, which is that the rate of flow of an electric current through a conductor, or the amperes, is equal to the pressure, or electromotive force or volts (all of which terms mean the same thing) divided by the resistance or ohms has become the very foundation of the science of electricity. It is usually written:

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Resistance}}$$

or for the sake of brevity the initial letters are used only and the expression becomes: $C = \frac{E}{R}$.

Nothing could be simpler than this when one understands it, and yet those who do not know any better imagine that the science of electricity is an exceedingly abstruse one. The contrary is really the fact, but unless one understands the A B C's he cannot read. It is worth while, therefore, that we devote some time in making Ohm's law entirely clear, for upon it is constructed practically the whole of the science with which we have to deal. The three letters $C = \frac{E}{R}$ (amperes equals the volts divided by the resistance or ohms) constitutes the whole alphabet of our science, and we only need to know how to use these letters to solve any electrical problem with which we are confronted.

RECOMMENDATIONS OF NEW YORK RAILROAD COMMISSIONERS.

The railroad commissioners of the state of New York made public their annual report on Tuesday last. Quite an extended reference is made to street railways, and an abstract is herewith given of this part of the report:

There are at present in this state forty-seven street railroads operated by the overhead electrical trolley system and three operated by the cable system. In changing from horses to either of these systems, the companies must apply to this board for its approval of such change. In granting such approval, the board invariably imposes conditions looking to the safety and convenience of the public. In addition to the conditions imposed at the time of granting its consent to the change the board during the past year issued the following circular:

"The Board of Railroad Commissioners recommends that every car operated by the electrical trolley system in this state on a double-track line be equipped with gates on both ends, and that only one gate—that opposite the other track on the rear platform—be open for the ingress and egress of passengers. Also, that no person (except an instructor when necessary) be allowed to ride on the platform with the motorman on any electric car. The board also recommends that on all open cars operated by the electrical trolley system on double-tracked lines there shall be attached a guard on the side of the car next to the opposite track, running the entire length of the car, to prevent passengers entering or leaving the car on that side; this guard to be of such a nature that it may be transferred from one side to the other."

The following further recommendations are now made:

First—An efficient guard or safety fender shall be attached to the trucks of all electric and cable cars. This to be done as quickly as possible. The question of fenders on electric and cable cars is one to which this board for the past year has given its careful consideration, by personal examination as to the practical working of the several forms in use in different cities in the state, and also by examination of types used in other states. The time has arrived, owing to the rapid increase in the number of electric and cable cars, when the adoption of the best obtainable form of fender is urgent; the companies should not wait until a perfect fender is obtained, but they should get the best forms at present in use and improve upon them until the above conditions, as near as may be, are realized. The final aim of railway officials and employes should be that while the car may be equipped with the most improved form of fender, its operation should be such that there will be no occasion for its use. The cars should be operated so carefully that accidents will rarely occur. If the suggestions made by the board as to regulations and care should be carried out, with due coöperation by the companies and by the public, electrical propulsion would be as safe as the use of horses has ever been.

Second—The speed of cars shall not exceed four miles an hour crossing streets.

Third.—Where two or more street car lines cross, or where they merge, an agreement shall be made as to which line shall have the right of way; the car that has not the right of way shall come to a full stop before entering or crossing over the tracks of the other line or the joint track.

Fourth.—Inspectors sufficient in number to attain and preserve the best discipline, shall be employed by all electric and cable railroad companies. Employes on cars shall wear a uniform cap at least.

Fifth.—Cars passing in opposite directions shall not meet on street crossings.

Sixth.—At congested points on the line of such roads a sufficient number of employes shall be placed to protect the public and insure all possible safety.

Seventh.—That the speed of such cars be reduced to the minimum on all curves where the view is obstructed.

Eighth.—That the use of some improved form of air-brake, similar to that used now on some of the cars of the Broadway and Seventh avenue and One Hundred and Twenty-fifth street cable railroads, in New York City, be considered by the managers of all electric and cable railroads. During the past year the board has made examinations as to the movements of street cars in the cities of the state, and is impressed with the benefits which might be derived from the use of some form of power brake by street railroad companies. The necessity of quick stops on steam railroads, which led to the adoption of the straight air-brake, and afterward to the automatic brake, is now being experienced on street railroads operated by cable and electric power. Instances are frequent where the reduction of speed in a second of time is necessary to prevent accident, and this can only be secured by the adoption of some form of air-brake.

Ninth—That all applicants for positions as motormen shall be subjected to a thorough examination as to their habits, physical ability and intelligence. If this examination is satisfactory, the applicant shall be placed in a shop or power-house where he can be taught and made familiar with the power and machinery he is about to control. When this is done he should be placed on a car with an instructor, and when the latter is satisfied as to the applicant's capability for the position of motorman he shall so certify to the manager, and, if appointed, the applicant should first serve on the lines of least travel. These requirements will necessitate the employment of first-class men, and they should be strictly held to the observance of all ordinances, rules and regulations.

Tenth—All cars on electric railroads where there is a grade of over 3 per cent. shall be equipped with sand-boxes and sand.

Eleventh—Stops should be made only on crossings. Where blocks are long, stations or stopping places should be designated.

STOPPING AT CROSSINGS.

As to the proper place to stop, the board says: "Under the old system of horse cars it has been customary for the cars at crossings to pass the first or near crossing and stop with the rear platform at the second crossing, thereby avoiding the blocking of cross streets by the horses and cars. Now that the use of horses has been practically dispensed with, the propriety of cars stopping at the first crossing so that egress and ingress can be had from the front platform is under discussion. The board is not yet ready to make a recommendation on this subject. Local authorities should use all possible means to prevent the unnecessary and oftentimes wilful obstruction of street car lines by persons in charge of vehicles. Drivers of vehicles in cities should use caution in driving from cross streets to streets where there are electric or cable car lines."

As to speed, twelve miles an hours is fixed as the limit in suburban districts. Local authorities should regulate the speed in populous districts. A mechanical governor to keep down speed is recommended.

The board says patrons are entitled to good lighting on surface and elevated cars, and recommends either gas or electricity.

As to New York, the report says:

The subject of rapid transit in the city of New York is engaging the attention of the local authorities, the Rapid Transit Commission, the officials of the railroad companies, as well as citizens generally, and causing them much perplexity. The Legislature created the Rapid Transit Commission to specially deal with this question, but as yet the problem in unsolved. The operation of the elevated railroads and the accommodations given are perhaps the best attainable with their present facilities. Great complaint is made through the public press, however, of the management of the roads.

It is but fair to state that no complaints have been received by this board in regard to the same. When attempts are made by the companies to acquire property or rights in order to provide increased facilities they are met with serious opposition on the part of property owners, and what the final outcome will be it is impossible to state. It is hoped that as the surface roads improve their facilities the pressure on the elevated roads will be lessened, but so far the increase in number of passengers has been more than the companies could, with their increased facilities, provide for in the busy hours.

ANNUAL MEETINGS OF THREE CHICAGO TRANSPORTATION COMPANIES.

The annual meetings of the North and West Chicago Street Railroad Companies and the Lake Street Elevated Railroad Company were held on last Tuesday, and summaries of the reports presented are published herewith. The showing made by the companies is considered extremely favorable, and the figures, it is expected, will be used to advantage by the bulls on the exchange.

NORTH CHICAGO STREET RAILROAD COMPANY.

In making his annual report President C. T. Yerkes stated that the year's business had more than met the anticipations of the year before. The receipts had increased while the operating expenses had been kept down in a greater degree than could have been anticipated. The report continues:

To sum up this part of our business, which is, I suppose, the most important of any of the items which you will examine, I can say that the increase in receipts amounts to $493,277.85, while the increase in expenses, or in other words, the amount which it cost to produce that sum, was $78,703.36.

The receipts of the company for the year were	$3,014,889.50
While the total expense of operating the road was	1,412,755.80
Leaving for fixed charges, dividends and surplus to income account	$1,602,133.70
The total number of miles run in 1893	9,224,173
The total number of miles run in 1892	8,547,791
Which is an increase over last year of	676,382
The total number of passengers carried in 1893 was	60,311,673
The total number of passengers carried in 1892 was	50 419,457
Being an increase over last year of	9,892,216

It is very satisfactory to the management to know that this great increase of business was done even more economically than had been done in previous years. When a corporation is making a large amount of money and its business is very profitable, there is always danger of extravagance in some of its departments, but I am happy to say that the business of the road has been conducted in the past year at proportionately less cost than at any other time.

While the present year is not as full of promise as the past, we cannot expect to have such a condition every year as we have had. Still, we will not feel the difference as much as if the exposition had been held on the North Side. I can congratulate our stockholders that it was not, and fully believe that we have made more money than if it had been.

In conclusion I might add that my opinion given at our last meeting in regard to the percentage at which we would be able to operate our road this year has been fully verified, as I find the percentage of expense to the gross receipts is 45 55-100 per cent.

According to the annual statement the total receipts from all sources including advertising, which aggregated $11-328.75, were $3,101,148.25. The cash balance was $1,100,000.

The biggest day's receipts of the year were on October 8, the day before Chicago Day at the fair, when $16,343 was taken in. The smallest day's receipts were on December 3, when the fares dropped to $4,382.50.

The cable lines carried 39,765,165 of the 60,311,673 passengers that were handled last year, and it cost the company just 1.788 cents to earn each nickel paid by the passengers. The expense of carrying passeugers on horse car lines was given at 3.414 cents per passenger. A comparison of the cable and horse car lines is as follows:

CABLE.

Receipts	$1,980,751.80
Expense	711,217.14
Miles run	5,695,212
Trips	709,403
Passengers carried	39,765,165
Number of miles run per day	15,603
Trips	,1,943
Passengers per trip	56
Passengers per mile	6,982
Receipts per day	$5,476.72
Receipts per trip	2.79
Receipts per mile, cents	.3478
Expense per day	$1,948.54
Expense per trip	1.00¼
Expense per mile	.12½

The principal items of expense in operating a cable line were given as follows:

Conductors and drivers	$277,050.60
Car repairs	36,500.93
Building repairs	7,044.08
Office salaries	13,534.03
General salaries	18,337.08
Rope expenditures	56,773.23

The report also showed that the company had expended $4,296.93 during the year in heating cable trains, or a little more than the profits for one day. The company paid $7,244.36 for car licenses during the year.

The horse car statement was as follows:

Receipts	$1,032,037.70
Expenditures	701.538.66
Miles run	3,528,961
Trips	741,328
Passengers hauled	20,546,508
Miles ruu daily	9,668
Daily trips	2,031
Passengers per trip	27,716
Passengers per mile	5.82
Average daily receipts	2,827.50
Average per trip	1.39
Average receipts per mile	.2924
Daily average expenses	1,922.02
Per trip	.9463
Per mile	.1988
Per passenger	.03414

Conductors and drivers received $270,652.46 in salaries; $23,005.16 was spent in repairing cars. The expense of heating the horse cars was $2,838.12.

The old board of directors was reëlected with the exception of C. A. Spring who declined to serve and F. H. Winston was elected in his place.

WEST CHICAGO STREET RAILROAD COMPANY.

At a meeting of the West Chicago Street Railroad Company the old board of directors was reëlected. In his annual report President Yerkes mentioned the fact that the year had been prosperous, and that company had profited by the World's Fair. Evidence of this fact is presented in the following extract from the report:

Gross earnings for the year	$5,235,633.53
Operating expenses	2,892,982.33
Net earnings	$2,342,651.20
Payments of fixed charges, interest, etc	941,749.39
Balance applicable to dividends	$1,400,901.81

In making charges to expense account during the last year, owing to the fact that it was realized our profits would be large, great liberality was shown in charging to that account many items that might have been properly placed in construction account. At the same time, we have added to our surplus $409,342, making it now a total of $1,862,851.

During the last year the cable roads on Blue Island avenue and on Halsted street have been opened, but are running in an unsatisfactory condition owing to the fact that it is necessary to convey the cars from a point east of Halsted street with horses.

This necessitates the keeping of our horses still on hand and deprives the company of the benefit of our cable plant. This condition will continue until the Van Buren street tunnel is finished, when these lines can then run in perfect order. I anticipate the time of the opening of the tunnel to be in the course of two months.

The crosstown lines, which are comparatively new, have much to our surprise and satisfaction, shown themselves able to not only pay expenses but to earn good profits. This condition will no doubt steadily increase. The opening of the Lake street elevated road was expected to cause a heavy falling off in the receipts from the territory through which it runs. We find, however, that with the exception of a decrease in the receipts on Lake street and Randolph street this competition is not perceptible. The roads mentioned are horse car lines, which are very unimportant in our system, and the decrease can very easily be offset by taking measures to lessen expenses. I believe the result will be that we will confine the operation of these streets in a great measure to the east end of it, thereby leaving to the elevated railroad the long hauls. Since my last report there has been an increase in the capital stock of the company, which amount has in a great measure been used to pay off the floating debt; consequently the amount of dividend necessary to be paid on this increase amounts to a little more than the amount of interest necessary to be paid in carrying the floating debt. I think I may safely say that there is no reason why there should not be a constant improvement in the affairs of the company. The cable road will be in full operation by spring; the new crosstown lines will be doing a very profitable business, and as there is every reason to suppose the general business of the country will improve as spring opens, it it not rash to predict a prosperous year. There is no doubt whatever in my mind that the present rate of dividend—namely, 9 per cent.—can be kept up and a still larger surplus passed to the income account. I would call your attention to the fact that this surplus now amounts to a very large sum, but just what will be done with it the directors of the company have not yet determined, but that their actions in this regard will be most satisfactory to the stockholders I am well convinced

The following figures are reproduced from the annual statement:

		Increase.
Gross earnings	$5,235,633,53	$615,408.23
Operating expenses	2,892,982.33	205,671.73
(Operating expenses are 55.25 per cent. of gross earnings.)		
Net earnings	2,342.651.20	409,736.50

FIXED CHARGES.

Rent of leased lines	$490,500.00
Coupon interest	223,151.86
Interest and taxes	228,097.53
Total	$941,749.39
Ballance applicable to dividends	1,400,901.81
Dividends paid	991,559.25
Balance carried to surplus	$509,312.56

EARNINGS AND EXPENSES.

		Increase.
Gross earnings from passengers	$5,196,171.95	$610,934.89
Manure	1,609.69	764.79
Advertising	20,032.62	3,730.55
Rents	17,819 27	22.00
Totals	$5,235,633.53	$615,408.23

OPERATING EXPENSES.

		Increase.
Conducting transportation	$1,377,849.01	$128,406.29
Maintenance of way	168,454.16	1,122.15
Motive power	906,159.90	64,380.72
Maintenance of cars	158,914.71	9,236.62
General expenses, including damages	281,604.55	2,525.95
Totals	$2,892,982.33	$205,671.73

			Increase.
Net earnings	$2,342,651.20		$409,736.50
From which deduct fixed charges as follows:			
Rentals	$490,500.00		
Coupon interest	223,151.86	Decrease	$30 344.81
Interest and taxes	228,097.53	Increase	77,018.75
Total charges	$941,749.39	Increase	$46,673 94
Dividends	991,559.25	Increase	266,559,25
Balance to income account			409,342.56

TRAFFIC COMPARISON.

Trips	2,018,785	Increase	201,385
Miles	16.813,134	Increase	1,230,993
Passengers	107,053,461	Increase	12,534,987
Receipts, horse			$2,969,991.47
Receipts, cable			2,265,542.06
Total			$5,235,633.53
Expenses, horse			$1,903 963.62
Expenses, cable			989,018.71
Total			$2,892,982,33
Miles run, horse			9,602,245.04
Miles run, cable			7,210 889.56
Total			16,813,134 60
Receipts per mile, horse			$0.30.69
Receipts per mile, cable			.31.18
Expenses per mile, horse			.19.83
Expenses per mile, cable			.13.71
Passengers carried, horse			61,120,388
Passengers carried, cable			45,933,073
Total			107,053,461
Receipts per passenger			$0.04.85
Maintenance of cars, each car			$87.60
Average number of horses on hand			4,385
Average number horses on wagons, cars, etc			207
Average number horses on car service daily			4.178
Average number of miles per horse, per day			12.59
Cost of feed per horse per day			$0.17.69
Cost of shoeing per horse per day			.02.76
Other cost keeping horse, per day			.17.49
Cable rope run, miles			615,536
Cost of operating rope per mile run			$0.25.44
Cost of operating power station			100,264.20
Cost of operating power station per mile of rope run			.16.28
Maintenance of track per mile, horse			6 78.34
Maintenance of track per mile, cable			7.07.64
Snow and ice per mile track, horse			$1.21.93
Snow and ice per mile of track, cable			.91.68
Sprinkling per mile, horse			.49.80
Sprinkling per mile, cable			.49.05

LAKE STREET ELEVATED RAILROAD COMPANY.

At the meeting of the Lake Street Elevated Railroad Company no financial statement was presented, as the road is still in the hands of the construction company. President Roche, however, in his annual report stated that the outlook was very encouraging. The road is now operating from Madison and Market streets to Hamlin avenue and nearly 30,000 passengers a day are being carried. When the road is fully completed to Fifty-second street it is expected that this number will be increased to at least 45,000. Mr. Roche said that he was confident that operating expenses would be less than 50 per cent. of the gross earnings. Since the road was opened, November 7, 1893, it had been earning considerably more than its operating expenses, there being now on hand an amount equivalent to about 33⅓ per cent. of the interest on $6,500,000, the bonds outstanding January 1.

The report covered the work accomplished during the last year, and outlined the company's plans for the future. It was stated that the contract for the construction and equipment of the present line of road to West Fifty-Second street called for the payment of $5,150,000 out of a total of $6,500,000 5 per cent. bond issue, and $6,500,000 out of a total capitalization of $10,000,000. The main line is now finished as far west as Forty-Fourth street. About 100 new cars are completed or under contract. It is expected that the entire main line will be in operation by May 1 next.

A resolution was adopted authorizing the directors to build and equip at once all branches of the road provided for by ordinances passed by the city council. The old board of directors was reelected.

Receivership of the United Electric Railway of Nashville.

The United Electric Railway Company of Nashville Tenn., passed into the hands of the Nashville Trust Company and Thomas W. Wrenne, president of the railway company as receivers on January 6. The appointment of receivers was made on the application of bondholders. This action was taken because of the failure of the company to meet the January interest on its bonds. The company's capital stock is $1,000,000 and its bonded indebtedness is $2,700,000. Mr. Wrenne has made the following statement:

"The first six months of the fiscal year, which ended December 1, last, seemed to indicate that the year's business of the company would be the most prosperous in its history. During that time the gross earnings of the company increased more than $18,000 over the same period of the preceding year. When the panic reached Nashville, and business being practically suspended, the earnings of the company, instead of keeping up, fell off perceptibly until the end of the fiscal year.

"Notwithstanding this, however, the gross earnings of the company for the year amounted to over $334,000, or within $8,000 of the year previous, while the net earnings of the company amounted to $109,000. The company not only earned all interest upon the old or underlying bonds, amounting to $91,800, but also nearly $18,000 in excess. The net earnings amounted to $109,000 after paying all operating expenses and providing for taxes and insurance.

"The falling off in receipts, however, for the last six months enabled the company only to pay operating expenses, together with the October interest upon the underlying bonds, interest, etc., and when the January interest matured the company was not prepared to meet it. Several suits had been instituted by holders of coupons upon the United Electric bonds, and threats of other suits were made by holders of coupons on underlying bonds.

"From time to time, as president, I have suggested plans for the reorganization of the company and the adjustment of its affairs so as to put it upon a sound financial basis. Generally each plan met the approval and co-operation of nearly all of the stockholders and United Electric bondholders, but as it was necessary in efforts of this kind to obtain the signature of every bondholder and stockholder, and as many of the bondholders were not known, and some, owing to the depressed financial conditions not able to submit to an assessment, or carry out the terms of the plans, each failed.

"With suits being instituted and threatened, it was deemed best that the affairs of the company should be put in shape to best protect the interests of all. As a receivership was inevitable, and by such proceeding the company would be enabled (at least, holders of the United Electric bonds would be enabled) to readjust and reorganize the company without requiring the unanimous consent of all parties in interest except as the court might act for them, it was deemed best to have the receiver selected, with a view to the best advantage of the company.

"Upon consultation had with Mr. Joseph H. Thompson, President of the Nashville Trust Company, by Capt. T. M. Steger, of the firm of Steger, Washington & Jackson; G. M. Fogg, of the firm of East & Fogg, and J. C. Bradford, counsel for the company, Mr. Thompson stated, in the event his company should be made co-receiver, that he would at once, upon the order of the court, provide all funds necessary to pay off the balance of the interest due upon the coupons that matured January 1, upon the old and underlying bonds, and also at an early day arrange for the payment of the past due taxes.

"The proposition of Mr. Thompson was so manifestly for the benefit of the security holders and parties interested in the company that I readily approved the steps necessary to have the receivership put into effect. The conservatism and financial strength and success of Mr. Thompson and his company will, I am sure, carry to every person interested in the company the assurance that the affairs of the company pending the receivership will be well and safely managed."

WHY RECEIPTS OF BROOKLYN ELEVATED ROADS HAVE DECREASED.

At the meeting of the Brooklyn Elevated Railroad Company on January 2, it was shown that the company had lost money in 1893. At the close of 1892 a surplus of $195,295.88 had been accumulated, of which $117,380.97 had been earned during the year, but at the end of 1893 not only had the company not earned its expenses, but the surplus was reduced to $178,180.91. In 1892 37,314,640 passengers were carried over the system, while in 1893, with three additional miles of road in operation for four months, the company transported 35,926,355, a decrease of about 3¾ per cent. In his report to the stockholders President Ladenburg attributed the decrease to business depression and to the competition of the trolley lines as follows:

Hard times have proven disastrous to nearly all business enterprises during the year 1893, and have also seriously affected carriers of passengers in large cities. I attribute fully one-half the diminution of travel upon your roads resulting in the closing of factories, which have put thousands of your patrons out of employment, to the paralysis in the building and the enforced general economy. There is, however, a special circumstance which must not be ignored in the consideration of the reasons which have intensified our loss, and that is the change of the motive power of competing surface roads from animal to trolley traction, and most especially their reckless speed. Against a reasonable and legitimate use of this power by our competitors there should be no protest. There is abundant business in normal times both for them and for us. Facility for travel begets travel and the development of territory occasioned by better transit facilities will result to the advantage of all the other railroads, and when we think of the great future of Brooklyn and its possibilities we feel the most absolute confidence in the success of our enterprise. But a protest has already been made by an indignant public, not against the use but against the abuse of the privileges accorded to the surface roads in being permitted without restraint to operate cars at a rate of speed which should never be tolerated upon surface roads operated upon the crowded streets of a great city. Why should a carriage going faster than six miles per hour be stopped by a policeman, and at the same time a street car be allowed to run at ten miles per hour legally and fifteen miles per hour actually? The enormous loss of life which has been consequent upon this misuse of public streets which we at great expense have obviated by the erection of costly elevated structures; upon which we are heavily taxed, is bringing retributive justice, and it is to be hoped that either by the voluntary action of the companies concerned, or as the result of the popular outcry, by regulation by the local or state authorities. this improper method of reckless speed will be corrected and brought within reasonable limits of safety. General conditions, we trust, will soon improve and eventually your profits will be swelled by the irrepressible growth of this great city.

TWO INTERESTING DECISIONS.

The Supreme Court of Massachusetts handed down two decisions last week which are interesting as they cover a certain class of suits that companies may be called upon at any time to defend. The first decision is one affirming a judgment of $6,666 in favor of a hackdriver named Uggia, who while driving on the streets of Boston was struck and injured by a falling trolley ear from the overhead construction of the West End Street Railway Company. The defendant company did not deny that the plaintiff was exercising due care, but claimed that upon the evidence it was not negligent. The court said:

"No one but the defendant was responsible for the safety of its apparatus, and from the circumstances of the accident it would not be reasonable to infer that it was due to the carelessness or willful act of any third person, or to any cause except the failure of the apparatus to support the strain to which it was subjected in the use for which it was designed and which was made of it by the defendant."

The court further holds correct the statement of the judge at the trial of what would be reasonable care on the part of the defendant. The statement was that the jury should "take into consideration, as one of the most important things, the apparent danger—what would be likely to happen if there was a failure to use proper care. If the danger is a danger of causing loss of life, causing death or serious bodily injury to persons traveling upon the street." they were told they might "properly say that reasonable care would be a high degree of care, because it would be degree of care commensurate with the apparent danger."

The court defined the rights of the driver of vehicles and railway companies respecting each other in a decision affirming a judgement of $2,000 in favor of Alexander Ellis against the Lynn & Boston Railroad Co. The plaintiff was riding in a buggy with his daughter along Beach street, Lynn, when his horse became frightened at the sound of the motor and continual sounding of the gong of an electric car, and ran away, throwing himself and his daughter from the carriage. The evidence tended to show that the electric car was 100 feet away when the animal first took fright, and that the motorman continued to sound his gong. The defendant contended that it was not negligence on its part to sound the gong, but rather a duty which it owed to pedestrians and other travelers on the street. The court, however, decided.

"It is a well known fact that most horses are frightened at their first view of a moving electric car, especially if they encounter it in a quiet place away from the distracting noises of a busy city street. It is only by careful training and a frequent repetition of the experience that they acquire courage to meet and pass a car on a narrow street without excitement.

"The rights of the driver of a horse and manager of an electric car under such circumstances are equal. Each may use the street, and each must use it with a reasonable regard for the safety and convenience of the other.

"The motorman is supposed to know that his car is likely to frighten horses that are unaccustomed to the sight of such vehicles, while most horses are easily taught, after a while, to pass without fear. It is his duty, if he sees a horse in the street before him that is greatly frightened at the car, so as to endanger his driver or other persons in the street, to do what he reasonably can in the management of his car to diminish the fright of the horse, and it is also his duty in running the car to look out and see whether, by frightening horses or otherwise, he is putting in peril other persons lawfully using the street, on foot or with teams. Of course, the owners and drivers of horses are required at the same time to use care in proportion to the danger to which they are exposed. The defendant's exceptions are overruled, and accordingly the verdict of $2,000 for the plaintiff is sustained."

New Graham Truck.

In the accompanying illustration Fig. 1 shows the new type of Graham truck, while Fig. 2 shows an enlarged view of the spring suspension. This

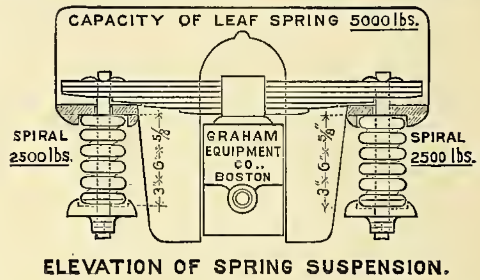


FIG. 2. SUSPENSION OF THE GRAHAM TRUCK.

truck is placed on the market by the Graham Equipment Company, of Boston, which claims that its design is such that the hammer blow upon the rail joint is reduced to a minimum. The spiral springs expand and contract as inequalities in the roadbed are met with. When the wheel drops into any depression, these springs expand, and as the wheel rises out of the depression the same springs cushion the shock which the ca would otherwise receive. The spiral springs carry the empty cars and any load up to 50 passengers. When a heavier load than this is placed on the car, the leaf spring takes it up. Other points of superiority claimed for the truck and to which attention is directed, are that it contains only 24 bolts, and these all of a uniform size; that the car-body can be removed by taking out four bolts only; that all parts are simple and interchangeable; that the car-body is but 23 inches from the rail, making the truck especially desirable for open cars, which are now very often found of much higher construction. The Graham Company is using a 5-inch steel beam for trucks intended to carry open cars, and the frame is extended out 12, 14, 16 or 18 feet as required, giving the sill a rigid support. This beam is supported by a special brace of 3-inch channel steel, making

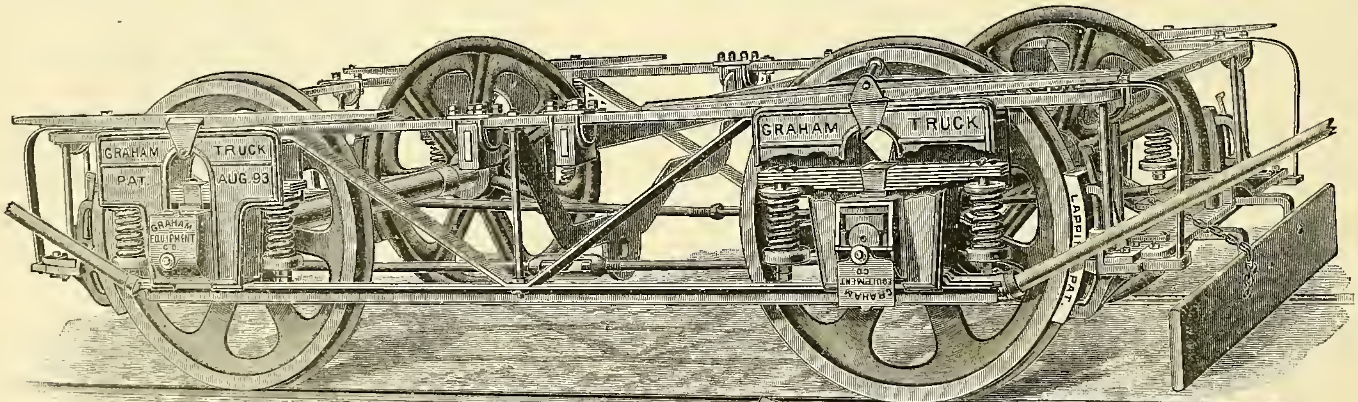


FIG. 1. THE IMPROVED GRAHAM TRUCK.

FINANCIAL DEPARTMENT.

Financial Notes.

Earnings of Syracuse Roads.—In Syracuse, N. Y., during 1893, the Consolidated carried 4,745,204 passengers and earned $332,522.86; the People's carried 2,987,340 passengers and earned $145,525.15. The increase in the number of passengers carried is 127,830, the People's increasing 210,835 and the Consolidated falling off 83,005. The increase in gross earnings is $25,265.23, of which $9,860 is by the People's and $15,405.23 by the Consolidated.

Philadelphia, Pa.—Director Windrim last week granted licenses to the Hestonville, Mantua and Fairmount Passenger Railway Company for 38 two-horse cars at $50 each, and 21 one-horse cars at $25 each, amounting in all to $2,400; to the People's Passenger Railway Company for 30 cars at $100 each, 105 two-horse cars at $50 each and 16 one-horse cars at $25 each, amounting in all to $8,650. The Cheltenham Passenger Railway Company was also granted licenses for six one-horse cars at $25 each.

St. Paul, Minn.—At a meeting of the St. Paul and White Bear Railroad Company W. S. Morton resigned the presidency and H. M. Byllesby was elected president and general manager. Lane K. Stone also resigned the office of vice-president of the company, and H. C. Lewis was elected in his stead. The board of directors, as at present constituted, comprises H. M. Byllesby, H. C. Lewis, Joseph Lockey and Lane K. Stone.

Pittsburgh, Pa.—The Pittsburgh Elevated Railroad has been given a charter to build a line 10 miles long from a point in the city to a point in Wilkinsburg. The capital of the company is $100,000. The officers are: John H. Dalzell, president; directors, Joshua Rhodes, Wm. B. Rhodes, George B. Hill, John D. Nicholson, Robert S. Frazer and Alex. M. Neeper.

Pittsburgh, Pa.—A charter has been issued to the North Side Elevated Railway, to build a line from a point in Allegheny to a point in Bellevue borough, a distance of five miles. The capital is $50 000. John Dalzell is president. The other directors are George B. Hill and Johnstone Rhodes.

The Consolidated Car-Heating Company of Albany, N. Y., at a meeting held January 9, 1894, declared its regular semi-annual dividend of three per cent., payable February 15, 1894; transfer books to close from February 1 to February 16. The affairs of the company were reported in a prosperous condition.

Cleveland, O.—At the annual meeting of the Cleveland City Railway Company the directors and officers were re-elected. It was stated that during the period from June 1 to December 31 there was expended $585,000 for permanent improvements.

North Chicago Dividends.—The directors of the North Chicago Street Railroad Company last week declared the usual quarterly dividend of 3 per cent. which will be paid January 15.

NEWS OF THE WEEK.

Columbus, O.—The board of directors of the Columbus & Clintonville Electric Street Railway Company has elected Mr. Hunter president, and C. F. Evans secretary and treasurer. A resolution was passed instructing the president and secretary to confer with companies owning connecting lines and obtain propositions from them looking toward effecting a through traffic arrangement.

Hartford, Conn.—The Hartford Suburban Railway Company has been organized by the election of David Henney, president of the Hartford Light & Power Company, as president, and Henry H. Goodrich, as secretary and treasurer. It will build electric lines to New Britain, Farmington and Unionville. It is also contemplated to absorb the Hartford Light & Power Company.

Philadelphia, Pa.—Henry J. McCarthy, the Master appointed by Common Pleas Court No. 4 to report upon four bills in equity filed against the Quaker City Elevated Railway Company, has filed his report, in which he recommends that the Court issue a perpetual injunction restraining the Quaker City Company from erecting its railroad.

Philadelphia, Pa.—The People's Passenger Railway Company has dispensed with transfer agents on the Fourth and Eighth streets line at Eighth street and Susquehanna avenue and Fourth and Walnut streets. The conductors now give transfers to passengers at these points.

Cincinnati, O.—The Cincinnati Street Railway Company has contracted with the Ahendroth & Root Manufacturing Company for twelve boilers for the new power stations for Eighth street, Price Hill and College Hill plants.

Chicago, Ill.—The amended ordinance giving a franchise to the Northwestern Elevated Railroad Company was vetoed by Mayor Hopkins at the last meeting of the City Council. The ordinance was again amended and adopted. The amended ordinance has been signed by the mayor.

Philadelphia, Pa.—The York and Dauphin Streets Line of the Philadelphia Traction Company is in operation. Eventually the line will be operated by the trolley system.

Warren, O.—It has been suggested that an electric railway be built connecting Warren and Kinsman. The distance is about 22 miles, including in part a territory where there is no railroad.

Corning, N. Y.—A resident of Corning has offered to furnish the money for the construction of an electric railway if the citizens will guarantee him 5 per cent. on the investment.

Bel Air, Md.—W. C. Simmons, civil engineer of Baltimore, is quoted as stating that the project for an electric railway connecting Bel Air and Bradshaw is entirely feasible.

Philadelphia, Pa.—It is authoritatively stated that the increase of traffic on the Thirteenth and Fifteenth streets line since the trolley cars were put in operation is 60 per cent.

New Berne, N. C.—An electric railway is to be built at once by a company that owns the electric light plant.

Fremont, O.—The work of equipping the street railway line for an electric system will commence at once.

Hot Springs, Ark.—Work has been commenced on an extension of the Electric Railway to the race track.

Columbia, Pa.—The Columbia and Donegal Electric Railway has been opened for business.

PERSONALS.

Isaac T. Van Duzer, a prominent railroad contractor and builder, died last week at his home in St. Paul. Deceased was seventy-seven years of age at the time of his death, and was noted as having been foreman of a crew of men engaged, fifty-two years ago, in the spring of 1841, in the construction of the first street railway line built in the city of New York. Mr. Van Duzer was at that time twenty-five years of age and since then, until about seven years ago, he had been actively engaged in the construction of railroads, having been identified with railroad lines in thirteen states of the Union, and having personally directed and supervised the building of more than 2,000 miles of railroad track.

Frank Hunloon, formerly connected with the Davenport & Rock Island Street Railway Company, has accepted the superintendency of the Manistee (Mich.) electric railway.

J. W. Marsh, general manager of the Standard Underground Cable Company of Pittsburg, was a visitor in Chicago this week.

Charles W. Price, of the *Electrical Review* of New York, was in Chicago this week.

John Dick, of Dick & Church, Meadville, Pa., was in Chicago this week.

TRADE NOTES.

The Northwestern Land and Coal Company, of Boston, is placing on the market what is known as the "394" compound, by the use of which it is claimed that coal bills may be materially reduced. According to the report of the company, tabulated statements made by experts of the amount of water evaporated by steam boilers throughout the United States with coal in its natural state show an average of only 7½ pounds of water evaporated with one pound of coal. The average tabulated results from the use of coal treated with "394" show that 11¼ pounds of water are evaporated with one pound of coal. The compound is the invention of Dr. H. M. Baker, chemist to the United States Government, and many testimonials from those who have found its use advantageous have been received. Information can be obtained at the general offices, 244 Washington street, Boston.

The Brown Electric Company of Boston finds that its supplies are in active demand. There is a constant increase in its trade in New England, especially from the street railway companies. Everything in the line of street railway equipment can be secured from this company, a fact that seems to be generally appreciated by the management of street railways. The "pug" calendars for 1894 and the neat memorandum book recently issued are in great demand. The company is now sole agent for all the specialties of the Iowa Manufacturing Company. The spark arresters for arc lamps are in active demand. A new socket will be put on the market about the 20th instant.

The Star Electric Lamp Company, 102 Michigan avenue, Chicago, is meeting with great success in the sale of the new Sunbeam incandescent lamp with luminous vapor. The lamps with luminous vapor are claimed to possess superior merits, and and the type is said to be of particular advantage in electric railway work where the voltage does not remain constant, as it is claimed that these lamps can be overrun without the least injury.

The Western Telephone Construction Company is making a specialty of telephones for street railway use. This company builds and constructs lines and all apparatus in connection with telephone plants, and furnishes all supplies in connection with the business of telephoning. It guarantees all apparatus and protects purchasers against suits for infringement of patents.

Removal.—The Metropolitan Electric Company is moving into its new building 166-168 Fifth avenue, Chicago, where it will have ample store and office facilities, besides ware-rooms. The company is putting in a large line of staple goods to enable it to take care of all orders without delay.

Street Railway Telephone System.—The Western Telephone Construction Company has begun the construction of the telephonic apparatus for a street railway plant, which will be the largest single street railway telephone exchange in the United States.

The Metropolitan Electric Company reports large sales of its new "Metropolitan" lamp as practical men are finding it to be thoroughly serviceable.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued December 26, 1893.

511,328. Method of Electric Commutation and a Fluid Electric Commutator. Charles E. Emery, Brooklyn, N. Y. Filed December 28, 1892.

This is a method of electric commutation which consists in supplying electric current through a circulating conducting fluid at the electric terminals of an armature and in utilizing the conductivity of such fluid to successively make and break the circuit.

511,341. Cleaning Device for Railway Conduits. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed June 16, 1891.

A bar extends through the conduit slot and to this a brush or scraper is pivoted within the conduit; a link is pivoted at one end to the free end of the brush, while at its other end it has a pivotal or sliding engagement with the bar; means are provided for locking this link at either limit of its movement.

511,342. Conduit Railway Trolley. John C. Love, Chicago, Ill., assignor to the Love Electric Traction Company, same place. Filed May 17, 1892.

The traveling contact of this trolley comprises a grooved shoe with means for supporting it; this latter consists of an arm adapted to swing in a vertical plane and comprises two parts connected by a pivot adapted to allow lateral movement in the outer end of the arm, a horizontally arranged arm is pivoted to the outer end of the main arm and is adapted to swing in a vertical plane; to this the shoe is connected by a vertical pivot.

511,343. Trolley for Conduit Railways. John C. Love, Chicago, Ill., assignor to the Love Electric Traction Company, same place. Filed May 17, 1892.

This is a traveling contact device for electric railways, comprising a supporting bar, a trolley wheel or contact piece, and an oscillating arm for supporting the same, adapted to swing in a vertical plane, a spring applied to the arm, tending to lift the free end thereof, and a second spring applied to limit the upward movement of the free end of the arm.

511,344. Support for Electrical Conductors. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed January 21, 1893.

Two gripping plates with jaws engage the conductor; the support for these plates comprises a clamping device to hold the plates in contact with the conductor, and insulating material interposed between the clamping device and the plates.

511,345. Tension Device for Electric Conductors. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed January 21, 1893.

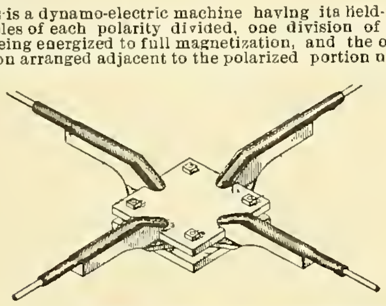
This invention comprises the combination with a conductor and insulators arranged at intervals along the conductor and secured thereto, the insulators being free to move upon their supports longitudinally with the conductor of a tension device having immediate connection with the conductor and exerting a constant longitudinal strain thereon.

511,346. Trolley-Bar Carrier for Cars. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed January 21, 1893.

The last claim of this patent reads as follows: "The combination of a supporting frame provided at its ends with horizontal ways and with outwardly facing inclines terminating at their junction in notches, and a trolley bar carrier the opposite ends of which are seated in the ways of the frame and provided with studs to engage the said inclines and notches."

511,375. Method of and Means for Compounding Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, of New York. Filed November 23, 1892.

This is a dynamo-electric machine having its field-magnet poles of each polarity divided, one division of such pole being energized to full magnetization, and the other division arranged adjacent to the polarized portion of the armature, whereby on an increase of load the second division is strengthened by magnetic induction from the armature in correspondence with the increase of load, thus acting to sustain or increase the electromotive force of the generated current.



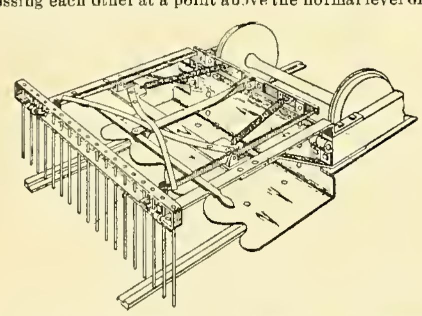
NO. 511,419. GEISE'S TROLLEY WIRE CROSSING.

511,376. Electric Measuring Instrument. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed March 2, 1893.

This comprises the combination of an oscillating horseshoe magnet, simple or compound, having its poles closely approximated, and a coil traversed by the current to be measured and having an extended flat portion between the magnet poles.

511,419. Trolley Wire Crossing. Henry Geise, Philadelphia, Pa., assignor of one-half to Edwin Jaquett Sellers and Horace Pettit, same place. Filed June 26, 1893.

This is a crossing device comprising in combination conducting wires insulated at the point of intersection and crossing each other at a point above the normal level of the wires, and a travel plate provided below the point of crossing and upon which the trolley wheels of both lines are adapted to travel. (See illustration.)



NO. 511,432. INGRAHAM'S LIFE GUARD OR FENDER FOR CARS.

511,425. Automatic Railway Switch. Charles S. Hoenes, Milwaukee, Wis. Filed December 17, 1892.

This switch is adapted to be operated from the car by means of an arm projecting from the roof which is brought into contact with a lever extending from a pole alongside the track; through this pole connection is made with the track switch by suitable levers, so that the turning of the lever projecting from the pole will operate the switch.

511,428. Life Guard for Street Cars. Charles W. Howe, Waltham, Mass. Filed February 20, 1893.

This fender is supported in engagement with slide ways on the car body and has a lever and rod connection between the fender, the car truck and the car body so that the vibrations of the car body do not affect the position of the fender relative to the surface of the track.

511,432. Life Guard or Fender for Cars. James F. Ingraham, West Peabody, Mass. Filed October 29, 1892.

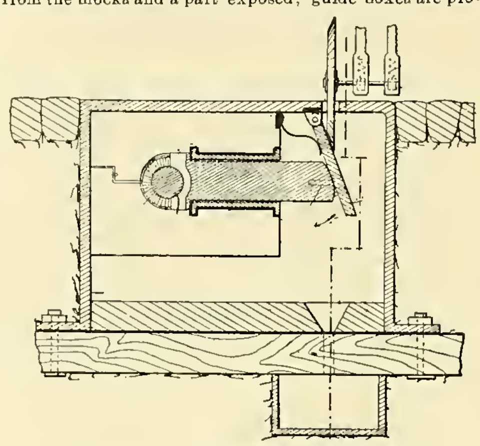
This comprises a swinging guard consisting of a frame provided with independent vertically movable bolts or rods, a pivoted or hinged scoop guard, and connections between the swinging guard and the scoop guard, whereby when the former encounters an obstruction it may release the latter. (See illustration.)

511,448. Electric Locomotive. John G. McCormick, Louisville, Ky. Filed April 1, 1892.

The first claim of this patent reads as follows: "In an electric locomotive, the combination with an axle or shaft and field magnets supported thereby, of a sleeve surrounding said axle or shaft, fixed collars on the axle at the ends of the sleeve and secured at their respective ends to the sleeve and fixed collars, and an armature carried by said sleeve."

510,452. Conduit for Electric Railways. Henry D. Oler, Paterson, N. J. Filed August 23, 1892.

Wooden blocks are fastened in the conduit and extend its entire length; in these blocks a groove is formed which holds the conductor; a part of the conductor is insulated from the blocks and a part exposed; guide boxes are provided in the groove and sliding blocks in these guide boxes, as shown in the accompanying illustration.



NO. 511,452. OLER'S CONDUIT FOR ELECTRIC RAILWAYS.

511,520. Means for Transmitting the Power of a Moving Car to a Motor Thereon. Richard D. Gallagher, Jr., Chicago, Ill. Filed January 28, 1893.

A fluid pump is connected with the car axle and operated by its rotation; a motor is supported on the car for driving mechanism, and fluid conducting pipe connections are provided between the pump and motor.

511,524. Converter System for Electric Railways. Gustaf E. Hesse, Brooklyn, N. Y., assignor of five-eighths to William W. Share and Valdemar F. Lassoe, same place. Filed November 21, 1892.

The first claim of this patent reads as follows:

"In combination, a vehicle, a motor carried thereby, an electro-magnet supported to move along with the motor and having its coils electrically connected with the motor, a primary magnet forming one of the supporting rails located along the path of the moving electro-magnet and means for sending an alternating or interrupted electric current through the coils of the primary magnet."

511,547. Electric Wire Covering. Franklin S. Randall, Philadelphia, Pa. Filed June 2, 1893.

This is a covering for electric wires consisting of raw cotton in bulk applied in a certain manner set forth in the patent.

511,586. Car Fender. George E. Gates and Diederich Reuschenberg, Brooklyn, N. Y. Filed August 17, 1893.

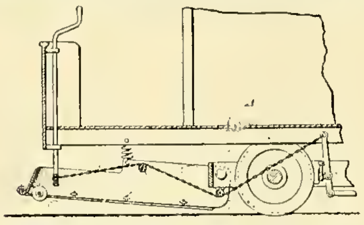
This consists of the combination with the car, the brake, lever and the brake applying mechanism, of a semi-circular fender pivotally connected at its rear end to a fixed support beneath the car, springs connecting the fender with the car in advance of its pivotal connection, a bearing located upon the fender in advance of its pivot, and a bearing on the truck which is located lower than the fender bearing, the brake chain, extending rearward over such fender bearing and under the truck bearing. (See illustration).

511,596. Cable Railway. Charles I. Earll, New York, N. Y. Filed April 11, 1893.

A pair of driving cables are located below the grip slot, and a cable shifter is placed at the successive oppositely disposed lateral curves for shifting the cables from and into the path of the grip.

511,597. Cable Railway. Charles I. Earll, New York, N. Y. Filed September 13, 1893.

This a cable shifter for cable railways comprising in combination a frame pivotally supported for rocking movement upon an axle longitudinally of the frame, a pair of cable sheaves carried on the frame out of alignment with each other and located one near each end of the frame, and frame tilting means for operating the cable shifter.



NO. 511,586. GATES & REUSCHENBERG'S CAR FENDER.

511,604. Fender for Street Cars. David Flanders, Watertown, Mass. Filed June 30, 1893.

This fender has a tilting two part frame, the parts being hinged together and to the car; means are provided for holding the parts in extended position combined with a spring adapted to tilt the frame into operative position; a notched bolt is secured to the frame, and a locking dog to nominally engage the bolt and hold the frame in inoperative position against the action of the spring. (See illustration.)

511,615. Radial Car Truck. Louis J. Hirt, Boston, Mass. Filed January 9, 1893.

The last claim of this patent reads as follows: "The combination of the swiveling end trucks and connected middle truck with radius bars and joint pieces connected with the ends thereof by substantially horizontal pivots, said joint pieces at one end of the radius bars being connected by substantially vertical pivots with the middle truck and at the other ends of the bars by substantially vertical pivots, with a portion of the frame fixed relative to the car body."

511,627. Electric Railway Switching Mechanism. Charles J. Kintner, New York, N. Y. Filed June 24, 1893.

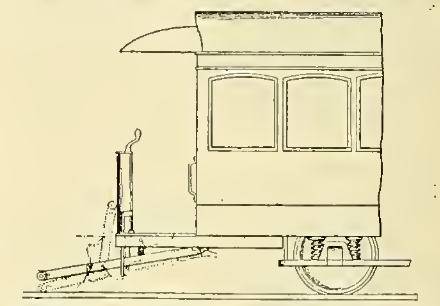
A series of fixed sectional trolley conductors are each provided with a pivoted section having circuit connections and locking mechanism for connecting and holding the free end thereof in electrical contact with the main insulated conductor.

511,634. Trolley Base. James L. Mauldin, Cleveland, Ohio, assignor of one-half to Frank J. Lewis, same place. Filed March 20, 1893.

The construction and operation of this trolley base will be readily understood from the accompanying illustration.

511,640. Car Fender. James W. McKinnon, New York, N. Y., assignor of two-thirds to Sarah B. McLeod and Ann M. Downs, same place. Filed August 4, 1893.

This is a fender adapted for pivotal or hinged engagement with the car at its rear ends, spring cushions carried by the fender and adapted to be interposed between it and the car, and an adjusting mechanism connected with the forward portion of the fender, whereby it may be raised and lowered.



NO. 511,604. FLANDERS' FENDER FOR STREET CARS.

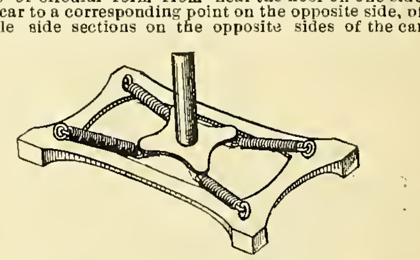
511,680. Truck Frame for Motor Cars. Charles E. Canfield, Chester, Pa., assignor of one-half to Henry Cochran, same place. Filed June 21, 1893.

The last claim of this patent reads as follows:

"As an improved constituent member of a car wheel truck, a side beam consisting of a central wheel piece possessing a deep vertical web having a longitudinal horizontal flange on its upper ridge, in combination with the cantilever extensions projecting from the ends of said wheel piece connected therewith, supported by braces integral with the material of the extensions and adapted to abut against the lower part of the pedestals."

Reissue, 11,396. Street Railway Car. George Moore, Boston, Mass., assignor of one-half to G. Waldon Smith, same place. Filed September 15, 1893.

In a railway car, the combination with the upright frames of circular form from near the floor on one side of the car to a corresponding point on the opposite side, of movable side sections on the opposite sides of the car arranged to slide upon the upright frames and to partly pass each other and overlap when in their raised position under the roof of the car.



NO. 511,634. MAULDIN'S TROLLEY BASE.

Engine Room Appliances.

511,320. Friction Clutch Mechanism.—Erskine L. Babcock and Edward D. Schmitt, Cuyahoga Falls, Ohio, assignor to the Falls Rivet and Machine Company, same place. Filed April 8, 1893.

511,415. Mechanism for Transmitting Power.—Alfred A. Fisher and William G. Nelson, Brooklyn, N. Y. Filed March 29, 1893.

511,510. Straightway Valve.—Joseph M. Coale, Baltimore, Md. Filed December 20, 1892.

511,529. Water Alarm for Steam Boilers.—Peter A. Kirchner, Fort Wayne, Ind. Filed April 3, 1893.

511,536. Boiler Furnace.—Joseph Lister, Chicago, Ill. Filed August 31, 1893.

511,710. Belt Clamp.—Harry J. McKeon, Le Roy, Minn. Filed September 23, 1893.

Copies of the specifications and drawings complete o any patent mentioned in this record—or of any othe patent issued since 1886—can be had for 25 cents. Giv date and number of patent desired and address the STREI RAILWAY GAZETTE CO., Monadnock Block, Chicago.

STREET RAILWAY GAZETTE

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CONTENTS.

Another Car Barn Burned. Another car barn has been burned, this time at Cleveland, and the loss on the building and its contents is estimated at a very considerable figure, as eighteen motor cars were destroyed. The incident suggests again the advisability of so constructing buildings in which valuable street railway apparatus is housed that they will not burn with the rapidity of tar barrels. According to the reports the flames made such rapid headway in the Cleveland barn that no chance existed of saving the cars five minutes after the discovery of the fire. Such a structure of a, certainty is not a desirable shelter for electric motors, which, even at existing prices must be considered expensive machinery. The destruction of apparatus sufficient to equip a small road is liable to make quite a serious inroad on a surplus.

Stopping at the First Crossings. The New York railroad commissioners, in their annual report, ask street railway companies to consider whether it would not be advisable to instruct motormen and gripmen to stop at the first instead of the second crossing of intersecting streets. The commissioners do not state their own views in the premises, but from the very fact that the matter is suggested for consideration, it is fair to assume that they are inclined to favor a change from the prevalling practice. It is undoubtedly the fact that much may be said in favor of stopping at the first crossing, especially from the point of view of safety. A great many accidents occur at these points which perhaps could be prevented were the cars starting slowly from a crossing. Several companies have made the change within the last few months, and reports are all to the effect that it is conducive to safety and meets with popular approval."

Economical Use of Steam. We give space elsewhere this week to a brief communication from Mr. Arthur P. Dodge, the promoter of the Angamar motor method of propulsion for street cars. It will be noticed that Mr. Dodge makes some very positive statements regarding the superiority of his method of using stored steam power over what he is pleased to call the indirect method of employing electricity. Without doubt the method used by Mr. Dodge is more direct, since the electric system requires two additional transformations of energy between the engine shaft and the car axle and involves a loss of power at each transformation, besides the loss due to the resistance of the line. But whether the system is, on this account, more efficient, is quite another thing. Against the advantage of the more direct application are to be weighed the disadvantages of the necessarily inefficient generation of steam in a large number of small and independent units, the excessive amount of dead weight that must be hauled on each motor car and the as yet undetermined factor of repairs for the machinery carried on each car. No man in his right senses would suppose that the electric method did not involve losses at each transformation of energy, but modern practice has proven beyond a doubt that these losses are more than counterbalanced by the saving in other directions.

Report of Chicago Railways. The annual meetings of the three great Chicago street railway companies have just been held and the figures presented in the annual reports indicate that last year was an unprecedented period of prosperity. In round numbers the companies carried 288 million passengers and the increase over the previous year was 55 millions. This remarkable increase was due in a great measure to the extraordinary travel of the World's Fair period; in the case of the Chicago City Railway, which was most directly benefited, over 90 per cent of the increase is attributed to Exposition traffic. The company has recognized the fact that it was under a certain obligation to the public for its extraordinary prosperity and the directors have been authorized to give a munificent sum toward the foundation of the Columbian Museum. The donation will aggregate some sixty odd thousand dollars. One of the other companies voted to give $25,000 toward a park menagerie as a sort of thank-offering for its prosperity in 1893. If there is anything to be learned from a consideration of the reports of the annual meetings, it is the vast importance of stimulating means for increasing traffic. It is not often that companies are given the opportunity of furthering so gigantic an enterprise as the World's Fair, but it is frequently the case that they can aid a public movement in a way that will increase their popularity and their profits at the same time. This fact seems to have received a vast de' of recognition within the last year. Everywhere companies are taking steps to secure the opening of parks, or to make more attractive resorts that are already in existence. It is a move in the right direction and the judicious investment of money in this way will bring large returns.

Movable Sidewalk Suggested for Chicago. The existing elevated companies in Chicago have been obliged to content themselves with terminals located at some little distance from the center of business. For this reason their lines have not been patronized as liberally as they could wish, as many persons prefer a comparatively long ride in a surface car to a brief ride in an elevated coach and a walk of several blocks to or from the business district. It is not strange that under these conditions the companies should be impressed with the necessity of extending their structures to meet the popular demands. Every effort to carry the roads into the business center, however, has heretofore excited such intense opposition among property owners that no serious attempt has apparently been made in this direction. The matter is one which has been daily agitated, especially since the annual meetings, when the figures in the reports impressed the owners of the properties with the necessity of taking steps to increase their traffic. Among the numerous schemes suggested for the solution of the problem has been a proposal to build a movable sidewalk on a common loop to accommodate the existing and projected elevated railways. This means of transportation was in operation at the Casino pier at the World's Fair, and the general principles of the system are familiar. The novel road for the most part gave satisfaction at the Fair, but the practicability of the application of the system to the long and devious loop, with its multiplicity of curves will probably be seriously questioned. The electrical part of such a system would doubtless involve no insuperable difficulties, but the mechanical problems might not as readily yield to solution. It is not easy to see how the movable sidewalk, even if approved by the elevated companies, would remove the obstacles that have stood in the way of extensions to the business center. The application of the system would involve the necessity of some sort of an elevated structure, and however light and inoffensive it might be, property owners seem to be committed against it. While it might be satisfactory to chronicle news of a different character, it must be admitted that to all appearances the loop problem is as far from solution as ever.

Conduits vs. Conduits. The December number of the *Transactions* of the American Institute of Electrical Engineers, just published, contains a synopsis of what has been done in the exploitation of electric railway conduits for the past six or seven years, and a description of the particular form of conduit with which Mr. Stetson, the author of the paper, is commercially identified. A few brief extracts from the paper will be found elsewhere in our columns, including the details of the conduit recently tested at Coney Island on a short piece of track. Mr. Stetson has certainly set forth the advantages of this conduit in glowing terms and makes for it claims that, to say the least, cannot be characterized as modest. Indeed, the almost universal way in which he handles the former attempt at constructing successful railway conduits leads to a suspicion of unfairness in the descriptions presented and opinions advanced regarding their operation or their probable failure. Why the committee on papers of the American Institute of Electrical Engineers should permit a paper of such a purely commercial and advertising character to pass their hands in the shape in which it appears it is difficult to imagine. We venture to say that there are very few, if any, editors of engineering journals who would not have found a quite frequent use for the "blue pencil" before allowing such a communication to appear in their columns. If the way is to be opened for promoters of undeveloped inventions to appear before the society and under the apparent sanction of its editing committee to belittle in every possible way the work of rival inventors while presenting the claims of their own, where can the line be drawn with justice to all? The present violation of good taste, to say the least, is a particularly flagrant one and we think many members of the Institute will join us in hoping that the council may at least protect the interests of all its members in refusing to allow papers of this character to appear in its *Transactions*, even if the presiding officer, who might not at the time realize the detrimental character of certain remarks, should allow them to be presented without rebuke.

Cleveland Electric Railway Co's Car Barns Burned.

The Willson Avenue Car barns of the Cleveland Electric Railway Co were destroyed by fire on last Saturday. When the flames had been extinguished only a portion of the walls were left standing. The burned building was 350 feet in length and had a frontage of 150 feet. The cause of the fire is not known definitely, but it has been assumed that it started from a car stove. It has been customary with the company to keep fires in the stoves during the night, but the practice has been to inspect them carefully. It is stated that a few moments before the discovery of the fire an employe made the rounds of the stoves and found them in safe condition. Unfortunately there was no power for moving the cars as the fire occurred soon after three o'clock in the morning. Before any arrangement for current could be made the cars were in flames. The loss on the building and its contents was estimated at about $100,000 which is covered by insurance. Eighteen motor cars and 12 trailers were burned. The public was not inconvenienced by the fire, as the company had in its Lake View car shops a sufficient number of cars to replace those which were destroyed.

What Electricity Has Done for St. Louis.

At a meeting of the Electric Club of St. Louis on January 6, Col. E. D. Meier read a paper on "What Electricity Has Done for Us." The subject related to the development of electrical industries and interests in St. Louis. Referring to the electric light fields, there were, according to the tables presented by Col. Meier, four central stations having an aggregate capacity of 12,000 horse power. Current was distributed to 135,000 incandescent lamps, 3,950 arc lamps and to motors of a capacity of 2,450 horse power. The power stations of the seven electric railways were equipped with generators of an aggregate capacity of 17,600 horse-power; there were 191 miles of single track, and the 382 motor cars and 172 trailers carried 167,900 passengers daily.

Col. Meier had, on two occasions, found the cost of power, taking into account the actual amounts paid for coal, labor, oil, grease and waste, water, repairs to both stationary and moving power plant; in fact every item except the pay of conductors and motorneers. The period in each case was six months. The cost per train mile (counting an ordinary motor car with trailer or a long double car indiscriminately as a train) was respectively 2.72 and 2.41 cents. The cost per passenger carried was respectively .88 and .79 cents. He had never heard that any advocate of the cable system claimed less than 4½ cents per train mile as the cost of power. The power cost per train mile of the Mekarski system of propulsion by compressed air in Nantes, France, (where wages are much cheaper than here) appeared to be 3.4 cents.

Referring to the wonderful changes which electric propulsion for cars had wrought in the facilities for reaching new residence localities and pleasure grounds, Col. Meier said that on summer afternoons and holidays, Carondelet, Benton, Tower Grove, Forest and O'Fallon Parks were now as accessible as Lafayette alone was four years ago. "When in June or July some 'hot wave,' having exhausted even the pinions of the willing wind that brought it, settles down on us an airy incubus, making the very act of breathing seem a labor, we find refreshing breezes on all sides as we dash with racing speed over any of these sixteen lines to which the lightning has been harnessed. And here let us consider that this speed which adds to our comfort in so many ways costs something. The experience of steam railroads has long ago shown that double speed means more than double cost. Hence, when we compare the cost of this electric power with the old horse or mule traction, let us multiply the latter by something more than two to make allowance for the present increased speed. Even then the comparison is unjust to the trolley, for the horse which might have lasted four years at a five-mile speed would not last half that time when required to vary its gait from eight to fifteen miles per hour. While the cost of this 17,600 horse power in electric plants shows a large figure on the debit side of the ledger, we may set against it on the credit side the added vitality which comes to some 100,000 workers enabled to spend their hours of recreation and sleep in healthy suburbs. This each one can feel for himself, but the aggregate can not be accurately gauged in figures. But we may confidently expect better conditions of public health and a decreased death rate in adults as well as children, to add to the goodly sum. When all these facts are fairly considered we will find that the ubiquitous trolley is well worth its cost, and we shall be glad that it has come to stay.

"In 1883, before the advent of the trolley, these same roads as horse car lines carried on an average 76,100 passengers daily; now the electric lines transport 167,900 per day. Within the distance formerly covered by the patient mule in forty minutes, the trolley saves each passenger fifteen minutes. Making due allowance for people of leisure, school children, etc., the average value of the time saved is worth at least 15 cents an hour. We have here a daily saving of some $6,300 or nearly $2,000,000 per annum. This may not be traced directly in the bank deposits of the community, it is true, but the value of this economized time is realized in some form or other. For in the long run, and for the mass of the community wage and salary fairly represent the average value of time. And the half hour saved in daily travel to and from work is utilized in some way in our daily task, in clearer thought or greater energy."

Annual Reports of Companies.

The annual meeting of the Chicago City Railway Company was held on January 16th, and the reports which were submitted indicated that the company had profited in a high degree from the World's Fair traffic. President Wheeler in his report to the stockholders submitted figures showing that last year 120,596,270 passengers had been carried. This number is 32,577,409 greater than in 1892. Of this increase 90.69 per cent. occurred during the World's Fair period, and 9.31 per cent. was recorded for the rest of the year. The revenue amounted to $6,029,813.51; the cost of operating, $3,422,040.62, or 56.75 per cent. of the receipts, and the net earnings were $2,438,711.77. The average receipts a day were $16,520.03, or an average increase of $4,494.60 compared with the daily average of 1892.

The cable furnished 65.27 per cent. of the receipts, the horse car lines 26.02 per cent. and the electric lines 8.71 per cent. The report also showed improvements made during the year in the construction of an electric power-house at Wabash avenue and 52d Street, the equipment of cross-town lines with electric motors and the reconstruction of 13.13 miles of single track for use by electric cars. Some 70 miles of feed and trolley wires were put into operation, and altogether 28¼ miles of single track have been changed from horse car lines to electric lines, and the number of horses in use has been reduced during the year from 2,601 to 2,266.

The following figures are produced from the annual report of the secretary:

	1893.	1892.
Total earnings	$6,059,989	$4,400,943
Operating expenses	3,422,040	2,809,431
Interest	199,237	230,873
Depreciation	....	29,500
Net earnings	2,438,711	1,331,137
Dividends	2,100,000	840,000
Balance	$ 338,771	$ 491,137
Per cent. of expenses to earnings	56.75	63.84
Per cent. of net to gross earnings	28.60	19 01
Per cent. earned on stock	27.00	19 00
Capital stock	$9,000,000	$7,000,000

The status of the income account is given below:

Income account Jan. 1, 1893		$2,082,669.20
Surplus Dec. 31, 1893		338,711.77
Total		$2,421,380.97
The following items are chargeable to income account:		
Dividend of bonds and other securities	$2,250,000.00	
Loss by fire	32,460.00	
Harness account	11,108.37	
Auditorium stock	11,250.00	
World's Fair stock	100,000.00	
Board of Trade membership	1,150.00	
		$2,405,968.58
Balance		$15,412.39

The distance traveled by the cars is given below:

	Miles.
Cable lines	19,713,610
Horse lines	5,053,050
Electric Lines	1,537,430
All lines	26,304,090
Increase over 1892 of	5,483,380

RECEIPTS PER MILE.

	Cents.
Cable	19.965
Horse	31.050
Electric	34.148

EXPENSES PER MILE.

	Cents.
Cable	9.921
Horse	24.863
Electric	13.600
Passengers carried 1893	120,596,270
Increase over 1892	32,577,409
Average receipts per day	$ 16,520.03
Increase over 1892 per day	4,494.60
	Per cent.
Increase during World's Fair period	90.69
Increase balance of the year	9.31

A statement of interest was elicited by an inquiry of a stockholder concerning the earnings for December, 1893. It was shown that the income for December was less by $750 a day than it was in 1892, while the earnings for the fourteen days of January were almost exactly equal to those of January, 1893.

Resolutions were adopted authorizing the directors to donate the company's $100,000 stock in the World's Fair to the Field Columbian museum, and also authorizing them to give the museum not more than $50,000 in cash provided they were assured the museum would remain in Jackson park permanently.

The directors were empowered to issue stock to the amount of $1,000,000 during the year at their discretion, the stock to be offered to stockholders at par and pro rata with their holdings. In response to an inquiry President Wheeler said the proceeds of the stock would be applied to the equipment of additional lines with electricity in case the city council should pass the ordinances now before it.

COMPARISON OF CHICAGO FIGURES.

As the reports of the three Chicago cable companies have now been published, the figures which they contained may be compared with those in the annual statements of a year ago. As will be seen from the tabulated figures all the roads made substantial gains last year, but the increase is especially noticeable in the case of the Chicago City Railway Company, which was benefited directly by World's Fair traffic.

	Passengers carried.	Increase.
Chicago City Railway	120,596,270	32,577,409
West Chicago Street Railroad	107,053,461	12,534,987
North Chicago Street Railroad	60,311,673	9,892,216
Total	287,961,404	55,004,612
	Gross earnings	Increase.
Chicago City Railway	$ 6,059,989	$1,659,046
West Chicago Street Railroad	5,235,633	615,408
North Chicago Street Railroad	3,014,889	493,277
Total	$14,310,511	$2,767,731
	Car miles.	Increase.
Chicago City Railway	26,304,090	5,483,380
West Chicago Street Railroad	16,813,134	1,230,993
North Chicago Street Railroad	9,224,173	676,382
Total	52,341,397	7,390,755
	Operating expenses	Increase.
Chicago City Railway	$3,422,040	$612,600
West Chicago Street Railroad	2,829,982	205,671
North Chicago Street Railroad	1,412,755	78,703
Total	$7,664,777	$896,983

EAST HARRISBURG PASSENGER RAILWAY COMPANY.

The annual meeting of the stockholders of the East Harrisburg Passenger Railway company was was held last week W. J. Calder, the secretary and treasurer, read a statement showing that 3,936,199 passengers were carried last year; receipts from all sources were $189,183.43. President Denny's report stated that during last year two new branches were opened. The total miles of track laid in extensions and reconstruction of old lines were 8½, at a cost of $97,625.25. During the year 8 closed and 4 opened summer cars were added, making a total of 62. Two dynamos were added, one electric sweeper and a switch board and station appliances.

YORK STREET RAILWAY COMPANY.

At the annual meeting of the York (Pa.) Street Railway company it was stated in the reports that the receipts for 1893 were $38,559 68 and the aggregated car miles were 300,876. The receipts during 1892 when the road was operated by horses were $23,032.07. The following figures were presented: The average receipts for all regular cars per car per mile were 13 cents; the average cost of operating per car per mile 10.4 cents; the average cost of operating for year 80 per cent.; the average cost of power per car mile 25 cents; the average cost of transportation 4.67 cents; the average cost of maintenance of rolling stock 1.31 cents; the average cost of maintenance of roadbed .3 cent; the average cost of general expense 1.62 cents.

WILKES BARRE AND WYOMING VALLEY TRACTION COMPANY.

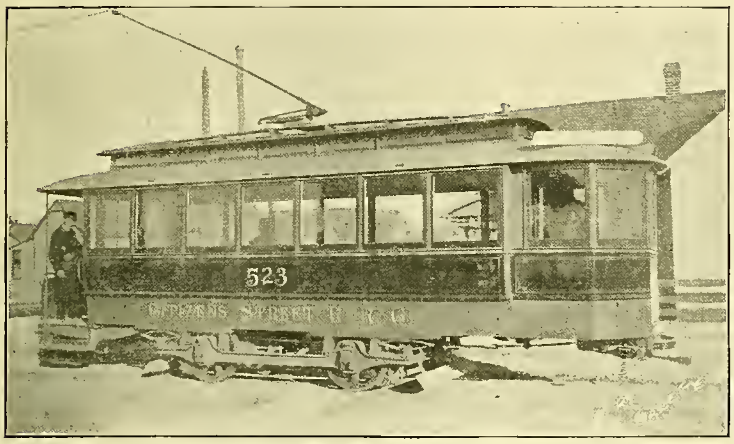
The annual meeting of the Wilkes-Barre & Wyoming Valley Traction Company was held last week. Reports of officers show that during last year the gross receipts from passenger traffic was $310,927 and other receipts swell the total to $312,190. The operating expenses were $149,240, or nearly 49 per cent., leaving net earnings of $162,750. The fixed charges for the year, aggregated $99,306, leaving a surplus of $63,444.

The total mileage is 43½ miles, of which 11½ miles were built during the year and 6½ miles were reconstructed.

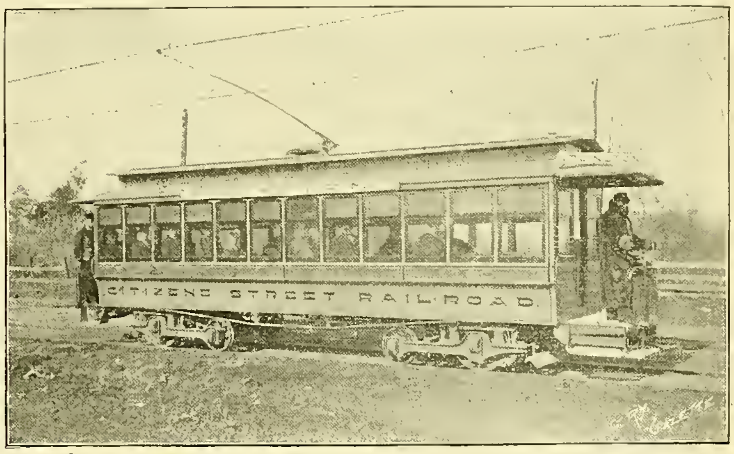
SCHUYLKILL ELECTRIC RAILWAY COMPANY.

At the annual meeting of the Schuylkill Valley Electric Railway Company of Pottsville, Pa., the directors were authorized to equip the Palo Alto line and procure eight new car equipments. It was estimated that $30,000 would be required for improvements. As it is proposed to end the fiscal year hereafter December 1st reports were presented covering a period of only eleven months of 1893. During this period 762,485 passengers were carried as compared with 797,531 for the entire preceding year. The receipts from passenger service during 1893 were $35,744.

Philadelphia, Pa.—It is stated that trolley cars will be running on the North Broad street extension of the Thirteenth and Fifteenth streets line in about 60 days. Ground was broken last week for the construction of the trolley system on the extension by William Wharton, Jr., & Co., the contractors, and the work of laying the heavy girder rails will go forward as fast as the weather will permit.



VESTIBULED STREET CAR USED IN INDIANAPOLIS.



AN EIGHT WHEEL CAR USED IN INDIANAPOLIS.

EIGHT-WHEELED INDIANAPOLIS CAR.

The accompanying engraving shows a 28 foot St. Louis car-body mounted upon two four-wheeled McGuire adjustable traction trucks. This truck is the latest production of the McGuire factory, and is so arranged that all the load is carried on the driving wheels when the car is running on a straight track, but when passing around curves 25% of the load is shifted to the guide wheels.

The car shown has been in use for some time on the Citizens' Railway Company's road in Indianapolis, but it is said that it had been abandoned by the company on account of its inability to make time. In addition to this the car body was set so high that the patrons of the road objected to its inconvenience.

Its equipment with the McGuire tracks, shown in the illustration, is said to have remedied all the difficulties so that it now runs satisfactorily.

A HANDSOME VESTIBULED CAR.

The accompanying illustration shows a new four-wheeled car in service on the Citizens' Street Railway Company's road at Indianapolis, Ind. The car, which was manufactured by the Pullman Company, has a 20-foot body and measures over all, including the vestibule, 29 feet. It is mounted on McGuire Columbian trucks, with a 7-foot wheel base.

The last order given by the Citizens' Company was for twenty-five Pullman car bodies and twenty five of the St. Louis Car Company's cars, all to be mounted upon McGuire Columbian trucks. The Citizen's Company has adopted these trucks as its standard and it is said that the company will eventually dispose of all other styles of trucks and replace them with the Columbian trucks on four-wheeled cars.

STREET RAILROAD TRANSPORTATION.*

BY A. E. DOLBEAR.

Any plan for rapid city transportation must possess the qualities of safety, economy and speed; the latter, however, will not be allowed at the expense of the other two. The cable system has the feature of speed sufficient for most city needs, but it has not proved itself to be either safe or economical; repairs are needed frequently and traffic is often delayed. Both installation and maintenance are costly, and as a system it has been abandoned in many places where much was hoped from it.

The trolley system of electric propulsion has much to recommend it. It dispenses with the conduit needed for the cable, but it demands much street space for its wires and their protection, and this has caused much complaint from the fire departments of every city that has adopted it. It is capable of working at any limit of speed, and with a much higher degree of economy than the cable system, but complaints are made of its danger, though this is overestimated.

In and about Boston there has, at times, been much clamor against the trolley system mostly instigated by companies interested in a secondary battery system from which much has been hoped for during 10 years, but the great weight needed to provide current for a single car, the danger of short circuiting and the necessity for an expert to run every car to look carefully after every cell every day, have prevented the use of secondary batteries hitherto and seem likely to in the future. The cost of maintaining such a system makes it quite out of the question for adoption. No community would be willing to pay the bare cost of such transportation, to say nothing of a return on the investment. What improvements may yet be made on such batteries I cannot tell, but at present there is no one I have knowledge of, that would answer the purpose of city transportation. The secondary battery is an important electrical device and has its proper field, but street car propulsion is not its proper work.

There, then, is the possibility of employing steam power, which would be economical enough and safe and rapid, but the common type of engine requiring fuel and stoking, with its escaping steam, smoke and noise, cannot be allowed in any place. But there is a modified form of steam engine which dispenses with all of those objectionable features while retaining the efficiency and economy of steam propulsion. Superheated water may be endowed with a great deal of energy which may be drawn upon at will without the customary furnace, so that a relatively small amount of water may contain energy enough to propel a train for a good many miles without any fire. This motor starts with its supply of water heated in another boiler and transferred to it through a pipe just before starting. With suitable condensers the steam that has done its work is not allowed to escape into the open air, but is retained. As steam is really the cheapest available source of power for most places, it is plain that for even street car propulsion it would be much more economical than either of the other methods already mentioned. The novelty of such a method might at first be thought objectionable, as was each of the other systems when first used, but there is no reason at all for thinking it will not be as safe, as rapid and very much cheaper than any other system now or likely to be devised. In principle it is all right, and I am of the opinion that with proper business tact and financial support such a motor has a great field.

*The Railroad Gazette.

New York.—Only four members of the old directory of the Dry Dock, East Broadway and Battery Railroad Company were reelected this year. The new members are George H. Prentiss, A. S. Rosenbaum, Simon Danzig, Soloman Mehrbach, John H. Waydell, E. W. Summer, Edward C. Hillier, Marshall S. Driggs and M. Feuchtwanger. Richard Kelly was chosen president.

WASHINGTON-BALTIMORE ELECTRIC RAILWAY.

Work has been begun on the Baltimore & Washington Boulevard Electric Railway. Ground was broken recently at Laurel, 22 miles from Baltimore, and it is stated that construction will be prosecuted as rapidly as the weather will permit. As it has already been stated the, list of stockholders includes T. Edward Hambleton of Baltimore, and P. A. B. Widener and W. L. Elkins of Philadelphia. Mr. Hambleton was recently quoted as saying that the financial arrangements for the railway were all made and that the work of construction would continue as rapidly as possible.

At first only one track will be laid, as it is wished to get the road in operation as soon as possible. Turnouts will be used while the second track is being put down. At Laurel the work is being done at one side of the Baltimore and Washington turnpike. The contractor has 200 men engaged and a good supply of ties and rails is on the ground.

It is stated that the electric line will be only 32 miles long, while the Baltimore & Ohio's steam road is 40 and the Pennsylvania's is 42 miles in length between the two cities. Entrance has been secured both in Baltimore and Washington, and connection will probably be had in the former city with the Edmondson avenue line of the Traction Company, which is to be converted into an electric railroad. The estimate of cost of the Boulevard road is $3,000,000. The boulevard is to be 100 feet wide and about one-fourth of that width is to be occupied by the railroad tracks. It is understood that the Legislature will be asked to extend the time for completing the road under the charter of the company, and that other necessary amendments may be requested.

Work will soon begin on the line in Baltimore county, the gang there working southward to meet the gang started in Prince George's county. The line will use the trolley system.

The Washington *News* says of this project:

"Nothing in the way of district improvements has created more marked interest among real estate men in Washington and also investors than this great project. The result of the work will be the investment of large sums of money in the northeastern suburban section, as also along the line of the road. Investors stand ready now to buy land along the route, and within a year many large purchases and sales will be heard of."

THE KINETIC MOTIVE POWER SYSTEM FOR STREET RAILWAYS.

BY A. P. DODGE.

The Kinetic motor is the direct result of many years of study. It is the evolution of the locomotive, the great moving power of the world. That which is new in the Kinetic motor consists of simple practical devices which do away entirely with the offensive and uneconomic features of the locomotive, retaining, however, its mechanical parts which, it is generally conceded, are at least unexcelled in point of perfection in the world of mechanics. The Kinetic motor enters service charged from the stationary boiler with the finished product of fuel and water, while the ordinary locomotive carries the raw material. The saving is very material and is, of course, especially interesting to the railroad company, but that which interests the public far more is the fact that they now have brought to them the power—the sureness of operation of the locomotive, but without any of its defects, the noise and show of steam, smoke and cinders being absolutely and wholly done away with.

The fact that most people, particularly in the West, seem to be looking for some indirect, mysterious solution of the motive power problem may be difficult of explanation. Electricity is yet mysterious, and it is the reproduction of another power. Is it not the height of absurdity to imagine that it can be utilized as cheaply as can be the power which creates it? Why do so many young experts look so confidently for electric motive power instead of trying to secure the proper application of primary power, in the most direct manner? Some need to be reminded that they are striving to get something out of nothing!

Even should electricity be successfully extracted from coal without the aid of combustion, what is the gain if by slow combustion about as much power results in the form of heated water, steam being applied so much more economically? There is no way yet known for storing up so much available energy as in the form of hot water, neither is there a process for administering motive power so correct mechanically; so free from friction and other losses as presented by the piston cylinder, connecting-rod, crank motion of the locomotive.

The following indicator test of the Angamar motor, of the Kinetic system in operation in Chicago, also the communication of Professor Dolbear upon the theoretical energy in hot water will, it is believed, prove of interest:

Cylinders (two)		9x10 stroke
Wheels—four driving wheels		31" dia.
Heating surface in motor boiler		188 sq ft.
Grate surface		6 sq. ft.
Mean effective pressure in cylinder	Averages: Throttle wide open: Lever in corner.	43 lbs. sq. in.
Indicated H. P. (2 cyl.)		43
Revolutions per minute		155
Temperature in steam chest		291.5°
Steam pressure due to temperature		59 lbs.
Miles per hour		14,1/1
Temperature at start		280°
Temperature at end of test		300°
Water evaporated		140 gal.=1,120 lbs.
Coal consumed in motor and stationary boiler		100 lbs.
Duration of test		1 hour
Time occupied in charging from stationary boiler		1.5 minutes
Hauled load consisting of two eight-wheel passenger cars approximate weight of same		25 tons
Rail-light track uneven.		
Grade level.		
Curves about		75 ft. radius
Engines behaved well, running very smoothly.		
It is to be remarked that the coal consumed per indicated H. P.		2.35 lbs.
Water evaporated per indicated H. P.		26 lbs.
Shows an exceptionally good result.		

MR. A. P. DODGE, Kinetic Power Company, Boston.

Dear Sir:—The following figures will show to one the theoretical amount of energy there is in hot water that may be utilized by suitable machinery.

Suppose water be heated to 373° Fah.=180 pounds per sq. in. pressure. 373°—212°=161° above boiling point.

1° Fah. per pound water gives 778 foot pounds work. 778×161=125,258 foot pounds work for 1 pound water at 373° 1 H. P.=33,000 foot pounds per minute $\frac{125,258}{33,000}=3.8=$ minutes 1 pound water would furnish 1 H. P.

$\frac{60}{3.8}=16$ (nearly)=number of pounds needed to supply 1 H. P. per hour.

16×20=320=pounds water needed to supply 20 H. P. per hour.

At 60 pounds per cubic foot $\frac{320}{60}=5.3$ cubic feet, and at 8 gallons per cubic foot there would be 8×5.3=42.4 gallons—less than a barrel and a half. Double this quantity for losses of all sorts and then a cylinder boiler four feet long and two feet in diameter will more than contain it. These figures show plainly that a suitably adapted engine is all that is needful to make hot water do the work now done by electricity and horses in street railways.

Yours truly,

(Signed) A. E. DOLBEAR.

The foregoing is respectfully submitted to the consideration of Mr. S. W. Allerton, who comes out with an interview in this morning's *Herald*, denouncing everyone as "slow" who do not agree with him in the notion that electricity is sure to supplant steam power. He talks as though he supposed electricity came to hand spontaneously made itself! He evidently is totally unaware of the fact that in addition to the electrical energy there is actually more steam power required in a system operated by an electric plant than is employed where there is no intermediary electric power, but where the steam is applied *directly*. The whole truth is this: Every competent person knows that the steam engine is the most efficient and economical, the only difficulty hitherto in the way being the offensive features, as above.

Unity Building, Chicago, January 15, 1894.

PROBLEMS FOR STREET RAILWAY ENGINEERS.

[Under this heading we will present each week during 1894 some practical street railway problem, the solution of which will call for the exercise of the same kind of engineering ability that is necessary in the every day practice of the consulting or designing engineer. Solutions to these problems are solicited and will be published when considered sufficiently accurate or when they contain valuable information.—EDS.]

PROBLEM III.—Design a power plant for an electric road operating 20 cars of ordinary size and carrying ordinary traffic from 5 A. M. to 11 P. M. Select what you consider an economical type and size of engine and generator, give dimensions of power house engine room and boiler room, give full details of what is considered the necessary equipment and state estimated cost. The plant is located at the centre of a five mile double track with practically no curves and few grades. About 16 cars will be in use at any one time and these equally distributed along the line. Condensing water is easily and abundantly obtained and coal (slack) can be put down at the furnace door for $1.00 a ton. The plant is located in Illinois.

COUNTRY ELECTRIC RAILWAYS.

The appended extract from an article by a supervisor in Cumberland county, New York, is interesting for more than one reason. It illustrates forcibly the fact that electric railways are so extending into sparsely settled districts that they are exciting the interest and attention of the rural legislator, and it shows at the same time the point of view of the local statesman in considering improvements in his neighborhood. The article appeared in the *Farmers' Friend*, of Mechanicsburg, and the following is an extract:

All over the state companies are forming to use the country roads, and charters with that in view are taken out at Harrisburg. In fact, there is a rush for charters. Some half-dozen companies have been formed for operation in the lower end of Cumberland county. These all traverse our public roads in the townships. The consent of the supervisors is taken for granted. Ought such consent to be taken for granted?

Even if the coming of the electric car is altogether a good thing for the small villages and rural parts, yet since they have the benefit of the public roads, they ought to help to keep them up, or in some way contribute to the relief of the public burden; for why should these corporations have valuable privileges for nothing? In cities and boroughs, I am told, the electric roads are obliged to pave the streets through which they run and maintain them. But, in fact, are these cars on country roads an unmixed blessing? If they leave the road for the ordinary purpose of travel as before, then this question may be affirmed. But there's the rub. In the wide streets of cities, where there are many persons to help in case of a fractious horse, the cars do not interfere with the ordinary use of the streets. But it is sure that on narrow country roads, where the railway will take up most of it, and where horses have less opportunity to get used to the cars, and where there are not always people by when horses frighten, with ladies perhaps driving, is it so sure, I repeat, that those electric roads are a desirable thing without any drawback? There are those who think they will virtually destroy the common country road on which they are laid for the usual and ordinary purposes of travel. Certainly there will for a long time be much danger for families driving when they encounter these cars running swiftly along. And if this be so, if the common country roads be virtually destroyed by the trolley cars, then, since the gift of them is irrevocable, new roads will have to be supplied at the expense of the public.

Rockford, Ill.—The rumor that the Rockford City Railway Company was to pass into the hands of a receiver is denied with a good deal of feeling by the officers. H. W. Price, the vice-president, is quoted as saying: "The report was started by some vicious individual and there was no truth in it whatever. The interest on the bonds fell due on Monday and as it was a legal holiday and the banks were closed we were not able to take up the coupons on the day they were due. The amount of the interest has been placed by the directors on deposit with the National Trust Company of Chicago."

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Third Article.)

Let us illustrate the use ot this law by a few numerical examples. Scientific men have very carefully determined the resistance in ohms of different sizes of pure copper wire and have found that at the ordinary temperature a No. 10, B & S wire which is a trifle over $\frac{1}{10}$ inch in diameter offers a resistance of a trifle over 1 ohm per thousand feet. (The exact figures are $\frac{10189}{100000}$ inches in diameter and $1\frac{454}{10000}$ ohms, resistance per thousand feet.) Let us discard the fractions and use the figures given. If we were designiug a dynamo or buying one, we could obtain one that would give us any voltage we desired. In street railway practice a pressure of 500 volts or thereabouts is always used and we will assume that we have a dynamo that will generate that pressure, and we have a circuit of No. 10 B & S wire of 10,000 feet and we desire to know what rate of flow (how many amperes) can be sent over that circuit.

One thousand feet of No. 10 wire offer a resistance of $\frac{1}{10}$ ohm; 10,000 feet will therefore offer a resistance of $10\times\frac{1}{10}$, or 1 ohm. The voltage or electromotive force at our disposal is 500. Ohm's law says that the current that will flow will be equal to the voltage or electromotive (in this case, 500) divided by the resistance (in this case 1 ohm) and therefore the answer is that C (or amperes) $=\frac{500}{1}$ or 500 amperes. Now, if we should make our circuit twice as long or 20,000 feet, the resistance would be just twice as great $(20\times\frac{1}{10}=2)$ and our equation would be $C=\frac{500}{2}=250$. That is to say, with the same size wire of double the length the rate of flow of current would be only half as great as 250 amperes instead of 500 amperes.

In the same way we find that if our circuit were only half as long or 5,000 feet, the resistance being also cut in two, the flow of current would be twice as great or 1,000 amperes. Now, if we double the amount of copper—that is use two No. 10 wires instead of one—each of these will carry the same amount of current, and at 10,000 feet could deliver 2×500 amperes or 1,000 amperes. That is to say, if we double the weight of our copper, either by using two wires of the same size, or a single one of the same weight as the two combined, we will reduce our resistance by half, and consequently be enabled to deliver twice as much current at the same distance.

But supposing we have other data given. Suppose it is required to determine what sized wire to use to transmit say 1,000 amperes to a distance of 20,000 feet—the electromotive force being as before, 500 volts. Referring to Ohm's law $C=\frac{E}{R}$ we have C, the amperes, equals 1,000 and E, the pressure or electromotive force is 500. Substituting these in the equation it becomes $1{,}000=\frac{500}{R}$.

By simple arithmetic this may be changed to $1{,}000\ R=500$ and $R=\frac{500}{1{,}000}=\frac{1}{2}$. Thus we find that the resistance of the conductor in ohms for 20,000 feet is $\frac{1}{2}$. The resistance of this same wire per 1,000 feet will be $\frac{1}{20}$ of $\frac{1}{2}$ or $\frac{1}{40}$ ohm. A No. 10 wire has a resistance of 1 ohm per 1000 feet and the required wire which has a resistance of but $\frac{1}{40}$ ohm per 1,000 feet must be forty times as heavy as a No. 10 wire or equivalent to 40 No. 10 wires which by reference to any wiring table will be found to be equal to two 0000 wires.

Or supposing we have our wire already strung—say a No. 10 wire and must deliver 1000 amperes over a circuit 20,000 feet in length, what electromotive force must we use?

The resistance of 1,000 feet of No. 10 wire is one ohm. The resistance of 20,000 feet will be $20\times\frac{1}{10}$ ohms. The amperes or current which we have to deliver is 1,000. By Ohm's law $C=\frac{E}{R}$. Substituting for C its value 1,000 and for R its value 20 our equation becomes $1{,}000=\frac{E}{20}$ or by simple arithmetic, $20{,}000=E$ which is to say that the electromotive force will have to be 20,000 volts to force a current of 1,000 amperes around a circuit of 20,000 feet of No. 10 wire.

Examples have now been given of all possible cases of wire calculation in their simplest form and these illustrate the way in which Ohm's law is used in electrical calculations. Of course others may and usually do arise in which some complications are introduced—for instance it is usually required not simply of determine what is the smallest wire that can possibly carry a given number of amperes a certain distance, but to determine what size wire will carry that current the required distance with a given drop or loss of potential or electromotive force or pressure, but we will not discuss that question now, merely passing it by with the statement that it is a very simple matter to do and requires no more knowledge of arithmetic than is involved in the examples already given.

It is strongly urged upon all who are not familiar with the use of Ohm's law,and who wish to derive benefit from the succeeding articles, to work out these problems over and over again until they are thoroughly familiar with the use of the law, for as before stated, it is the key to the whole science of electricity. It will be observed that in Ohm's law there are three elements involved, viz , the pressure or electromotive force or voltage, whichever we choose to call it, the rate of flow of the current, or amperes, and the resistance which that flow encounters in the conductors, which is measured in ohms. These same three elements are involved in the flow of any other fluids as well, but are simply disguised under different names. As before stated, the flow of water in pipes involves pressure, (usually measured in pounds per square inch, or head in feet, corresponding to volts in electric currents) rate of flow (usually measured in gallons or barrels or cubic feet per minute or second, corresponding to amperes) and frictional resistance (usually measured in loss of feet or inches in head or in pounds pressure, corresponding to ohms in electricity) and as shown by the examples, if any two of these three elements are given, the third may be determined.

RATE OF WORK.

In mechanics we say that when energy is expended at such a rate as to lift a weight of one pound one foot in one second that it is doing work at the rate of one foot pound per second and when it is doing an amount of work equivalent to raising 550 pounds one foot high per second, or what is the same thing, raising 33,000 pounds one foot high per minute, the work done is equal to one horse power. A mechanical horse power is therefore defined as that expenditure of energy which will raise a weight of 550 pounds one foot high in one second or 33,000 pounds (60x550) one foot high in one minute.

Since the raising of a weight usually conveys to our minds the idea of a lift or pull, rather than of a pressure, and we have heretofore been speaking only of pressures, it may be well, in order to make clear the exact similarity between the mechanical and electrical units of work to translate the "pull" or "lift" into a pressure. That "pull" and "pressure" are really equivalent will be apparent from a familiar example. When it is desired to move a car in the barns it is immaterial whether we get behind and push or get in front and pull. One method may be more convenient than the other but the amount of work done in either case if the car be moved the same distance in the same time will be exactly the same, and if the work thus performed is the same as that required to lift or press upward a weight of 550 pounds through a height of one foot in one second it will be exactly a mechanical horse-power. Thus we see that in the measure of rate of mechanical work which we call the horse-power, four elements are involved viz: pressure, weight or quantity, distance and the time occupied in lifting or pushing the given weight or quantity through that distance.

Now in electrical language, it will be remembered that the volt or electromotive force has been defined as the equivalent of mechanical pressure. We might also now say that it is the equivalent of mechanical pull or lift. We have defined the ampere as a rate of flow of current and likened it to the flow of so many gallons of water per second. While electricity is not supposed to have weight we may for present purposes suppose that it has. A gallon of water weighs about 8 pounds and if it is lifted through one foot in one second, 8 foot pounds of work will have been done. If we lift it or push it so fast that in one second we have lifted it through $\frac{550}{8}=81\frac{1}{4}$ feet in one second instead, we will have done work equivalent to 550 foot pounds in one second which is equivalent to one horse-power. Therefore since the ampere is a similar electrical expression to the mechanical expression of a flow of so many gallons per minute, and since the volt is equivalent to the mechanical expression of so many pounds pressure and the product of pressure into gallons per second gives us foot pounds per second, 550 of which make a mechanical horse power, we ought to expect that the product of electrical pressure (the volts) into the rate of flow of the electrical currents (the ampere) would give us something similar to the foot pound per second, and that a certain number of these would be equivalent to a mechanical horse power, and so it is. If we have an electric current of one ampere flowing under a pressure of one volt, we have electrical energy expended at the rate of one *watt*, and this unit is of such a size that 740 of them are equivalent to one mechanical horse power. Or in other words, if 746 amperes under 1 volt pressure, or 1 ampere under 746 volts pressure be wholly expended on an electric motor, that motor will be capable of lifting a weight of 550 pounds one foot high in one second, or one pound 550 feet high in the same time, or 33,000 pounds one foot high in a minute, or will be equivalent to a horse power. Thus while the watt is not exactly the same thing as a foot pound per second, it is a unit of exactly the same kind but of a different size, just as although an ounce is not the same thing as a pound, it is a unit of the same kind. But 746 watts *is* exactly the same thing as a horse power, just as 16 ounces is the same thing as a pound.

Thus we have the electrical unit of rate of work or expenditure of energy also named after a distinguished early investigator, and it has no meaning whatever except that which electricians have assigned to it as described. The watt is equivalent to $\frac{1}{746}$ of a horse power, and the foot pound per second is $\frac{1}{550}$ of a horse power, so that the watt is somewhat smaller than the foot pound per second; but the electrical horse power and the mechanical horse power are exactly the same thing. The watt is also sometimes called the volt-ampere because it is obtained by multiplying the volt by the ampere. The kilowatt is merely a thousand watts, the word kilo meaning thousand. Since 746 watts equal a horse power, a kilowatt is equal to $\frac{1000}{746}$, which is equal to nearly $1\frac{1}{3}$ horse power.

EXAMPLES.

How many electrical horse-power can be delivered over a No. 10 wire whose length is 20,000 feet, the electromotive force being 500 volts?

Ans.—The resistance of No. 10 wire is 1 ohm per 1,000 feet. The resistance of 20,000 feet will therefore be 20 ohms. According to Ohm's law, $C=\frac{E}{R}$. According to the problems the electromotive force, or $E=500$, and the resistance or $R=20$. Substituting these in the equation, it becomes $C=\frac{500}{20}=25$. That is to say, that 25 amperes can be delivered over 20,000 feet of No. 10 wire if the pressure is 500 volts.

The watts delivered will be equal to the electromotive force multiplied by the current in amperes, or $25\times500=125,000$ watts. Since 746 watts equal 1 horse-power, the horse power delivered will be $\frac{125000}{746}=167\frac{418}{746}$ horse power.

The current passing over a given circuit is 800 amperes and the resistance of that circuit is known to be 15 ohms. What is the horse power expended?

Ans. In this case C=800 and R=15. Substituting these values in Ohm's law the equation becomes

$$800=\frac{E}{15} \text{ or } E=15\times800=12,000$$

That is to say, the electromotive force on that circuit is 12,000 volts. The number of watts= C×E (amperes multiplied by volts) which in this case is $800\times12,000=9,600,000$ watts. Since 746 watts equal one horse power

$$\frac{9,600,000}{746}=12,868\tfrac{472}{746} \text{ horse-power}$$

The electromotive force of a given current is 500 volts and the resistance of the circuit is 25 ohms. How many horse power can be delivered?

Ans. E=500, R=25. Substituting these values in Ohm's law the equation becomes

$$C=\frac{500}{25}=20$$

That is to say, the current that will flow under these conditions will be 20 amperes. Watts= $C\times E=20\times500=10,000$ watts. (This may also be called 10 kilowatts).

$$\text{Horse power}=\frac{\text{watts}}{746}=\frac{10,000}{746}=13\frac{302}{746}\text{ horse power.}$$

600 horse power are delivered over a given circuit, the electromotive force of which is 500 volts. What is the current?

Ans. Since 1 horse power is equal to 746 volts, 600 horse power will be equal to $600\times746=447,600$ watts.

Since watts are equal to the volts multiplied by the amperes there will be as many amperes as 500 is contained times in 447,600 watts

$$\frac{447,600}{500}=895\frac{1}{5} \text{ amperes.}$$

A street car motor is generating 10 horse power while taking 35 amperes. What must be the electromotive force of the current?

Ans. 1 H. P.=746 watts. 10 H. P.=10×746 watts= 7,460 watts. Watts=C×E=7,460. But C=35. Substituting for C its value we have 35E=7,460

$$E=\frac{7460}{35}=213\frac{5}{35} \text{ volts.}$$

With these examples the use of Ohm's law and the conversion of electrical into mechanical units and vice versa will have been sufficiently illustrated to show the extreme simplicity of the operation. It would be well for those desiring to really familiarize themselves with electrical problems to take figures which they may obtain from the actual operation of the roads with which they are connected and attempt their solution in the same manner. By watching the ammeter and voltmeter in the power-house they can obtain an endless variety of problems as to how much work is being done on the line, and other data usually obtainable at the office will enable them to ring in changes on these problems which it will be not only interesting but exceedingly instructive to investigate.

Warren, O.—It is reported that representatives of a Cleveland company are looking over the territory with a view to connecting all the leading Northern Ohio towns between Cleveland and the Ohio river by an electric railway, running through Warren, Youngstown, Letonia, and on to East Liverpool, with branches to Salem and New Lisbon. It is not the intention to commence operations for a year or so, but a franchise is asked now so as to have the right of way to avoid any delay.

Local Authorities and Their Right to Make Conditions.

Judge Mitchell, of the Supreme Court of Pennsylvania recently handed down a decision in the case of the city of Allegheny respondent against the Millvale Railway Co. appellant. The case is one of importance as it refers to the powers of local authorities in granting privileges to street railway companies. The court deals with the subject generally. Judge Mitchell says:

"By Section 9, Article 17, of the Constitution, 'no street passenger railway shall be constructed within the limits of any city, borough or township, without the consent of its local authorities.' This language is repeated in Section 15 of the Street Railway act of May 14, 1889, P. L. 217; but this is merely an express subjection *ex majore cautela*, of the privileges to be granted by the act, to the terms of the Constitution, which would be implied without it. It neither enlarged nor diminished the constitutional powers of the local authorities, and may, therefore, be disregarded. The provision of the Constitution is peremptory and unlimited. It is part of the pervading intent of that instrument to give local bodies the control of local affairs. The public history of the time of which the court may take judicial notice, shows that one of the prime objects of the people in calling a constitutional convention was to do away with special legislation which interfered with local affairs, or granted privileges to particular bodies and withheld them from others with a semblance of partiality rather than of equal favor to all.

"That object was carried out in the constitution adopted so broadly that it is a matter of grave doubt whether the object itself has not sometimes been defeated by tying the hands of the Legislature too closely to permit it to help special localities with special needs by legislation which they really want and ought to have. But, however that may be in other matters, the provision now under consideration, as already said, is peremptory and without expressed limitation of any kind. It is a gift directly from the constitution to the local bodies and needs no help nor permits any interference from the Legislature. If any limitations are to be implied by the courts the implication must arise from clear necessity, as absolute, as peremptory and as unavoidable as the constitutional mandate itself. The burden, therefore, is on the party affirming that the exercise of the local authority is not valid. *Omne majus in se continet minus.* The man who can give the whole can give part, or who can grant absolutely can grant with a reservation of rent or other condition. He who can consent or refuse without reason does not make his consent or his refusal either better or worse by a good or a bad reason. The same principle applies to the present subject.

"It is conceded that the local authorities may impose some conditions, such as those relative to the police power; but where is the grant to any other body to supervise and limit the conditions or say what they shall be? The Legislature clearly cannot do it. The very purpose of the provision was to put an end to the Legislature's interference. Nor can the courts trespass upon the discretion given absolutely by the Constitution to the local bodies. We do not undertake to say that no condition could possibly be attached to consent, which would be an abuse of or transcend the discretion given. A condition, conceivable for the purpose of illustration, that the members of Council voting for the consent should have perpetual free passes or other gratuities, might be declared void as against the fundamental principle of the purity of the administration of public affairs for the public benefit. But even then the question would remain whether the consent was not void, as well as the condition on which it was given. But it would require a very clear case of the contravention of some controlling and paramount principle of public policy to justify an interference by the courts to put a limit on the unlimited Constitution.

"There is nothing of that kind here. There is nothing illegal in the conditions as to the rate of fares or the taxation of the dividends. The Legislature could have imposed both as conditions to the grant of the charter or could have delegated that power to the cities as a condition of their consent. If the authority would have been legal on a delegation from the Legislature, *a fortiori*, it cannot be illegal on a grant from the Constitution. Neither the Constitution or the Legislature has, in fact, conferred such power on the cities; but the illustration holds good to show that there is nothing in the conditions imposed by the city of Allegheny intrinsically opposed to the law or to public policy. It is not a question of the municipality's power to regulate fares or tax dividends. There is no contention for that. If the city was assuming such authority as against the railway company the argument for appellant would be of convincing force. But the city is not doing so. It simply says: 'I have the sole and exclusive power to consent or refuse. On certain conditions I consent, otherwise I refuse. I don't compel you to do anything. I merely give you a choice between alternatives. You have no power or right to demand my consent. You ask it, and I give it on my own terms or not at all.' "

THE TESLA ENGINE.

At a recent meeting of the New York Electrical Society Nikola Tesla delivered an address, from which we take the following extract:

When we look at a steam engine and inquire where the power comes from that drives the steam engine, we will always find that the power comes from a little box—a cylinder with a piston in it—and all the other appurtenances are really but to keep it going. You may do away with the fly wheel, with the cross heads, with the eccentrics, with all the appliances, provided that you can in some other simple way govern the motion of the mechanism. So then my first idea was to apply the motion of the piston, which is freely movable, to a magnetic field, to move a magnet or a coil in a magnetic field, and so generate currents by this direct motion. Now let us see what we can do in that respect. First, we reduce the weight of the engine for the same pressure and the same piston speed to one-thirtieth or one-fortieth if not one-fiftieth of its weight. Furthermore, we do away with all mechanical frictions. The engine designed according to my ideas has a mechanical efficiency of 99¾ per cent. Now, that is in itself a very big item and renders it worth while endeavoring to make this mechanism a commercial success. But there are other far greater things. You will find that engineers often say what an advantage it is to apply the direct motion of the steam piston to a pump. In reality the advantage in a pump is but a very minute one. The water column has got an enormous inertia, and what we do gain in the direct acting pump is merely a matter of overcoming some additional frictions which we have in the ordinary engine. We may take the mechanical efficiency—I gather the data from various works —we may take the efficiency as say 81 to 82 per cent. at the full load. But the efficiency is much less on a varying load. Then, furthermore, we have got these variously estimated. I take the figures which I have found to be fair, giving this as the efficiency. Now the dynamo again has got mechanical losses due to friction, and, furthermore, the wire is never utilized fully in the dynamo. In my construction the dynamo may consist of a simple coil of the magnet, and a simpler coil, which is all immersed in the magnetic field. There is no useless wire. Consequently dynamo and engine, if they are reduced considerably in weight, increase in efficiency. There is only one engine which can equal it in output, and that is the turbine. With the steam turbine we can obtain an enormous output, and that is the reason why the steam turbine, in my opinion, may be found a valuable adaptation for driving dynamos; and then convert the motion by means of alternating dynamos: and I think the steam turbine has in itself a physical cause why it cannot surpass a certain efficiency, that is that we drive turbines by impact. A turbine might be very efficient in the medium which propels it were incompressible and homogeneous, But it cannot be efficient if we drive it by means of isolated shocks. Furthermore, we cannot in a turbine gain all the expansion. These causes, I think, will limit the efficiency obtained in turbines. But in reciprocating mechanisms we can, provided we obtain a sufficiently high speed of the piston, expand the steam at an enormous rate. It is perfectly practicable in these mechanisms which I have been working up to obtain, if you want, a speed of 100 meters a second, and while I do not contemplate producing such speeds yet it is quite possible to do it. But since we can produce higher speeds we might as well increase the speed two or three times, and so augment the activity of the mechanism and raise the efficiency. Furthermore, as I am enabled now to work without a packing, I found that in these mechanisms the packing is actually objectionable, the expansion occurring at an enormous rate, and the engine being of such character that the exhaust can be reduced to pretty nearly the atmospheric pressure very easily. The mechanical friction is reduced to such a small figure that we can raise the temperature of the steam very considerably. You know that in high pressure steam engines one of the greatest troubles is the lubrication. We can go so far with the mineral oil, we can go so far with ordinary oil, but then we reach a point at which we cannot go any further; the lubricant will not work; and I am informed by very able practical engineers that about 250 pounds per square inch of steam pressure is as high as we practically go. With this engine we can go much higher. I am now preparing a boiler which will give me up to 350 pounds pressure. It is very important, of course, to get the pressure very high. In these mechanisms we are confronted with two things. For what are they going to be used—for light or for power? If we want to drive motors we must have a long stroke and a slow frequency. If we want to operate lamps then we want a very short stroke and a very rapid motion. To have a high speed with short stroke we must have a great initial pressure, because, you know, the number of vibrations increases only as the square root of the pressure. So if we want to have twice the number of vibrations we must have four times the pressure. But, on the other hand, four times the pressure and twice the number of vibrations means eight times the output. So it is very important in this mechanism in which the power depends on the square to obtain as high a pressure as possible. It is on this line now that I am working.

We have had such reciprocating engines as far back as 1868 or 1870, and it would be a very erroneous idea to think that I had evolved something radically novel in that part of the mechanism.

It is more economical to produce rapid vibrations than low vibrations. But so far as the economy of the dynamo is concerned, and so far as the economy of the engine in general is concerned, it is better to produce a long stroke, because a long stroke means a high velocity.

I have an apparatus which runs lights in the laboratory, and shortly I think I will have something which will be ready for practical application. I think I am not mistaken in believing that we are going to have very shortly a means at hand of producing twice as much electricity from coal as we can produce at the present time —provided I am not mistaken. This is subject, of course, to a test, but I am quite confident that it can be done.

Florence, Cal.—An electric railway from Cañon to Florence has been projected.

THE WORKS OF THE J. W. FOWLER CAR COMPANY.

The new factory which has been erected by the J. W. Fowler Car Company, at Elizabethport,

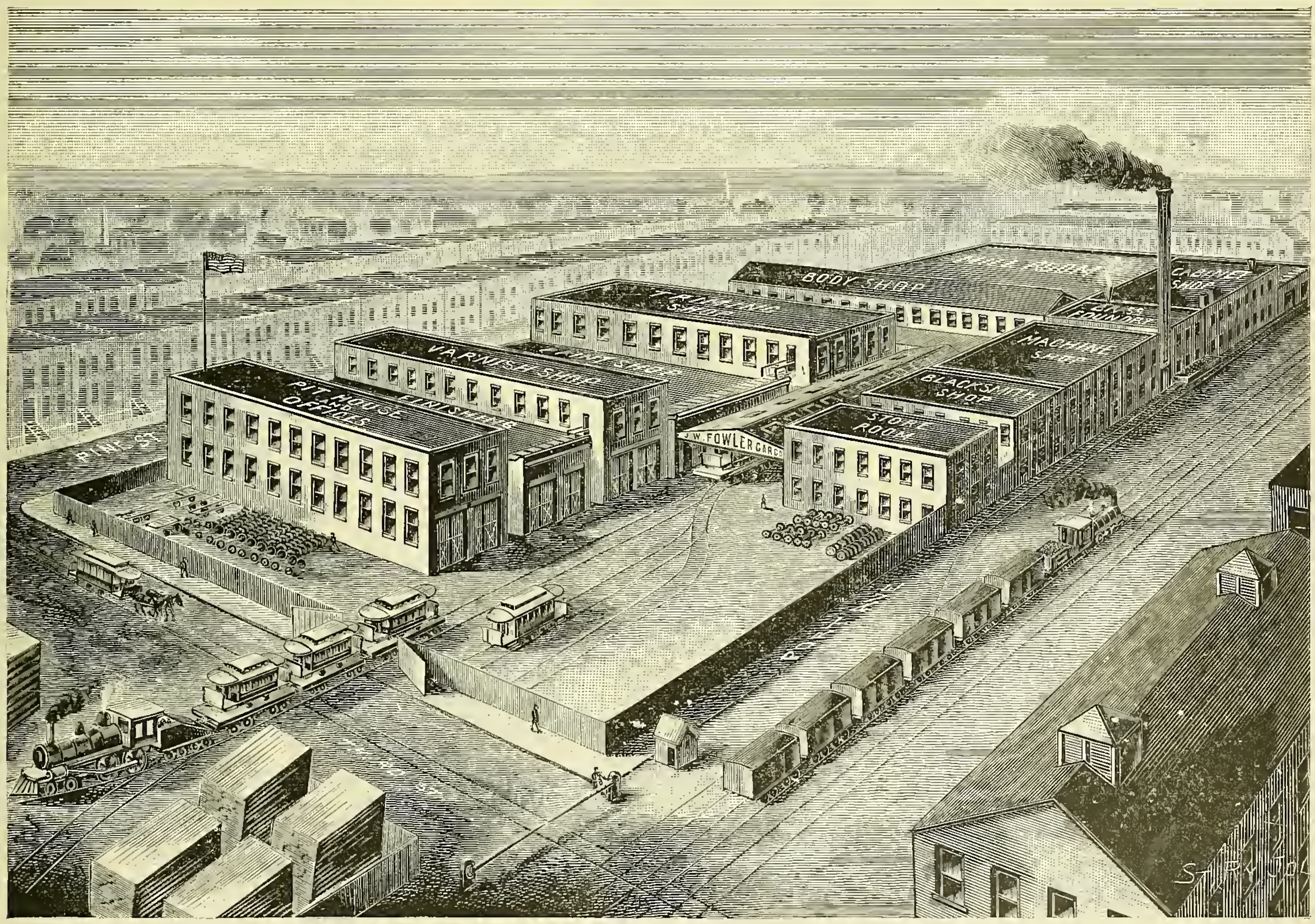
J. W. COOPER.

J. W. FOWLER.

N. J., is shown in the accompanying Fig. 1. These works, which, it is well known, have been built during the last year, are equipped with the latest and most approved appliances for the manufacture of street railway cars and all necessary parts for the complete rolling stock of a street railway company, including in this category snow plows and snow sweepers, as well as every variety of passenger car. The works were erected under the supervision of, and are operated and managed by persons of long experience in just this class of work, and represent the most approved ideas for securing the best of work, together with the greatest facilities for manufacture.

The factory comprises eleven brick buildings, with a total of 100,000 sq. ft. of floor space. The buildings are arranged somewhat in the form of the letter U, a covered passageway being provided between two wings as shown in the figure. The arrangement is such that the movement of the material used in the construction of the cars is constantly in one direction, reducing to the minimum all necessary transportation, the receipt of lumber being at the northwestern end of the works, and the shipment of the cars at the eastern end, as shown.

Following the raw material as it is handled at this factory, we enter, first, the kiln-dry rooms. These are two in number, with concrete floors, and have a total capacity of 60,000 ft. of lumber each. The process of drying and seasoning is



GENERAL VIEW OF THE WORKS OF THE J. W. FOWLER CAR CO. AT ELIZABETPORT, N. J.

aided by a draft of hot air supplied by a Sturtevant blower fan which keeps a continuous current of hot air passing through the rooms. Adjoining the kiln-dry rooms is a lumber shed, with a capacity of 500,000 ft. of kiln-dried lumber, and opening into this is a third building containing, on the ground floor, the mill, and on the second floor, the cabinet shop. Both of these are furnished with a great variety of wood-working machinery, of the latest pattern, necessary for performing the varied work pertaining to the manufacture of street cars.

Continuing in the direction which the material takes, the visitor next enters the body shop, where the different parts, when finished in the mill and cabinet shop, are taken to be fitted together. A spur from the railroad tracks enters into this room through the covered passage-way already mentioned, which is thirty-two feet wide and is lighted by skylights. This enables the company to load the bodies of the cars and the trucks directly onto the platform cars for shipment.

On each side of this passage-way are located the rest of the buildings comprising the factory of the J. W. Fowler Car Company. Each building is two stories in height and entirely distinct from those on each side, though connected by passage-ways on each floor, so that easy access is allowed from one to the other. These different shops include the body room, trimming room, varnish shop, machine shop, brass foundry, engine room, register and stove departments, etc. Particular attention is paid by the J. W. Fowler Car Company to the manufacture of snow sweepers and snow plows. Fig. 2 shows one of the many sweepers built by the company this season for service during the winter on different roads. This one was built for the Atlantic Avenue Railway Company of Brooklyn, N. Y. The cab is short, the motorman standing on the outside. The cabs are furnished with windows at the sides and ends, affording plenty of light and permitting inspection of the street and roadway by the operators. Doors are located at each end of the cab. To permit of easy access to the motors and brooms, one-half of one side of the cab is made detachable. This side can be removed in a short space of time, and can be put in place again just as rapidly.

The revolving brooms, which are of rattan, are thirty-seven inches in diameter and are driven by special motors, so that their speed is entirely independent of the speed of the sweeper. In this way, in case a heavy drift is encountered, the brooms can be operated at full speed, while the sweeper advances slowly. Connection between the broom shaft and motor shafts is made by sprocket chains manufactured by the Link Belt Engineering Company, of Philadelphia. In addition to the revolving brooms, the mould boards of the sweeper are also equipped with rattan brooms to clear the tracks of snow. The motors employed are of the Westinghouse type, but any type of motor can be used.

Every part of the sweeper is made with special care to provide sufficient strength for the necessarily arduous work imposed upon a sweeper, and extra strong knuckle joint brakes form part of the equipment.

The personnel of the J. W. Fowler Car Company is a strong one, and includes the following well-known names: President, John W. Fowler; treasurer, John W. Cooper; secretary, R. C. Swan; superintendent of construction, John Hutton; superintendent of supply department, John England; superintendent of machine department, James Grady. In the sales department of the company is George S. Whipp.

The president of the company, John W. Fowler, whose portrait we present, is well known in the street railway fraternity. The development of a high standard of street car construction is due in large measure to Mr. Fowler, who has always insisted that the products of his works should be of the best, both in material and workmanship.

Mr. Fowler started in the manufacture of street railway appliances in 1877, when the first car register of the firm of Lewis & Fowler, was upon the market. Mr. Fowler was previous to this time, and had been for a number of years, in the mechanical department of the Brooklyn City Railway Company. The success from the start achieved by this register led to an extension of the manufacturing business of the firm with which Mr. Fowler was then connected, to other street railway appliances, and on December 1, 1883, the firm was merged into the Lewis & Fowler Manufacturing Company. Mr. Fowler being elected president of the company. The business of the company was continued at the same place, No. 8 Columbia Heights, Brooklyn, until April, 1886, when owing to the large increase of business, the factory was moved to larger quarters on Walworth street, where Mr. Fowler remained president and manager until November, 1892, when he resigned his position and sold out his interest in the company, having served nine consecutive years as its president. In March, 1893, the J. W. Fowler Car Company was organized. Work was immediately commenced on the Elizabethport factory of the new company, which was put in operation September 6, 1893.

Mr. Fowler was born on Long Island, in 1848, and is now a resident of Brooklyn. He is also the owner of a beautiful country residence at Northport, L. I.

Mr. Fowler is ably assisted in his present work by John W. Cooper, treasurer of the company, and a lifelong friend of Mr. Fowler. Mr. Cooper was born in the City of Brooklyn in 1845. At the age of fourteen years he entered upon his business career, which has so far been a very satisfactory one, both to himself and to his immediate social and business acquaintances.

His first employers were Metcalf & Duncan, ship-brokers, whose office was at 23 South street. A more promising position was offered him by Davis, Morris & Company, drug brokers, then at 87 Wall street, but now (under the firm name of Davis, Wolt & Company) 58 Pine Street. Finally, he became connected with Mr. Thompson in the South American trade, where he engaged his time as chief clerk and confidential man for six years. He was with Mr. Thompson for eight years, the last two of which he had a special interest in the business welfare of this house. About 1870, Mr. Cooper established himself at No. 259 Front Street, but has since removed his office and warerooms, to Nos. 36 and 38 Dover Street.

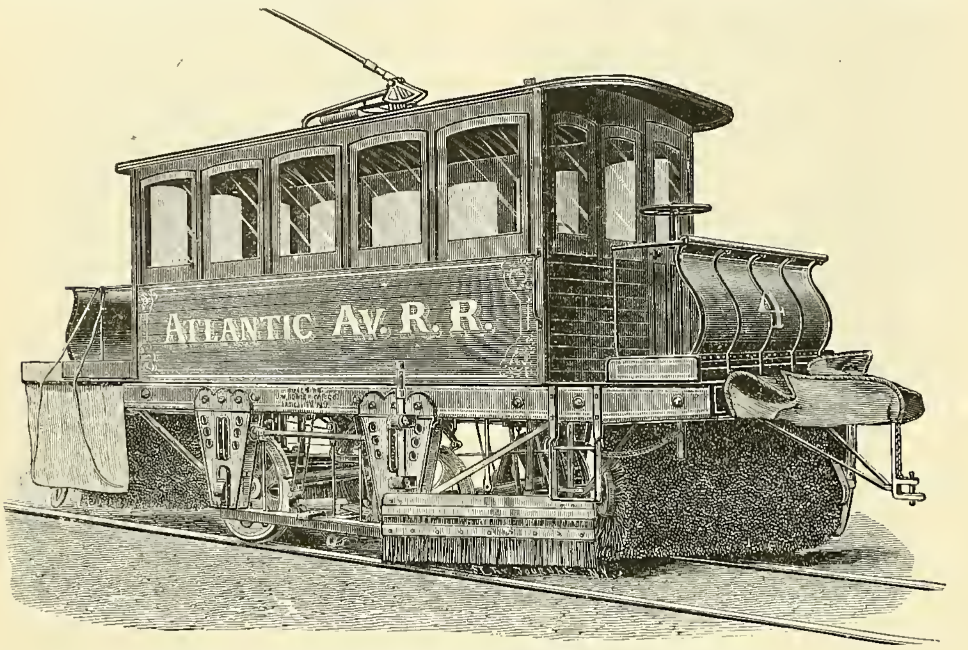


FIG. 2. SNOW SWEEPER BUILT BY THE J. W. FOWLER CAR CO.

A Comparative Report of Massachusetts Railways.

In the annual report of some of the Massachusetts railway companies some interesting facts are brought to light, and none more so than a comparison of the figures of steam and street railways. The reports are made up to June 30. The Boston & Maine, Boston & Albany, New York & New England and Fitchburg railroads carried 91,077,130 passengers. The West End Street Railway carried 145,068,370 passengers, this including free transfers. On the steam railroads 362 fatal injuries are reported and on the West End 20. Of this number 45 of those killed on the steam railroads were passengers, and on the West End, one. Of those killed on the steam roads, about 300 were employes.

On the steam roads 1,470 were injured, and on the West End 310. On the steam railroads one person was killed or injured to every 23,225 miles run. On the West End, one person was killed or injured to every 56,575 miles run. In this connection it should be noted that the cars of the West End railway run upon the thoroughfares.

It is a significant fact that out of 145,068,370 passengers carried by the West End road, but one was killed, and there was but one injured to every 858,392 carried. On the steam railroads there was one fatal injury in every 3,794,840 carried, and one injury in every 427,592 carried. The steam roads ran 18,864,235 passenger miles, and the West End, 18,669,809 passenger miles.

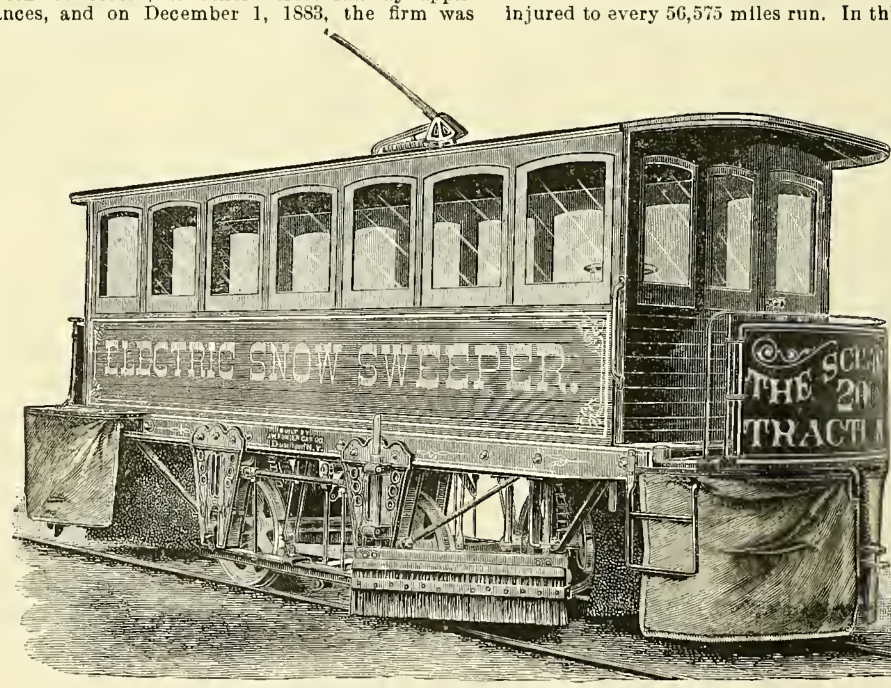


FIG. 3. SNOW SWEEPER BUILT BY THE J. W. FOWLER CAR CO.

The Practicability of Electric Conduit Railways.*

BY ALBERT STETSON.

Two years ago, if an electrical engineer had been asked as to the practicability of an electric conduit railway, he would probably have shrugged his shoulders and expressed great skepticism as to ultimate success. The writer hopes to be able to show that some real progress has been made since then, and that the way out of the difficulty is in sight. Electric traction for street railways has come to stay, and we must choose between the trolley, secondary battery and a conduit construction (either slotted or closed).

Secondary batteries have been used in nearly every large city of the civilized world, to supply the demands for electric traction, but have been given up as too costly. I know there are still people who are willing to spend their money on this *ignis fatuus*, but the number is growing beautifully less year by year. The writer has spent much time in investigating the subject here and abroad, has examined everything in this line that Europe has offered, and he asserts, without fear of successful contradiction, that not one instance can be found in the world where a traction secondary battery has paid an honest dividend. The cars (if supplied with sufficient power) are too heavy for ordinary track construction, the heaviest ballasted steam track being scarcely good enough to insure them a commercial life. The conditions essential to the life of a secondary battery, are large, thick and heavy plates. Such a battery can probably be commercially employed in lighting stations, but those are diametrically opposed to the conditions for a traction battery. In traction, the battery must be small (on account of the limited space at our disposal), and it must be light; for every 150 pounds of lead, carried means the cost of transporting a passenger. To run successfully, we must be able to ascend such grades as exist in railway work, and when sufficient battery power for this is carried, the car becomes unwieldy. A sudden call for power from a small battery may tear it all to pieces, and the "self-contained" car then becomes anything but an "ideal" motive power. When, in 1881, Sir Wm. Thomson carried across the channel, Faure's little box containing 1,200,000 foot-pounds of electrical energy, great hopes were excited, and those million foot-pounds of energy were soon changed into millions of shares, and that changing process has been going on ever since. The average investor did not, of course, know that those large figures represented about the energy of $1\frac{1}{2}$ ounces of coal, and that, if Sir William had brought his pockets full of good cannel coal, the supply of energy in Old England would have been much increased, but investors did believe that there was the "ideal" system for electric traction. The best electrical, chemical, mechanical and engineering skill was employed, improvements were made on the original cell, millions upon millions of dollars were spent, and the results have been financially disastrous. Remember, please, that, to any but the electrical crank, the treasurer's books are the court of last appeal. The experience has been costly, and the shores of Old England are strewn with the wreckage of secondary battery ventures, and the bones of many a victim lie bleaching in the sun. But has nothing been done since then that gives promises of better things? Judged by my standard (the dividends paid) I answer, "No!" and to one who understands the principles involved in a successful traction battery, there seems to be nothing in sight to bid us hope for a successful solution of the difficulty from this direction. Should future metallurgists make us acquainted with some new metals, or should a cheap supply of palladium become available, the problem may be changed. But the writer believes the experiments of the E. P. S. company in England, and those of the Julien company in this country exhausted the possibilities under commercial conditions, and that we have seen no better battery than theirs. It is often said that the patent complications stopped the secondary battery experiments in this country (they did not in Europe), but I am unable to understand how. The Brush company has the patent rights, and the Julien company, or its successors, the exclusive license, and I have not heard of any extraordinary exertions on the part of the Brush company to reduce their surplus by secondary battery experiments—and I do know that the cars used in the Julien company's Fourth Avenue trials are for sale at "genuine bargain" prices. I admit that I may be mistaken, but universal experience is a pretty safe guide, and anyone trying to work out a system of accumulator traction has my sympathy, and my prayers that he may early see the error of his way and return to the fold before the last fatted calf has been killed and eaten!

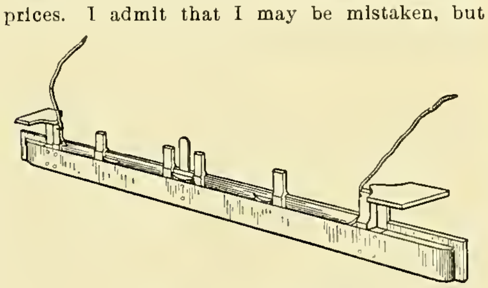


FIG. I. CONDUIT SHOE.

[Mr. Stetson then discussed at considerable length some of the various types of conduits that have been used when in experimental work or in actual service, condemning these in nearly every instance and describes in the following manner his own conduit—EDS.].

A conduit is used, similar to that of cable roads, but nothing like so large or expensive. With our improved shoe, a conduit two or three inches wide and seven inches deep will answer perfectly. In the slot of the conduit, attached to the cars, runs a shoe extending nearly the entire length of the car.

Fig. I shows the shoe detached from the car; the upwardly projecting pieces are the guides for making the shoe follow the conduit and conform to the curves.

The shoe is so supported that should the car leave the track it detaches itself immediately and remains on the top of the conduit. It cannot be caught, as the cable grip sometimes does, and drag the car along through crowded streets at a dangerous speed. As seen in the illustration, the shoe is somewhat like a cigar in shape, so as not to give any sharp blow to the contact arms. The sides of the shoe are formed of conducting material, insulated from each other, and perfectly flexible so as to follow any curves. The shoe can be attached to and detached from a car in five to ten seconds.

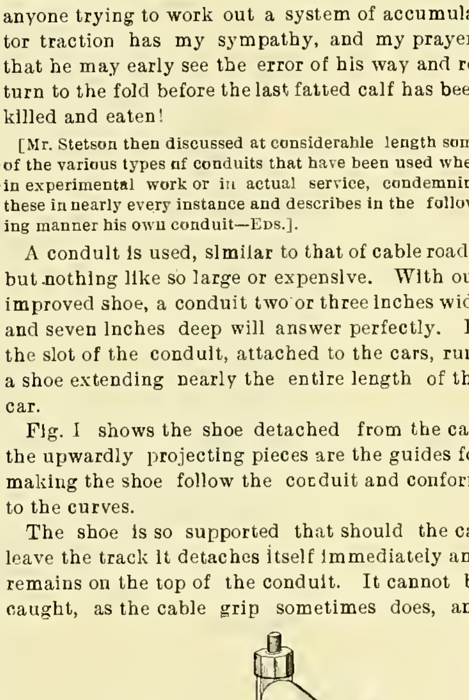


FIG. 2. BOX CLOSED.

In the conduit are placed two insulated cables, a metallic return being used. This I regard as necessary to ensure perfectly safe working. These cables run into and through contact boxes placed at intervals of ten feet on each side, they being arranged diagonally opposite, so that the distance between the boxes is about five feet. The construction of the boxes and the functions of their various parts will be really understood from the illustrations. One shows the box closed and the cable running into the box, the other the box opened and the method of securing contact with the cable (see Figs. 2 and 3).

The main is carried into the box and, as can be seen, the lead and insulation removed for about two inches. Onto this bared cable there is placed a brass clamp with two upwardly projecting tongues.

The contact-making portion of the device is a vertical rod, having at its upper end an arm projecting into the conduit, and at its lower end a brush adapted to be brought into contact with the tongues attached to the cable. This rod and its bearings must, of course, be properly insulated from the contact box. When no car is passing, the brush is out of all electrical connection with the current conductor, but when the shoe on the car reaches the arm projecting into the conduit, it swings it to one side, bringing the brush on the rod into contact with the tongues fastened to the conductor, and the current passes to the motor on the car. As soon as the shoe on the car has passed the box, a torsion spring forces the rod back into its normal position, and that box is dead. The box is filled as far as it can be without interfering with the movement of the brush with solid paraffine, and above that with "transil oil." This makes excellent insulation. Of course the spindle at times becomes "alive," and its bearings are thoroughly insulated from all parts of the box and cable. Nothing can be better than an insulated cable, covered throughout its entire length with a highly resisting material, and at the points where current is supplied to the car an insulation practically infinite.

No accident to persons or animals appears possible with this system. To avoid sparking within the box, the ends of the shoe are made of insulating material, thereby establishing mechanical contact within the box before the metallic portion comes into contact with the arm, and also holding the inside contact after the current ceases to flow to the motor. This is an important feature, for without such an arrangement the brushes would soon burn out, the oil become carbonized and the boxes useless.

Thus far I have described the box that we used at the Island, but it has long since been consigned to the usual receptacle for the rejected productions of progressive inventors. It did its work and did it well, it pointed the way to better things, and we have several forms of box, entirely obviating the defects in the first. The number of working parts has been reduced, and we now have the device brought down to its lowest terms. I regret that it is not possible for me to show these improvements, but patents have not been obtained on some, and on others not yet applied for.

As a guide for future investigators, I will enumerate the best features and the defects of the old box as I understand them. 1st. Its insulation was excellent, that is, the theory of its insulation was. But oil insulation is in many cases a fraud, a deception and a snare. The best oil insulation is not so good as that of air containing 80% of moisture. Oil and water, perhaps, won't mix, but oil will attract moisture, and the two will make an emulsion that will cause the investigator much sorrow and mental anguish. Ordinary paraffin oil, even the highest grades obtainable, contains a great deal of water, which, in a device like this, will cause disastrous short-circuiting. Transil oil seems the best for the purpose. At Coney Island, before we adopted transil oil, our boxes would go wrong, in spite of all we could do, and we only discovered the trouble by putting some of our oil in a bottle to settle over night, and in the morning found an abundance of water in the bottom. Solid paraffin is the only substance that we found capable of withstanding

*Abstract of a paper read before the American Institute of Electrical Engineers.

the action of paraffin oil, and it must be the refined variety, such as is sold in hard, white cakes. Its use even was discarded, for when the water would work down the spindle through our imperfect stuffing box, the solid layer formed a bed for the moisture to rest upon, and being close to our brush, it short-circuited the box. It is better to let the moisture settle to the bottom of the box, out of harm's way. I don't think oil should be used on account of its insulating properties, but for keeping the working parts from rusting. 2d. Our old box was made in severa parts (a mistake, remedied in our new one-piece box), the joints required planing, an expensive operation. Paraffin oil is difficult stuff to hold, going through almost everything. In the joints we used oil paper, screwed them together as tightly as possible, but the oil softened the paper and the boxes leaked. This we remedied by painting the joints with "Insullac," which withstood the oil excellently. 3d. Our stuffing box was a crude device, and did not, in many cases, keep out the water; but this is a simple mechanical affair remedied in our new boxes. 4th. A torsion spring is not so good as a straight one, nor so reliable in its action. 5th. We had a short brush in our box, when a long one should be used. Flexibility and sure contact are thereby secured. 6th. It was a mistake to have the two upwardly projecting tongues; one contact is the thing, and the brush always resting against it when the shoe touches the arm. Otherwise there will be a break

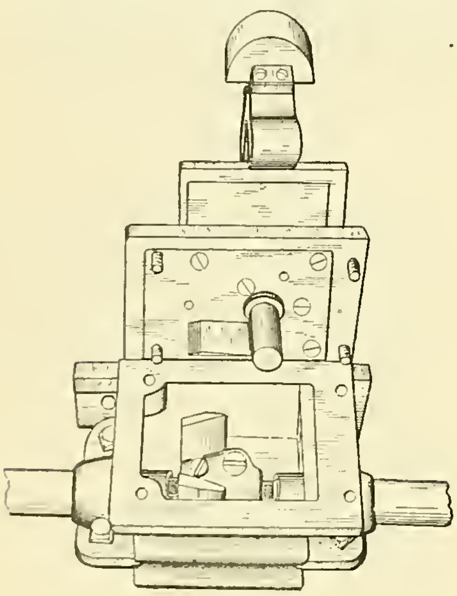


FIG. 3. BOX OPEN.

on reversing and consequent "frilling" of the brushes, with carbonization of the oil. 7th. To make an oil-tight joint between the cable and the box was almost an impossibility. We taped the cable where it entered the box, but when it was tightened up there was often contact between the lead covering and the box. 8th. The box is too large. 9th. Great care must be used in selecting and laying the cable. A slight defect gives leakage; this decomposes the alkaline earths; chlorine and caustic soda are perhaps produced, and the cable eaten away. Every joint must be carefully made and carefully sealed. Some one may say that it is impossible, but I answer it is the duty of the supervising engineer to see that it is properly done. If anyone thinks this cannot be done, he is not my ideal engineer, and certainly does not want to meddle with electric conduit railways. These are the defects, but we have cured them all in our new system. The excellent principle of the old box has remained untouched by long experiment, the laterally yielding arm being the only form likely to answer the purpose.

The question has often been raised as to whether snow and ice would clog up the conduit and stop the car. The experience with the Cleveland Bentley Knight road shows that snow did not stop a road with a bare conductor in the conduit, and it certainly could not affect ours. You must drain the conduit, and during such weather as the conduit might get, if left to itself, frozen up, it may be necessary to run a car over the track at intervals all night. But this would only be required once, say, in a winter.

I believe that our road has solved the question of conduit traction. I have not meant in my review of other systems to be in the least unjust to other workers in the same field. I only take my stand on other well-established principles, keep strictly to the laws of nature and electricity, take our climate as it is and our streets as we find them, and I assert, without fear of successful contradiction, that any road to succeed must be laid down practically on these lines.

To sum up, then, the objects of such a system are: To remove from the streets of our cities and large towns the unsightly structure that the trolley construction demands; to dispel all chance of injury to persons and animals; to present no such lightning conductor as the trolley line forms; to offer no obstacle to the work of the firemen, in case of a conflagration; to remove all risk of fires being set by the electric current, as frequently takes place with the trolley; to avoid corroding action on water and gas pipes, and the iron foundations of buildings. Finally, to furnish all the advantages of electric traction, without any of the present attendant evils.

The main advantages of such a system are evident, but there are others. The car runs backwards as well as forwards, and is handled as nicely and easily as a locomotive. There is no trolley wheel to slip off the wire, depriving the motorman of his power at the very time he needs it most to prevent accidents.

I have endeavored to present our system to you as it is. I have not in any manner exaggerated its advantages, nor do I speak as one who is led to be enthusiastic over something that is new. I am too experienced in such matters and have seen too many new things spring into momentary notoriety, only to sink into oblivion. I believe in the practicability of the electric conduit, and believe that you can profitably devote your attention to the forwarding of that method of electric traction.

Indianapolis.—An attempt to wreck a car on the Irvington line was made Tuesday night. A heavy wire was stretched across the tracks, the ends being fastened to a telegraph pole and one of the center poles. The car struck the wire and was stopped. Fortunately the car was of the vestibuled type and the motorman was not injured.

AN ALUMINIUM STATIONARY FARE REGISTER.

The accompanying illustration shows a new type of fare register for street-cars placed on the market by the International Register Company of 300 Dearborn Street, Chicago. In designing this register the aim has been to produce a simple, durable, and accurate piece of apparatus and one which at the same time was artistic in design.

The machine is a double register, with a round, clock face, the design having a tally, or permanent register, with a capacity of one hundred thousand fares, and a trip, or changeable register, with a capacity of one hundred fares and capable of being cancelled and returned to zero. The permanent register is composed of a series of five wheels, or dials, arranged in a horizontal row across the face, just below the center. The figures on this dial are easily distinguished at a distance. The cards used are entirely machine cut and no springs, or pawls, whatever, are employed. It is impossible to change the reading of the dial in either direction even though the tally dials are exposed.

The trip register comprises a pointer and a main dial the latter being divided into one hundred equal spaces around its outer edge, the

AN ALUMINIUM FARE REGISTER.

pointer moving one space for every fare recorded. At the end of the trip this pointer is returned to zero by pushing in the handle on the right hand side and turning it to the right until it locks. The pointer cannot be returned to zero without changing the direction of the sign, nor can the sign be changed without turning the pointer back to zero. When the pointer is standing at zero the sign can be changed at will, but this operation will always lock the register mechanism.

In the construction of all dials, or places upon which figures are shown, the company has adopted the use of pure aluminium, the satin-finished surface of which presents a very handsome appearance. The advantage claimed for this material is that it always retains its finish and lustre, giving the register a new appearance at all times. Should dust settle on the dials it can be removed with a little soap and water without destroying either the finish or the figures.

Hamilton, Ont.—The Hamilton, Grimsby & Beamsville Electric Railway Company has let the contract for building eleven trolley cars to Ahearn and Soper, of Ottawa, and for fifty tons of copper wire to the Eugene F. Phillips Electrial works, Montreal.

FINANCIAL DEPARTMENT.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn Street this city, said yesterday: "The market in cable stocks has been active within narrow limits, this week, with the principal trading in West Chicago. North Chicago is steadily absorbed by investors, and gives all appearances of having very little stock on the market. West Chicago has been subject to bear raids, but there have been no signs of liquidation by long holders. We think that prices in these stocks will soon advance, as improvement is beginning to show itself in the general commercial world. Elevated stocks have been weak, but active. The demand for street railway bonds continues good for all issues. The traction stocks opened strong without material change from yesterday closing quotations. Met was inclined to be a little more active to-day the first sales were at 100½, odd lots sold at 101, and at 1 P. M. the quotations are 100 ⅞ sales and bid.

Chicago, Ill.—The Chicago Suburban Rapid Transit Company has filed articles of incorporation. The capital stock is to be $500,000, and the main office is to be in Chicago. The route to be followed is described to be "from some point in the city of Chicago to such points in the towns of Wayne and Winfield, in DuPage county, as may hereafter be determined, and from some point in Chicago to such points in the town of Maine, in the county of Cook, as may be determined." The largest settlement in the town of Maine is the village of Des Plaines. Wayne and Winfield are just south of the line separating DuPage and Cook counties. The incorporators named are William E. Gehring, Albert D. Baldwin, Charles H. Jackson, L. E. Sauter and Edward G. Henkel, all of Chicago, and they constitute the board of directors for the first year. They are only nominally interested in the enterprise. The real backers are said to be Chicago men of capital.

Pennsylvania Steel Co.—Alfred Earnshaw, Chairman of the Special Conference Committee appointed to devise a means to adjust the financial troubles of the Pennsylvania and Maryland Steel Companies, has addressed the following letter to the stockholders: "At the meeting of creditors of the Pennsylvania Steel Company and Maryland Steel Company, held November 29, there was general hope expressed that the Committee of Conference (with Stockholders' Committee) to be appointed by the Chairman, would be enabled to make an early report to the creditors at a meeting to be called for that purpose. This committee have met, in conference, a very cordial reception from the Stockholders' Committee, but regret to find that it will be impossible for them to make any definite report to their fellow-creditors before some time in February at the earliest, as some of the figures which it is necessary the committee should have before them, cannot be sooner obtained."

The Berlin Iron Bridge Company, of East Berlin, Conn., is putting the roof on a building for the United States Government, at Fort Wadsworth, N. Y. The building is 41 feet wide and 231 feet long, the roof being made entirely of iron—iron trusses covered with corrugated iron.

More Capital Needed.—The Boston News Bureau says: "It is estimated that the West End Street Railway Company requires about $2,000,000 more capital to complete its electric equipment."

Offer of Settlement Withdrawn.—The receiver for the Ansonia Electric Company has withdrawn his former offer of settlement with the creditors and expects to make another and less liberal cash offer in a short time.

Pittsburg Dividend.—At the annual meeting of the Second Avenue Traction Co. last week a semi-annual of 2 per cent. was declared.

Oakland, Cal.—Receiver Ira Bishop of the Consolidated Piedmont Cable Company has been empowered to issue $15,000 certificates.

NEWS OF THE WEEK.

General Electric Removal to Schenectady.—The Boston *Globe* has the following regarding the removal of the General Electric force to Schenectady: It is settled beyond doubt, that technical director E Wilbur Rice Jr., will go to Schenectady, and private secretary John T. Broderick with him. Prof. Elihu Thomson will not go unless he so wishes. He is not the servant of the company to the extent that he is obliged to remain at one or the other of its plants. He has an elegant home in Swampscott and is understood to prefer residence there. The engineering department will go to Schenectady, and engineers Walter H. Knight, H. G. Reist, Frederick Fish, F. O. Blackwell and James B. Cahoon and their corps of assistants are preparing to leave Lynn. To-day a number of subordinate officials, clerks and stenographers were notified that their services would not be needed after February 1. It is not definitely known whether the drafting department will be removed. The departments of manufacture which will remain at the Lynn plant are the arc lamp, meter, instrument, alternating current dynamo and small stationary motor departments. These will be confined to factory C, and the other buildings of the plant locked up. The machines and tools in them, of which there are duplicate sets at the Schenectady works, will be allowed to remain, constituting a reserve or emergency plant. About 600 hands will have employment in the factory C. The river works will be left undisturbed to furnish castings for both the Schenectady and Lynn plants. These statements all come from well-informed persons at the works.

Johnstown, Pa.—President A. J. Moxham, of the Johnson Company's steel rail manufacturing plant, is quoted as saying that a committee is now traveling over the country investigating the advantages of the various steel centers. He said that this meant that the new steel rail mill contemplated by the company might not be located in Johnstown, and further, that the rolling mills here might go wherever the new plant goes. For the present, he said, the switch works and foundries would remain in Johnstown. The hope of the management, he said, was that Johnstown would be the favored point. The plant projected, but which has not been formally decided upon, is a ten-ton converter and automatic rail mill in connection with the one now in use. It is also intended to increase the capacity of the present shape mill by adding an engine to the finishing mill, which will enable the company to roll rails from 90 to 100, instead of 60 feet in length as now. A further additional mill is contemplated, but not yet definitely decided upon. The money involved in the contemplated change is about $3,000,000. The annual meeting of the stockholders is to be held February 19, when a vote will be taken on a proposition to increase the indebtedness of the company from nothing to $2,000,000.

Philadelphia, Pa.—The People's Traction Company has awarded the contract for 250 new trolley cars for Fourth and Eighth streets, Girard and Germantown avenues, to the St. Louis Car Company. The Lamokin Car Company was also awarded the contract for 40 summer cars. The J. G. Brill Company, and the Peckham Motor, Truck and Wheel Company, will furnish the trucks. The cars will be 20 feet long inside, and will be finished in the best style. The Electric Traction Company has also contracted for cars and motors for the Tenth and Eleventh street line. The Pullman Company, will build forty closed cars for this road. They will be 18 feet long inside and will be mounted on the McGuire Columbian truck. The summer cars for this line have not yet been contracted for. The General Electric Company and the Curtis Manufacturing Company, of Jersey City, received the contract for the motors for these cars. The General Electrict Company will supply 30 "G. E 800" equipments. Ten sets of the Curtis motors, each motor of 30 horse-power, will be furnished by the Curtis Manufacturing Company.

Jackson, O.—The city council has granted a franchise to the recently organized Wellston Street & Belt Railway Company. It has a capital of one million, and the line will run between McArthur Junction and Jackson with branches, in all about forty miles, using both steam and electricity. The directors are Harvey Wells, J. C. Clutts and H. S. Willard of Wellston, and C. L. Currier and Isaac E. Adams of Chicago.

Chicago, Ill.—President Hopkins, of the South Side Rapid Transit Company, has made a statement to the effect that the company will not build a branch line to Englewood unless the residents of that suburb furnish a right of way for such an extension.

Savannah, Ga.—The reserve power-house and machinery and car sheds of the Savannah Street Railway Co. were burned January 17. The loss is estimated at $50,000, partially covered by insurance. The fire is supposed to be the work of an incendiary.

Kansas City, Mo.—The mail carriers are circulating a petition memorializing the council to insert in all future franchises for street railways a provision that mail carriers in uniform shall be permitted to ride free.

Albany, Ore.—The station of the Albany Street Railway Company was burned last week. The loss was $8,000, and the insurance, $2,500.

St. Joseph, Mich.—There has been some talk of an electric railway from St. Joseph to South Bend.

Shamokin, Pa.—At the annual meeting of the Shamokin Street Railway Company last week a dividend of 4 per cent. payable January 20 was declared.

PERSONALS.

Dr. Louis Bell read a paper before the American Institute of Electrical Engineers, Wednesday of this week, on the "Practical Properties of Polyphase Apparatus."

A. K. Stone, superintendent of the Omaha & Council Bluffs Motor Company, has resigned his position.

TRADE NOTES.

A Test of Stokers.—Messrs. Fraser & Chalmers of this city, who have had two of the Jones underfeed mechanical stokers in operation at one of their plants for the past six months, recently secured the services of the Robert W. Hunt Co. Consulting Engineers, to make comparative evaporation tests, showing the actual results that were being obtained in their several plants. In one of the plants oil was used for fuel. In the other two coal was used, in one instance being fired by hand and the other by the Jones stoker. The results as reported by the Robert W. Hunt Co., showed a saving in fuel of 20.7 per cent. in favor of the furnace fired by the Jones stoker, over the hand fired furnace and 35.1 per cent. over the furnaces in which oil was used for fuel. As a result of this test Fraser & Chalmers have given the manufacturers of the Jones stoker an order to equip their entire plant with stokers.

Recent Sales.—J. Holt Gates, western manager of the Waddell-Entz Company, reports the sale of 125 H. P. direct connected railway generator and Ideal engine to the South Chicago City Railway Company; three direct connected generators and three McEwen engines to the West Chicago Street Railway Company; one 1,200 light machine direct connected with Erie Ball engine, to Willoughby, Hill & Co.; one 1,000 light direct connected machine, with Cooper engine, to the Hartford Safety Deposit building; two 600 light direct connected generators with Ball & Wood engines to the Faribault (Minn.) school for feeble minded; a 1,000 light and a 600 light machine, direct connected with Ideal engines, to the Kent apartment building. The Waddell-Entz Company makes a specialty of direct connected machines, both for railway and lighting purposes. The company is now preparing to build direct connected railway machines in sizes from 15 K. W. at 350 revolutions to 1,500 K. W. at 70 revolutions.

The Graham Equipment Company has been incorporated in Rhode Island with a capital stock of $100,000 paid up. The officers are J. H. Graham, president; G. S. A. Gardiner, vice-president and treasurer; E. G. Rodgers, secretary. Offices are at 258 Washington street and 232 Carter street, Philadelphia, Pa. Works have been established in Boston and Philadelphia and it is claimed that orders are already booked that will pay 10 per cent. on the capital stock. Last week an order for two hundred trucks was secured from one concern alone which is equipping four street lines.

Geo. H. Carter & Co., of Chicago, have secured the contract for supplying the wire and cables to be used in the Champlain building of this city. The wire to be used is special Habirshaw. The contract calls for 100,000 feet No. 14 besides a large amount of cable. This concern reports some large sales of the Anchor incandescent lamp for which it is general agent and also reports numerous inquiries for storage batteries for traction work

A. Groetzinger & Sons, of Allegheny, Pa., are sending to their friends and customers a neat paper-weight calling attention to their "Dermaglutine" gears, pinions, etc., which the company says is "the best material for electric motor gears and for mechanical purposes generally."

Some Good Orders.—The Electric Traction Company of Philadelphia, of which J. Sullivan is president, has placed an order for forty McGuire Columbian trucks, and the Hamilton, Grimsby & Beamssville road at Hamilton, Ont., has ordered eighteen McGuire trucks for service on its road.

Geo. W. Connover formerly with the Ansonia Electric Company has been appointed manager for the Perkins Electric Switch Manufacturing Company of Hartford, Conn. The company will carry a complete stock in Chicago. Its office is 1536 Monadnock block.

An Iron Factory.—The new works of the Stanley Electric Manufacturing Company, at Pittsfield, Mass., will be entirely of iron, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued January 2, 1894.

511,763. Trolley. William F. Duncker, Steelton, Pa. Filed Aug., 26, 1893.

This is an iron cleaning attachment for trolleys comprising a main frame and support having the upper and lower section hinged at their rear faces, the upper section being provided with arms, a spring for holding a section of the main frame in position on oscillating frame journal between the arms, and rollers carried by the oscillating frame journal.

511,784. Railway Frog. Walter C. Meeker, Jersey City, N. J. Assignor to the Lewis & Fowler Girder Rail Company, Brooklyn N. Y. Filed Nov. 27, 1891.

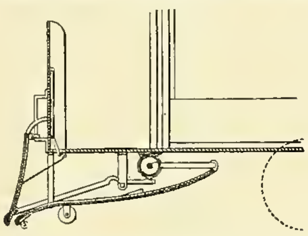
The rails of this frog are halved together, the web of one being cut and bent instead of being only cut away so as to bear against the outside of the other rail, and secured thereto. (See illustration).

511,791. Ammeter and Voltmeter. John Perry and Charles E. Holland, London, England. Filed April 6, 1893.

This comprises a combination with a magnifying spring, or lever, a soft iron core and the coil of a regulating spring, or bell crank lever connected to the spring, and an adjusting screw connected to the lever.

511,793. Truck. George Phillon, Mishawaka, Ind. Filed Aug. 6, 1892.

This is a balanced truck consisting of a frame, or platform, having front and rear rollers and main central wide rollers of larger diameter than the first mentioned rollers,



512,181. SAFETY GUARD FOR RAILWAY CARS.

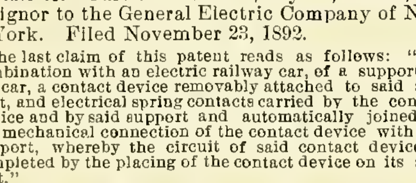
and axle boxes for said rollers having ribs fitted into the body of the said frame, or platform, whereby in turning the truck under a heavy load the displacement of said bearings by horizontal pressure is prevented.

511,824. Trolley Mechanism for Electrically Propelled Vehicles. Curtis H. Veeder, Lynn., Mass., assignor to the General Electric Company of New York. Filed November 23, 1892.

The last claim of this patent reads as follows: "The combination with an electric railway car, of a support on the car, a contact device removably attached to said support, and electrical spring contacts carried by the contact device and by said support and automatically joined by the mechanical connection of the contact device with the support, whereby the circuit of said contact device is completed by the placing of the contact device on its support."

511,831. Street Railway Special Work. William C. Wood, Brooklyn, N. Y., assignor to the Lewis & Fowler Girder Rail Company, same place. Filed April 8, 1893.

In a frog. or other piece of street railway special work, constructed mainly of box girder rail, the combination of a rail continuous at the top excepting a shallow intersec-



511,784. RAILWAY FROG.

tion notch, or notches, an adjoining rail, connected with the first named rail at the intersection, a wedge, or wedges, interposed between the rails within the crotch, and horizontal bolts uniting the wedge and rails.

511,853. Trolley Wire Support. Charles T. Lee, Boston, Mass., assignor to the Johns-Pratt Company, Hartford, Conn. Filed April 15, 1893.

This is an ear for electric conductors provided with one or more metallic strips temporarily secured by solder to the ear and of sufficient length to be bent around the conductor to hold it to the ear while it is being permanently secured to it.

511,862. Electric Locomotive for Elevated Tracks. Charles H. Roberts, Hartwell, Ohio. Filed October 29, 1891.

This is a combination of a suspended track beam, provided with upper and lower track rails with upper tracks whose wheels engage the upper rails, and lower tracks suspended from the upper tracks by longitudinally yielding hanger rods.

511,889. Electric Switch. Jesse L. Hinds, Syracuse, N. Y., assignor of one-half to the Electric Engineering and Supply Company, same place. Filed May 6, 1892.

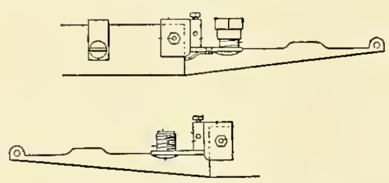
The first claim of this patent reads as follows: "In combination a base plate, a terminal support fixed to the base plate and having a bearing opening and arms extending outwardly from the walls of said opening, a terminal mounted in the bearing opening, a clamp for drawing the arms together and securing the terminal to its support, and an electric wire secured to said terminal, substantially as described."

511,915. Electrical Transmission of Power. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Original application filed May 5, 1888.

This is a method of operating electro-magnetic motors having independent energizing circuits which consists in passing an alternating current through one of the energizing circuits and inducing by such current a current in the other circuit of the motor.

511,916. Electric Generator. Nikola Tesla, New York, N. Y. Filed August 19, 1893.

This is a method of producing electric currents of constant period, which consists in imparting the oscillations



511,928. SECTION INSULATOR.

of an engine to the moving elements in an electric generator and regulating the period of mechanical oscillation by the adjustment of the reaction to the generator.

511,928. Section Insulator. Henry M. Brockbank, Brooklyn, N. Y. Filed August 21, 1893.

The first claim of this patent reads as follows:

"The combination in a section insulator of conducting members, an insulating member separating said conducting members and a conductor from each conducting member extending along a surface of said insulating member, substantially as set forth." (See illustration).

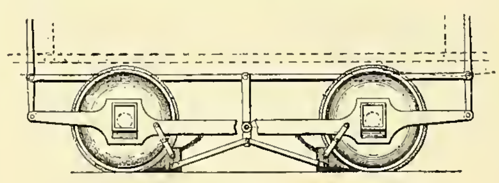
511,941. Trolley Catcher. George E. Gay and John H. Parsons, Augusta, Me. Filed February 28, 1893.

The single claim of this patent reads as follows:

"In a trolley rope reel, the combination of a fixed shaft, a disk or arm having one or more projections on its side and rigidly attached to said shaft, the reel winding springs, a spring connecting sleeve, a casing or drum adapted to revolve on said shaft, a dog adapted to engage with said projections on the disk or arm when thrown outward by rapid turning of the wheel in connection with a trolley rope, or cord."

511,961. Heating and Ventilating Apparatus for Street Railway Cars. Joseph A. Long, Brooklyn, N. Y. Assignor to Aaron H. Eastmond, same place. Filed September 29, 1893.

This is a combination, in a street car heater, of a casing adapted to be placed beneath the seat and having lining of asbestos, or similar material, and air pipes extending laterally beneath the car seat, a frame having an opening and

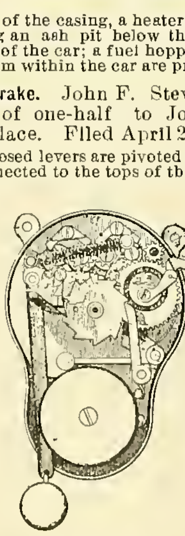


511,973. CAR BRAKE.

forming the base of the casing, a heater supported by the frame and having an ash pit below the heater accessible from the outside of the car; a fuel hopper and door which are accessible from within the car are provided.

511,973. Car Brake. John F. Stevens, Ottumwa, Ia., assignor of one-half to John Philip Ullrich, same place. Filed April 21, 1893.

Vertically disposed levers are pivoted to the truck frame and rods are connected to the tops of these levers extend-



512,057. FARE REGISTER.

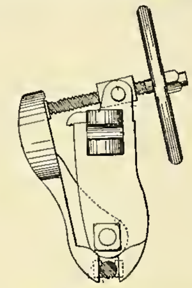
ing to the ends of the car. Hand levers are provided to which the rods are connected. The brake shoes have both track and wheel faces and these are suitably connected by links with the rods and levers. (See illustration).

511,988 Electric Locomotive. Edward M. Bentley, Boston, Mass. Filed October 24, 1881.

A motor is supported at both ends upon the truck frame and thus connected with the axle through gearing upon the hollow sleeve surrounding the axle and the flexible coupling, or casing, inclosing such gearing and having an aperture as large as the plate of the axle in the sleeve requires. A cover, is placed, upon the axle to close the aperture.

512,057. Fare Register. Charles E. Pratt, Chicago, Ill., assignor to the International Register Company, same place. Filed January 5, 1893.

The first claim of this patent reads as follows: "In a register, a direction indicator consisting of a rotatable



512,112. CABLE GRIP.

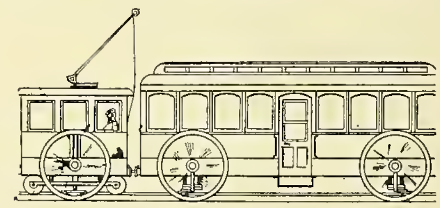
part with an eccentric groove therein, an indicator pivoted at one point and provided with a finger to extend into the eccentric groove at another point so that by the motion of the rotating part the indicator is moved as the finger travels to or from the center of rotation."

512,112. Cable Grip. Alfred N. Humphreys, Irwin, Pa. Filed October 31, 1892.

This is a grip comprising a frame terminating in a jaw, an arm pivoted to the frame and terminating in a jaw which is opposite the frame jaw, a screw carried by the frame and engaging the arm, and a coupling bar secured to the frame and provided with coupling beads. (See illustration.

512,174. Roadway and Vehicle Therefor. Elmer O. Evans, Boston, Mass. Filed March 31, 1893.

This is a roadway having a level surface of unlimited width for the carrying wheels of a vehicle to travel on without side guide-rails, and a single central rail, in combination with a vehicle having wheels traveling on the



512,174. ROADWAY AND VEHICLE THEREFOR.

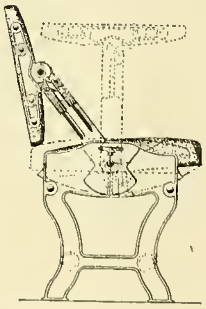
level surface of the roadway and carried by an axle which is pivoted to the vehicle frame, and horizontally supported driving-wheels carried by the said axle and at one side thereof and engaging opposite sides of the said central rail. (See illustration).

512,181. Safety Guard for Railway Cars. William J. Foster, Hoboken, N. J. Filed October 20, 1893.

This is a combination with a fender mounted at the end of a car to move up and down; of a cradle arranged to move forward along the track in the path extending above the plane normally occupied by the movable fender, and means for actuating the cradle. (See illustration.)

512,201. Overhead Trolley Wire Switch. George W. Mackenzie, Moses B. Sloan and Thomas C. Sloan, Beaver, Pa., Filed December 30, 1892.

This is a switch for overhead wires comprising two arch pieces connecting the separated ends of the main wire and



512,240. CAR SEAT.

branch wires, and bridge pieces pivoted at the ends of the branch wires and arranged to connect both branches with the main wire.

512,240. Car Seat. Moritz Weber, St. Louis, Mo., assignor of one-half to George J. Kobusch, same place. Filed March 27, 1893.

This is a car seat comprising a pivoted arm constructed with an outer longitudinal piece and an inner longitudinal piece secured together; the outer piece being formed with a short slot, and the inner piece being longitudinally grooved, and the locking bar, adapted to slide in the groove, having a pin traveling in the short slot. (See illustration.)

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CONTENTS.

Experiments for Motormen. In Mr. Perry's series of articles, the fourth of which we publish this week, some very interesting experiments are described for studying the construction and operation of electric motors. In the article found elsewhere in this issue Mr. Perry describes the material needed for carrying on these experiments. Very little material is needed and none is required which is expensive. The experiments are simple and may be easily made by anyone who will give careful attention to the directions for constructing the experimental apparatus and for conducting the work. Mr. Perry has taken care to perform all the experiments himself, with apparatus which he has constructed with his own hands, so that very little trouble need be anticipated. This method of study will be continued by Mr. Perry whenever it is found advantageous, and we feel sure that any motormen, or set of men, who will undertake the work, will feel amply repaid for their trouble.

Progressive Philadelphia. At no point in the country has there been, during the past few months, greater activity in electric railway building than in the city of Philadelphia. Many miles of new line have been constructed and many of the former horse car lines have changed their equipment to electricity. Some very large orders have recently been placed by the Electric Traction Company and the People's Traction Company, both for cars and trucks and for their electrical equipment. It is interesting to notice that one-half of the total equipment of two hundred and fifty cars for the People's Traction Company is to be fitted with a type of motor that requires but one for each car and that one connected to both the car axles.

Fifty Thousand Dollar Prize. The amount of interest that a $50,000 prize can excite is something remarkable. Since the Metropolitan Traction Company of New York announced its willingness to donate this splendid sum to the discoverer of a system of street railway propulsion that would be as satisfactory in operation as the trolley, but embodying no characteristic features objectionable to the public, there has been great activity among inventors and promoters. It might be thought that the numbers of persons who would care to grapple with surface street railroad problems would be small, but such a view would be decidedly erroneous. It is stated that already over fifteen hundred persons have made application to enter the contest. Certainly something valuable both to the companies and to the public should result from such extraordinary competition, although we do not expect to see the immediate development of a system that will tend in any way to impair the usefulness of the overhead trolley. We shall expect to see trolley lines extending for some little time.

Intelligent Motormen. We have more than once called attention to the fact that the more intelligent the motorman in charge of a car the less liability there was of accident. In consequence of this opinion, which we have long held, we have secured a series of articles, which we are now publishing, from Mr. Nelson W. Perry, to give the motormen a chance of improving their knowledge of the construction and working of the machines entrusted to their care and to give them a more definite idea of the methods employed in their management. Our opinion in this respect is very strongly endorsed by Mr. John Scullin, president of the Union Depot Street Railway Company, of St. Louis. In a recently published interview on the speed of cars operated on his line, published elsewhere in our issue this week, Mr. Scullin is reported as saying that "life and property depend on the motormen and naturally it is cheaper for us to have the best class of employes than to give work to reckless and incompetent men." We believe that street railway managers will be doing themselves a great favor if they will bring Mr. Perry's series of articles to the attention of their motormen and give them facilities for reading and discussing them from week to week.

The Lamp Situation. The condition of the incandescent lamp business in this country, at the present time, seems to be decidedly confusing. A decision was rendered last week by Judge Ricks, in the case of the General Electric Company against the Buckeye Company, dissolving the temporary injunction that had been obtained to prevent the Buckeye Company from manufacturing lamps that were claimed to infringe the fundamental and now famous Edison filament patent. It is reported that the injunction was dissolved because of the opinion of the court that the Edison patent had expired on Nov. 10, 1893, simultaneously with the expiration of the English patent for the same invention. If this opinion of the court is sustained in future decisions it will be seen that, so far as the infringement of the Edison patent is concerned, incandescent lamp companies are now at liberty to manufacture, without danger of interference. The General Electric Company has announced, through its counsel, F. P. Fish, that the case will be appealed from Judge Ricks' decision. Mr. Fish refers to the fact that Judge Shipman decided recently that the English patent had nothing whatever to do with the term of the American patent. The Edison people have obtained decisions in their favor in similar suits in New York City, Boston, Chicago, and Milwaukee, while adverse decisions have been handed down in the suit brought against the Columbia company in St. Louis and in the present case against the Buckeye company, at Cleveland. A number of these cases have been appealed and are now awaiting the decision of the higher courts. In the meantime the price of the lamps has been reduced so that they can now be bought at not far from thirty cents apiece and there is a good prospect of even further reduction. This will be especially true if the field should finally be left clear for the various competitors who are anxiously awaiting the result of the protracted litigation.

Change for Large Bills. Many a dispute arises on a street car from the fact that a conductor cannot give satisfactory change when tendered a bill of $5 or $10. The passenger objects very strenuously to receiving a miscellaneous collection of silver coins, and if he cannot secure his money in the form that he wishes it, he is likely to think he should be given his money back and be granted a free ride. Every rider in street cars is familiar with incidents of this sort in which certain self-important individuals assume that they have made a proffer of their fare that is the end of it, when the conductor cannot make the change. This position is not sustained by law or by common sense, and a verdict of a jury in a recent trial in New York establishes the fact very completely. A conductor on the electric road running from College Point to Flushing was handed a $5 bill by a passenger who remarked that he had no smaller bill. The former took the money but could not make the necessary change; he stopped the conductors of trains going in the opposite direction and requested them to help him out, but they were unable to accommodate him. Delay in traffic was caused by the persistent effort of the conductor, but to no purpose. The passenger then demanded his money, but the railway employe refused to return it stating that he would be obliged to keep it till he reached the company's office where the treasurer would be able to give the necessary change. The passenger lost his temper by this time and, refusing to give his name and address, left the car. He immediately secured the arrest of the conductor on the charge of larceny, but upon the trial he was acquitted. At this time the passenger was tendered his proper change, $4.95, but he refused to accept it as he proposed to make the matter a test case. The tables were turned, however. The conductor by this time wanted vengeance for the humiliation to which he had been subjected by being placed under arrest. He sued for damages and a jury has just awarded him a verdict of $110 which the owner of the five dollar bill will be called upon to pay. The court held that "In accepting pay for specific purposes the payee is not obliged to make change, and that changing a bill is merely an act of courtesy or custom, without means of legal enforcement." This termination of the suit is decidedly satisfactory, especially in view of the fact that there is a very decided suspicion that some passengers are mean enough occasionally to tender a large bill in the hope of eluding payment altogether. The decision makes the conductor somewhat of an autocrat, who must be treated with some consideration by the traveling public.

Trolley Speeds in Brooklyn.

Mayor Schieren of Brooklyn has been investigating the speeds of trolley cars, and as a result he has directed the police to report all cases in which they are run at a rate in excess of the ten-mile an hour limit allowed by the ordinance. The mayor came to the conclusion that cars were run too fast by reading the following report signed by George W. Plympton, Commissioner of Electrical Subways:

The following velocities of trolley cars have been determined by careful measurements under the direction of this board:

On Fulton street below Fort Greene place, December 14, 2:30 to 3 P. M., 13 6-10 miles per hour, 13 3-10 and 13; January 18, 2 P. M., 11 8-10 and 13 3-10 miles.

Between Bedford and Nostrand avenues, January 18, 2:30 P. M., 12 and 13 3-10 miles per hour.

From Irving place, west, January 18, 8 P. M., 10½ and 14 7-10 miles per hour.

On De Kalb avenue, between St. Felix street and Fort Greene place, January 18, 3 P. M., 11 6-10 miles per hour.

On Vanderbilt avenue, between Greene avenue and Fulton street, January 18, 3:15 P. M., 19½ miles per hour.

On Bergen street, west of Carlton avenue, January 18, 8:30 P. M., 13 6-10 miles per hour.

On Seventh avenue, at St. John's place, January 18, 8:45 P. M., 14 7-10 miles per hour.

On Smith street, between State and Schermerhorn streets, January 18, 9 P. M., 12½ miles per hour.

It should be added that the above measurements were made on lengths of 200 feet in each case, and in no case involving a street crossing. The results show that the limit of speed assigned by municipal regulation is frequently exceeded on all the trolley lines.

Car Speeds and Accidents in St. Louis.

St. Louis papers have recently been investigating the speeds made by local electric cars, and if their reports approximate the truth the city is certainly provided with decidedly rapid transit. A reporter alleges that, as timed by a stop watch, a California avenue car covered a distance of 7,290 feet in two minutes and forty-five seconds. The speed was over 30 miles per hour. Other cars ran at 23, 17, 15 and 13 miles an hour, which speeds were all in excess of those permitted by city ordinances. The first speed of 30 miles an hour is probably exaggerated; the other speed mentioned may be and very likely are correct. It is doubtless the fact that motormen allow their cars to attain speeds that are too great to be consistent with safety, and it is true that they should be disciplined when they disobey orders in this respect. Whether St. Louis cars proceed fast or slowly it is not surprising that the residents are sometimes injured if they possess the characteristics attributed to them in this extract from an article dealing with the topic of local accidents:

"Any one who will take the trouble to stand at the corner of the streets where the street cars cross will find himself wondering that more accidents do not happen. Pedestrians who do not seem to be in any particular hurry until a car is seen rush across the track when the slightest misstep would cost them their lives. Clerks, hurrying from luncheon, appear to take a keen delight in running across the track directly in front of the car, and frequently so close to it that the car almost brushes their long coats. Ladies on a shopping tour flit across the street oblivious to the clanging bells and hysterical shouts of the motormen. Old men, hobbling about on canes or supporting themselves with crutches, indulge in an insane desire to dispute the right-of-way granted to the road. Small boys dare each other to stand on the track and the drivers of all kinds of vehicles act as though the streets belonged to them exclusively.

"Notwithstanding the foolhardiness and thoughtlessness of down-town pedestrians, it is seldom that an accident happens there, where it seems most likely to happen. The record of street car casualities shows that nearly every accident has taken place in the suburbs."

The street railway men have been quoted in regard to speed and accidents and their views are worth reproducing. John Scullin, president of the Union Depot Street Railway Company, denied emphatically that the company's cars ever attained such a speed as 30 miles an hour as had been charged. Speaking generally he said:

"We cannot make any change in our speed and suit our patrons. I frequently receive letters calling attention to the time made by other lines and asking us if we cannot make better time than we do. Everyone wants to ride fast, and the faster the better. If street railways could change their speed to 35 miles an hour next week, the public would be asking them to make 40. It is absolutely impossible to please everyone and the only thing a street car company can do is to give good service and pay no attention to the complaints unless they plainly show that there is negligence on the part of the employes.

"We employ the best class of men we can find, and do not tolerate a breach of discipline. One of the causes of accidents is that motormen do not pay attention to their duty and lose their presence of mind whenever any danger threatens. The way to stop an electric car is to shut off the current and apply the brakes. To reverse the car is dangerous, and is seldom productive of good results. It causes the wheels to slide along the rails and the car retains its speed for some time. When the wheels slip because of the application of the brakes the motorman should loosen the brake and then tighten it again as quickly as possible. A wheel that is sliding on the track does not do much to stop the car but one that is moving under the friction of the brake will soon retard the motion of the car.

"We have very few accidents, but we had one that cost us $40,000, and I have always believed that if the motorman instead of reversing the car had applied the brake, and when the wheels began to slip loosened it and caught it again, that accident might have been averted. Thus you see life and property depend on the motorman, and naturally it is cheaper for us to have the best class of employes than to give work to reckless and incompetent men.

"Another cause of accidents is the carelessness of the public. The average citizen is stupid when it comes to calculating the length of time it requires for a car to reach a given point. He is worse. He is reckless. A man who is perfectly sane in all other respects feels a sudden impulse to beat a car across the track. He generally does it and no one hears about it, but some day, when his foot slips, everybody in the city is made aware of the fact that another horrible accident happened and that it is doubtless due to the carelessness of the street car company. The victim is asked how fast he thinks the car was running when it struck him, and, naturally, enough, he exaggerates the speed. If the public would only be a little more careful and would realize that because they have had ten thousand narrow escapes, that is no reason why they will always be fortunate, there would be very few street car accidents. Women are very careless, and when they start to cross a track and see that the car is nearer than they supposed it to be, they are apt to stand in the center of the track for an instant or so while they formulate a plan for escape. The recklessness and stupidity of the passengers is the cause of many accidents, and if the public could be made to observe rules as rigidly as employes do there would be no accidents at all."

Charles Turner, president of the St. Louis & Suburban Railway Company was positive that cars on his line had not run as rapidly as 23 miles an hour as was charged. He remarked that in the suburbs his road was allowed by the terms of the franchise to run 20 miles an hour, but that the highest rate of speed registered by the test which the superintendent of the road and an electrician had made was 13 1-10 miles an hour. He was very positive that none of the cars of the Suburban line ran faster than the rate of speed mentioned in the franchise granted to the road. When asked if the speed of 20 miles an hour mentioned in the franchise was not faster than any street car should be allowed to run, he said that he had not considered the matter in that light, but that his road was very careful to comply with the terms of the ordinance. Speaking of the causes of accidents Mr. Turner made the following statement:

"The reason that accidents happen, is because people are so careless. Not long ago one of our cars collided with an ice wagon. No damage of any consequence was done, but the testimony of the witnesses proved conclusively that the driver of the wagon had started across the track when the car was only 25 feet away. He was going in the same direction that the car was going, and knew that the car was behind him. There was no excuse whatever for his conduct.

"The wants and needs of 10,000 people are more important than the wants of one. Therefore, it seems to me that our cars have a better right of way than an ice wagon, and the driver of the ice wagon who knows that we are coming should look out for us. The cause of many of the accidents is the sediment which forms a layer on the track on rainy or damp days. Comparison will show that most of the accidents happen on damp and rainy days when the track is in such a condition that the car cannot be stopped quickly.

"To counteract this we have on our cars a sand box. The motorman, whenever he sees that there is danger of a collision, can turn a little lever and throw sand on the track in an instant. A car running at an ordinary rate of speed can, by the use of sand, be brought to a standstill in 30 feet. The last 10 feet that it runs before stopping the speed would be so slow that it would not do any serious injury if it struck. Therefore, the danger can be averted if the motorman can see the danger when he is 20 feet away.

"Our patrons demand quick transit and we have to give it to them. We receive letters every day urging us to make better time, and yet we make as good or better time than any of our competitors. Our new cars are provided with trailers and we are using every possible endeavor to prevent accidents."

Indianapolis Franchise.

The Citizens Street Railroad Company, of Indianapolis was formally served with a notice last week that its thirty-year franchise expired on January 18 and that its continued occupancy of the streets was without authority. Notice was also given that unless the company restored the streets to the city within five days the city would proceed to enforce its rights in the courts. The city officials naturally do not expect that the company will acknowledge the rights of the city to immediate possession of the streets. City Attorney Scott will draw up a petition asking the federal court to allow the city to interplead in the suit now in court between the City Company and the Citizen's Company. The former company was some months ago the successful bidder for a new exclusive franchise for operating cars in the city, which the council held it had the right to grant as it was claimed the Citizens' charter had expired.

The city rests its case upon the facts that thirty years ago a thirty-year franchise was granted to the company and that it of necessity expired by lapse to time. On April 20, 1893, a franchise was granted to the City railway company, and that company joins with the city in its claim that the Citizens' company has now no legal right to use the streets of the city for the operation of its lines.

On the other hand the Citizens' company maintains that it has a perpetual right to use the streets of the city, basing its claims upon an amendatory ordinance passed April, 1880, which declared that the original ordinance granting the Citizens' company its charter should be extended to a period of twenty-seven years from date of the original ordinance, and hence under no circumstances can the charter of the company expire for seven years yet. It holds that this extension was made at the request of the company, it desiring to negotiate a loan upon an issue of bonds running twenty years from date. While it acknowledges that there was no forma acceptance of this amendment, it nevertheless holds that there was an implied acceptance by its action issuing the bonds.

The Cambria Iron Company's annual meeting was held in Philadelphia on Tuesday last and the following directors were elected: Josiah M. Bacon, A. J. Drexel, Jr., Robert F. Kennedy, James McMillan, David Reeves, Powell Stackhouse, John W. Townsend, John Lowber Welch and R. Francis Wood. A special meeting was afterward held for the purpose of voting on a proposition to increase the company's stock from $5,000,000 to $10,000,000, and also for or against a proposed increase of the funded indebtedness by an issue of bonds to the amount of $2,500,000. A resolution was adopted giving the board of directors authority to make the proposed increase at its discretion.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Fourth Article.*)

The Electric Current and Its Properties.

While all fluids resemble each other in some respects, each has some peculiarity of its own by which it is distinguished from every other fluid, and while we may partially describe one by showing its resemblances to other liquids or fluids, if we go no further than this we will miss the very characteristics by which this particular fluid differs from the others. If we cannot liken these peculiarities to anything else we can only become familiar with them by experimenting with the liquid itself and observing the peculiarities, and perhaps that will be the best way for us in this case. I think we can select a few experiments which will cost us little to perform and require little skill to prepare which will not only familiarize us with many of the peculiarities of the electric current, but will at the same time greatly assist us in understanding the principle upon which the electric motor operates, and it is proposed in this chapter to give a few of these, with full instructions how to prepare and perform them.

A word of advice here is, that two or three motormen perform these experiments together and divide the expense of the material. This method will have several advantages, one of which is that where several work together it results in mutual benefit through discussions of the "whys" and "wherefores" of the phenomena, and this, it must be understood, is what we must strive after in all cases; to know *why* a thing is so, as far as it is possible to know it, and in those cases where it is impossible to know *why* a thing is so, we must enendeavor to satisfy our minds whether, if it *is* so, it is *always* so or only occasionally or accidentally so. If it is *always* so, and we are satisfied of that fact, it is then a law. If it is only occasionally so, then there is surely some reason why it is ever so or why it is not always so, and we must not be satisfied until we have discovered this reason. That is the scientific way of doing things and in fact the only satisfactory way. Another advantage in working together is that by sharing the expense of the material among two or three it need not exceed an amount which any motorman can spare. If there be three together, 75 cents apiece should buy everything that is needed, and I feel sure that the entertainment and benefit that will be derived from this investment will many times repay the outlay.

Thus far the flow of an electric current in a wire has been likened to the flow of water in a pipe, and in fact the resemblance is so strong that many electrical phenomena may be clearly predicted if we assume that our conductor is a small pipe and the electric current is a current of water flowing through that pipe urged along under a given pressure. Some years ago the writer became acquainted with a German mechanic who was at that time in charge of the shops of one of our largest electrical factories and who had already gotten out a number of inventions on minor details of electrical apparatus that were of the utmost benefit to the concern that employed him and which are in use to-day. In conversation with this mechanic one day he told the writer that he had never had any instruction in electricity whatever. Upon being asked how it was possible, then, for him to devise such excellent electrical apparatus, he replied that he had been educated as a hydraulic engineer and understood the mathematics of the flow of water through pipes thoroughly, and that when he wanted to know how the electric current would act under new conditions, he simply assumed that he was dealing with water, figured out his problem accordingly and was pretty sure to find that his results with electricity would correspond.

But while the flow of electricity corresponds closely in many respects with the flow of water, it differs radically from it in many others, and it is some of these differences that the following experiments are intended to show.

To start with, we must, of course, have a generator of electricity, and for this purpose any cheap primary battery will answer. If it is desired to make the battery oneself, it can be done very simply and cheaply and will prove both interesting and instructive. The galvanic battery depends upon the simple principle that if two unlike substances that are conductors of electricity are immersed at one d in a liquid capable of

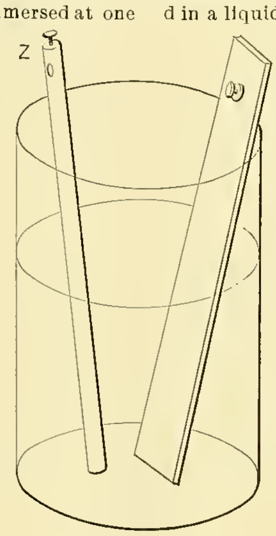


FIG. 1.

acting upon or corroding one of them more than the other, and the other ends of these (the two ends not immersed in the liquid) be connected together by a wire a current of electricity will at once flow through that wire. Since almost all chemicals corrode metals to at least some extent and hardly ever corrode any two metals to exactly the same extent, it would be almost impossible to select any two metals or any two conductors of electricity which would not form a battery if immersed in any solution we choose to employ. We therefore have an almost infinite variety of materials to choose from with which to make our battery, but of course they do not all make equally good batteries. If we can find two substances, one of which is very rapidly and easily corroded by our solution and the other not corroded at all, then we have the elements of a good battery. If the solution and both of the substances which are immersed in it are cheap, so much the better. Now it happens that zinc is both cheap and readily soluble in a large number of solutions and carbon is also cheap and practically insoluble in all solutions, so zinc and carbon are usually employed in all modern batteries. It is a peculiar fact that a solution of table salt in water will not corrode zinc when acting upon it alone nor will it corrode the zinc if

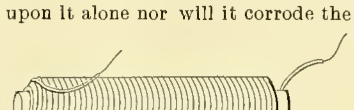


FIG. 2.

there be placed in the same vessel with it a stick of carbon so that the two might remain together in the same solution almost indefinitely, if they do not touch, without the zinc being corroded at all, but if their outer ends be connected by a wire, the salt water will at once begin to attack the zinc and an electric current will commence to flow and continue until either the zinc is used up or the salt water has dissolved so much of it that it cannot dissolve any more—that is providing the zinc and carbon remain connected by the wire, but the corrosion of the zinc will at once cease if this connection be broken. This property of salt water and zinc renders them peculiarly suitable substances to employ in electrical batteries, because if the carbon and zinc be disconnected when the battery is not in use, there is no waste of material and the battery is always ready for use, requiring only that the zinc and carbon be connected again to start the current to flowing.

While an excellent battery may be made with a solution of ordinary table salt, there is still a better substance for this purpose, salammoniac which is almost equally cheap and quite as harmless to handle.

To make a battery, procure a wide mouthed jar either of earthenware or glass, and buy a stick of battery carbon about 2 inches wide, ½ inch thick and eight inches long, and also a "pencil zinc." These may be procured of any electrical supply dealer, and should both be provided at their upper ends with binding posts or means to facilitate the attachment of wires. The carbon will cost 10 cents and the zinc 5 cents. At the same place or at the nearest drug store 5 cents worth of salammoniac should be purchased, and we have all that is necessary to make a fairly good electric battery.

Empty the salammoniac into the jar and fill it three-quarters full of water and when it is dissolved insert the carbon and zinc with their binding posts up. If we had an electric bell and should connect one of its binding posts to the binding post of the zinc and the other to the binding post of the carbon, the bell would ring vigorously and continue to ring for a long time, showing that quite a strong current was flowing. If we had used table salt instead of salammoniac, the only difference would have been that the battery would not last so long and the current would not be quite so strong.

Fig. 1 shows a battery such as described above, the zinc pencil being marked *Z* and the carbon marked *C*. In using such a battery, or "cell" as it is more properly called, it is better not to let the zinc and carbon touch each other in the liquid and they *must not* be allowed to touch each other outside the liquid, for if they do it is the same as though they were connected by a wire, and if allowed to remain this way when not in use the battery will become entirely exhausted. For the reason that a little jarring might cause the zinc and carbon to come in contact with each other when the cell is not in use, it would be a wise precaution to remove either one or both from the liquid before setting the jar away.

It may perhaps be found more convenient to buy a battery and if so a good dry battery which can be bought for fifty cents will be found as convenient as any. With the dry battery there is no danger of spilling any liquid and the zinc and carbon are fastened in so that there is no possibility of their coming in contact with each other.

In a galvanic cell such as either of the above, the current is supposed to flow through the wire *from* the least soluble element to the one most readily corroded by the battery fluid. Where the elements are carbon and zinc as above, the current must always be considered as flowing *from* the carbon through the wire *to* the zinc. The carbon is therefore called the *positive* pole and the zinc the *negative* pole and correspond respectively to the positive brush of the dynamo from which the current is supposed to flow, and the negative brush through which it returns to the dynamo.

In addition to procuring the foregoing, an 8 ounce spool of No. 24 cotton insulated copper wire should be purchased to complete the equipment for the following experiments. This can be had wherever the other supplies are purchased for 40 cents.

In preparation for the experiments, cut out a piece of brown manilla or ordinary writing paper about 2 inches square and wrap this carefully into a cylinder around an ordinary lead pencil. A round lead pencil is better for this purpose than an octagonal pencil. Next take the spool of insulated wire and while the paper is still on the lead pencil, beginning at the left hand end of the paper overwind it tightly and closely with the wire until the right hand end of the paper is reached. Then overwind this layer again with another layer proceeding to the left and then with a second layer winding to the right, and to prevent the wire from becoming loose at either end wind them with a few turns of strong thread or string and tie tightly. The wire may now be cut from the spool leaving an end beyond the coil of 3 or 4 inches. There should be about the same length of loose wire left at the beginning of the coil. The paper cylinder with its overwrapped coils may now be slipped from the pencil and we have a hollow cylinder of paper overwound with three layers of insulated wire, the two ends of which, each some 3 or 4 inches long extend out loosely as in Fig. 2. The insulation should be carefully removed with a knife from about an inch of both ends of the wire to enable the coil to be placed in the circuit of the battery.

Cut off from the spool two more pieces of wire each about a foot long and after removing the insulation from both ends of these for an inch or two, fasten one end of one in the zinc binding post and one end of the other in the carbon binding post. To the loose ends of the two wires twist the two loose ends of the small coil just made. If this is properly done the carbon and zinc will be connected by wire and the current will flow from the carbon around the various windings of the coil to the zinc. But as yet we have no evidence of this fact. Procure a large darning needle and insert it, point first, into the hollow coil and after allowing it to remain there a few minutes take the needle out and examine it. No change will be observed—it is apparently exactly like the needle that was put in there a moment before, and yet one of the most remarkable changes known to science has quietly taken place. Cut a small piece of cork (about the size of a good sized pea) large enough to float the needle in water, run the needle through this until the cork is in the middle and drop the needle with its float into a saucer full of water. The needle will swing around until it points exactly north and south. Reverse the position of the needle or point it in any direction we choose, it will swing around so that it points north and south again. If on first trying, the point of the needle is toward the north and the eye toward the south, it will always take up the same position again, the point always being toward the north and the eye toward the south. The act of passing the current around the needle while inside the coil has given it this remarkable property, that ever afterward when free to move, it will take up a north and south position, and the same end will always point north. We have magnetized the needle and by rendering it free to move whichever way it

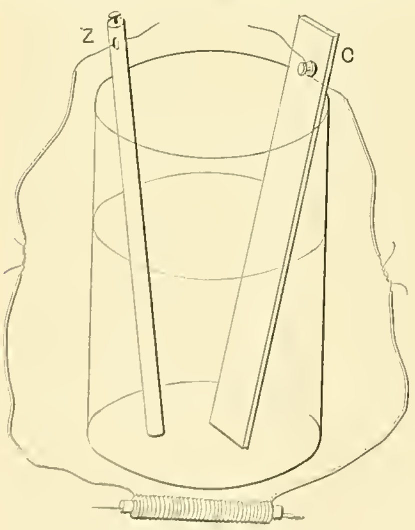


FIG. 3.

likes, have made one of the most remarkable instruments the world has ever seen, viz: a compass.

Place another needle in the coil in the same way—point first—and then float it on water. If the first needle took up a position with its point toward the north, the second one will do the same, and when it has come to rest *its* point will be toward the north and its eye toward the south.

Try a third needle, but introduce this into the coil eye first. Float this and the eye will be toward the north instead of the point. We have discovered two laws, one that a needle which has been placed in a coil through which an electric current is passing, acquires the property of taking up a north and south position when free to move, the same end always being toward the north; and second, that every needle which is placed in that

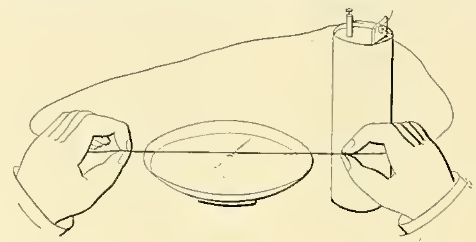


FIG. 4.

coil in the same way will act in the same way, and the end which goes in first will always be the one to point north if that was the one that pointed north in the first experiment. For these reasons the north end of the needle is called the north seeking pole and the other the south seeking pole.

While one of the needles is floating in the water, if we bring the north seeking pole of another needle near its north pole it will rapidly repel it. If, on the contrary, we bring a north pole near a south pole the two will attract each other strongly and the floating needle will rush to and attach itself to the other so strongly that it may with care be lifted out of the water. In fact we have two magnets with which we can produce all the phenomena of magnetism with which everyone is familiar.

Now let us remove our coil from the battery circuit and insert in its stead a straight piece of wire, say a foot long, by twisting its two ends to the battery wires and then stretch it in a north and south direction directly over our floating needle or compass. It will be observed that the latter is deflected through a considerable angle from its former north and south position, and if the wire be *over* the needle the deflection will always be in the same direction. If we examine closely we will find that if the current is flowing from north to south, the needle will always be deflected to the east. If we reverse our wire, however, so that the current is flowing from south to north, the deflection will be to the west. Place the wire under the saucer, or even under the table upon which the saucer rests, and if the distance be not too great the needle will be again deflected but in the opposite direction, viz.: if the current flows through the wire from north to south *under* the needle, its north pole will be deflected to the west, and if the wire be reversed so that the current flows from south to north, the north end of the needle will be deflected to the east.

ELECTRIC ROADS IN COUNTRY DISTRICTS.

The subject of electricity as applied to country roads in the state of Ohio has just received extended treatment by a commission appointed by the governor of that state. On this report a correspondent of the New York *Evening Post* says:

The discussion of road improvement has received a unique and original contribution in the report of an Ohio commission appointed last spring by Gov. McKinley, under direction of the legislature, to investigate the subject in all its relations. The governor appointed Martin A. Dodge of Cleveland, the author of the resolution, who is an enthusiastic advocate of the application of electricity to country roads, David S. Oliver of Cincinnati, J. H. Dunlap of Hardin County, and D. W. Sprague of Lake County upon the commission. A careful investigation was carried on throughout the summer, and the result is a report of more than usual interest.

It shows that in two-thirds of the counties of Ohio there are nothing but common dirt roads, which are well-nigh impassable a third of the year. The cost of macadam turnpikes ranges from $1,500 a mile in counties like Miami and Union, where a good quality of gravel is readily obtainable, to $10,000 a mile in Muskingum, where limestone is the only material available. The mileage of common roads in the state is 80,000 in round figures, and only 11,500 are improved. 7,000 macadam, and 3,500 gravel. The cost of moving freight over the roads of the state is reported to vary in different counties from 10 to 25 cents a ton. The commission estimates that it would require the enormous sum of $400,000,000 to improve all the roads in Ohio, and that even then the actual cost to the farmer of transporting his products to market would exceed 10 cents a mile and probably approximate 25 cents per ton. In the city of Cleveland, with paved streets, for example, the commission's inquiries lead to the conclusion that the average cost of drayage is not far from 25 cents a mile per ton. The commission holds that comparisons prove "that the steam cars and the electric cars have already contributed more to cheapen transportation without the aid of public money than the wagon road improvement has done with the aid of public money."

Regarding the proper authorities to be charged with road improvement the report says:

"Without going into an exhaustive discussion of the subject, we are convinced that national or state aid is unwise, and that with the governmental machinery existing in Ohio, the county authorities are the proper ones to manage road construction, and that the necessary funds should be raised within the limits of the county where the roads are built. The community of interest in a county is such that it may properly be considered a unit in the matter of road building, and the fairest plan for all concerned is, perhaps, to assess a portion of the cost upon the abutting land, and place the balance upon the general tax duplicate.

"The people who use a road are those living in the immediate neighborhood. Statistics are not at hand, and perhaps could not be gathered, but it is safe to say that the average haul on our roads is not over five to ten miles at the outside. No one would pretend for a moment that a pike between Cincinnati and Cleveland was necessary or desirable on account of the through traffic between those cities. Further, it is largely a matter of indifference to the citizens of Cincinnati whether there are good roads leading into Cleveland or not. They are only concerned with the condition of the roads about their own city. Therefore, it cannot be asserted with any degree of truth that the building of roads is a concern of the state at large, and that the state as such should raise money by taxation to be expended by her in improving the roads where good roads are lacking."

Regarding the application of electricity to the country road, the commission begins with this interesting paragraph:

"There is another consideration that should deter us from entering upon any extensive scheme for improving our roads requiring the expenditure of vast sums of money. It is a significant fact, to which attention has been frequently called, that the history of the development of the means of transportation shows no instance in which, after a better means has been devised, mankind has gone back to a former method. Every improvement in the means of transportation reduces the comparative value of the former means of transportation and frequently destroys it altogether. The bridle-path and the pack animal disappear as soon as wheeled vehicles are placed upon the common roads in competition. The ox-team is abandoned for horses, and the post-rider for the stage coach. These, in turn, all give way and disappear wherever it is possible to introduce a steam car or an electric car. It is undeniable that the development of the railway arrested the building of wagon-roads on a large scale, such as the 'National Road' running through Ohio. The horse-car in cities superseded other methods for carrying passengers, and the electric and cable-cars have about rendered the horse-car obsolete. With the advent of the electric car has come a development along a line totally unexpected, and that is its extension into the suburban and rural districts. It is too early to predict the extent to which the building of electric railways in the country districts will be carried. The franchises that are being granted for construction of electric lines connecting different towns would seem to indicate a possible expansion in this direction hitherto unthought of. There are no reasons why these railways should not be carriers of freight as well as passengers, and it is not at all visionary to surmise that as the steam railway superseded horse-power for long hauls, so the electric railway may supplant it for short hauls."

A diagram is presented showing the relative distances over which $1.25 will carry a ton of freight on wagon, electric road, steam railway, and lake steamship. They are respectively 5, 25, 250 and 1,000 miles. The commission concludes "that steam-cars and electric cars are both better means than horse power, so far as they can be applied," and it continues:

"This may certainly be assumed: That we are only at the threshold of the door that leads to a more extended use of inanimate power to take the place of animal power as a means of transportation; that more electric roads will be built; that they will be almost innumerable, in fact unlimited, is evinced by every indication, so that the problem of building the wagon road is made easier and easier by reason of the shortened distances for which horses may be profitably used for purposes of transportation. Five miles will probably measure the distance beyond which the horse cannot be used either for pleasure or for profit. It should also be observed that the ordinary earth road when in good condition, as it is during most of the year, is more suitable for light purposes and pleasure driving than macadamized roads or roads made hard with any kind of metal. By introducing the iron rails and inanimate power for rapid transit, and to take the heavier loads, the problem is solved."

The commission accordingly recommends "masterly inactivity" in the matter by the legislature and discourages schemes calling for large expenditures and involving a heavy increase in local indebtedness.

A minority report signed by Martin A. Dodge and D. W. Sprague, two of the commission, goes much further than the main report in advocacy of electric roads through the country districts. It shows that the power necessary to move a ton of freight over steel rails is one-eighth that required on a macadam road, one-eighteenth that on a graveled road, and one-twenty-fifth that on a common dirt road in fair condition, and declares that "the profitable use of steel rails and the application of inanimate power can only be limited by the convenience or inconvenience of terminal facilities." The conclusions of this minority report are radical and are summed up in the following paragraph:

"It seems probable that the application of electricity to the cars upon our streets and roads is destined to do for the short haul what the steam-cars have already done for the long haul. So far as electricity has been applied already, it has shown that the cost of transportation by that means is far less than upon the steam-cars, which is indicated by the rate of charge for transportation—the common rate upon steam-cars being three cents per mile for passengers, while in many cases upon the electric cars it is but one cent, or even less per mile. What has been done by way of cheapening transportation of passengers may be done to a great extent in cheapening the transportation of certain kinds of freight, especially the food products that are raised upon the farms and conveyed to the markets for immediate consumption. This may be done either with or without the aid of public money. Neither the steam-cars nor the street cars, up to the present time, have received the aid of public money; but one element in the cheapening of transportation, which has assisted the electric street cars, is the use of the public streets and roads, which, though not money, is a contribution as valuable as money itself. The cheap rates which prevail upon the street cars could never be attained if the companies that operate these cars were obliged to appropriate and buy the lands upon which they build their roads; so that public aid, though not public money, has been given—and properly given—to cheapen transportation by that means."

MOVABLE SIDEWALK FOR CHICAGO STREETS.

The Central Construction Company's directors, some time ago, appointed a committee to investigate the question of rapid transit for the down-town district of Chicago. This committee has made a careful study of the matter and has just presented its report, which is given herewith in full, together with one view prepared by the committee showing a cross section of the proposed structure. The report is as follows:

Your committee, charged with the duty of selecting and recommending a down-town terminal system for the elevated railways of Chicago, has expended much time and care upon the subject. Were it not for one overshadowing reason, we should report unanimously and positively against any such system, being by no means certain that the value of down-town property will be increased thereby; and, on the other hand, feeling very sure that what there is of spaciousness and beauty in our streets will be impaired.

That overshadowing consideration is this: We may believe the present system of elevated railroads, with a small change in their terminals, ample and satisfactory; that Van Buren street is far enough north for a terminal of the Alley L; that Sherman street is convenient enough for the Metropolitan elevated; that Madison and Fifth avenue would be convenient for the Lake Street line, and that Lake street is far enough south for any North Side line. We may deprecate any system of elevated construction, for any system whatever disfigures the streets. But the demand of the public for increased facilities and extensions cannot be ignored.

For the present, a law compelling the elevated roads to secure the consent of a majority of the abutting property owners in each mile is in force. We believe this to be a wise and salutary statute. We also fear and believe that the necessities, real or supposed, of the elevated roads, and popular pressure, will inevitably force the repeal of this act, and thereby expose property owners to enormous loss and the city to great disfigurement. We are property owners in the heart of a great city, to and from which ebbs and flows daily a crowd of from 300,000 to 500,000 people. It is not neccessary to dwell upon the frequent congestion of traffic upon our streets; it is enough to say that this great multitude of our fellow citizens is demanding in a more and more unequivocal way the privilege of rapid transit from start to finish of its daily journey. We doubt whether the comparatively few property holders in the heart of the city can ignore this demand and successfully contest the repeal of this law. In our judgment a wise regard for our own interests, and a just recognition of the convenience of the public, calls upon us for some action at the present time. We have approached this problem, therefore, as representatives of property owners, with three general objects of view: To occupy the minimum of the public streets; to furnish the maximum of public service; and to build a system capable of modification or extension without great waste or interruption of traffic.

With these general observations we proceed to details:

(1) LOOPS OR EXTENSIONS OF EXISTING ROADS.

Each of the existing roads has made some attempt to secure its own terminal loop penetrating the heart of the city, and each has failed up to date, because of the necessity of securing a majority of consents. Like the rest of the public, we are opposed to this plan of independent loops because each is intended to serve but one road, and in no way tends to make the property passed by it accessible to other roads. Such a loop, passing property, inflicts the maximum of damage, while conferring the benefit of accessibility to the line only, absolutely shutting out all others. In this it closely resembles the existing cable lines, which do not transfer passengers, and each of which tends to shut the other out from its own territory. It has been proposed, however, to extend each road to a common terminal in the business section, about at follows: A double track down Wabash avenue or State street, with a loop at the north end, to accommodate the South Side Alley Road; another east on streets or alleys from the Lake Street road; and a third from the Metropolitan Road; all brought to a common terminal; the most ample space to locate this common terminal being found on State street, north of Randolph street. No streets in the business district, except Wabash avenue and State street, are more than 80 feet wide, and some are 66 feet only. If the city authorities and property-holders would permit a double track road in the center of State street or Wabash avenue, immediately over the cable car tracks, supported on columns placed in the street outside the street railway tracks, a structure might possibly be constructed which would not be absolutely prohibitory. But when any other streets than Wabash avenue or State street are considered, it is impossible to build even a single track structure without practically appropriating the street, as has been done on Sixty-third street and West Lake street.

There are no continuous north and south alleys which can be used for any of these loops, though there are a few east and west, which run nearly across the city. It is, therefore, impracticable to run through alleys.

In fact, no plan of extending the present roads has been suggested which is not stubbornly objected to by property owners consulted. We are, therefore, compelled to drop all such propositions from consideration.

The alternative is a

(2) BELT LINE OR DOWN-TOWN LOCAL SYSTEM.

Beside the movement of passengers to and from the heart of the city to the terminals of the elevated lines, there is a heavy movement to and from the principal railway stations; and besides these there is an enormous circulating movement of people around and across the heart of the city in every direction. Neither of these three movements is sufficiently provided for by the surface railways. It is constantly necessary to change cars or walk long distances in moving about the South Side. We believe that no down-town system is complete or satisfactory which does not provide for moving passengers to and from the railroad depots as well as the elevated railways, and for the circulatory movement of the vast crowd which now throngs the heart of the city. It becomes necessary, therefore, to examine the character of this movement. In a general way, the main current of travel sets north and south along the easterly portion of the heart of the city, and of late a subordinate current of considerable strength sets north and south on Fifth avenue. West of State street the main current sets east and west on Madison and Adams streets, with lesser currents upon other streets, while all around the edge of the business district are scattered such objective points as the Randolph and Van Buren street stations of the Illinois Central, the Dearborn, Rock Island, Northern Pacific, Union and Northwestern depots; the Alley, Metropolitan and Lake Street L terminals; and the North and West Side bridges. To reach these points requires something in the nature of a belt line; and to convey passengers from the belt line to the center of the city requires north and south and east and west cross lines. Careful study of the streets and of the character of the buildings and ownership thereon indicates that, all things considered, Wabash avenue and Fifth Avenue are the most feasible and desirable streets to property owners and public alike through which to construct north and south double track lines; further, that by connecting these lines with double track cross lines through South Water street and Polk street, a belt line is secured which passes in the near neighborhood of most of the points above enumerated; and if, in addition to this belt line, one or two east and west double track cross lines are provided on other streets, a system is created which will accommodate the main and lesser north and south and east and west currents of travel above described; and upon which a passenger, by simply crossing a platform from one line to another can be transferred from any point to any point in the business district, walking not over a block and a half at either end. This would require the occupation of but two north and south thoroughfares, and one, or perhaps two, east and west thoroughfares, of importance, as South Water street and Polk street, from their position on the extreme edge of the business district, are not important thoroughfares. Should such a system be placed overhead or underground?

(3) UNDERGROUND SYSTEMS.

Two plans were submitted to us for placing the system underground:

1. To tunnel 40 or 50 feet below sewers, pipes and street obstructions of all kinds, and the foundations of buildings, even passing under the Chicago river; to operate trains therein on the Greathead system as used in London, and to lower passengers thereto by means of elevators from the surface and from the elevated roads. The cost of constructing such an underground system would be very great, though it might not be prohibitory; but the extent to which the public would use it if constructed is problematical. In our judgment, placing the system a great distance underground would practically destroy its usefulness for the shorter distances over which our system would naturally carry passengers.

II. To use the space now under the sidewalks of the central part of the city. These sidewalks vary from 14 to 24 feet in width, and a part of the space under them averages nine and a half feet in height above the foundations of most of the buildings. A subway could be constructed thereunder so arranged that every abutting building should open on a passage way leading to corner entrances. The street crossings would have to be tunneled, and water pipes, gas pipes, electric wires and sewers must be curved under the system, the latter so arranged that the drainage should be unimpaired. Unfortunately, in the center of the city only the very widest walks would afford room for such a subway, as the foundations of the buildings would greatly interfere with its construction. In many cases the curb wall would have to be removed and built further out in the street. Nevertheless, the cost of construction would be moderate, and if such a subway, with its platform say 8 feet 6 inches form the sidewalk level, could be built, we believe that people would prefer to descend 8 feet 6 inches and travel in a well-lighted tunnel rather than climb 18 feet to the grade of an elevated road; and that for short hauls it would be more profitable than the latter.

The legal question as to whether the space under the sidewalks is owned by abuttors or by the city is practically of small importance: if owned by the city or corporation building such a subway would still have to pay damages to the abutting owners, caused by its construction; and if owned by the latter it would have to be condemned under the law of eminent domain. In either case the entrance to basements would be injured in many places, and damages paid. Legal complications would be serious and litigation protracted. From the terminals of the elevated railways to the platforms of such subways would be a descent of 26 feet, and for all through traffic from elevated roads it would be much less convenient than an elevated terminal system.

Consultation convinces us that the objections to the use of the space under the sidewalks are widespread among property owners and would be difficult to overcome. We cannot, therefore, consider that system practicable.

We now pass to the consideration of

(4) OVERHEAD CONSTRUCTION.

As the surface of the streets is occupied by the street cars, there only remains the method of overhead construction, two kinds of which have been used in elevated railway practice; the one consisting of double tracks placed in the middle of the street, over the street railway tracks, supported by trusses bridging the street and resting upon pillars placed five or six feet outside of the street car tracks, as in Sixth avenue, New York. It is objected to this that the foundations of pillars set in the middle of the street interfere with water, sewer, gas and other pipes, the work of construction seriously interferes with the operation of cable trains, and the posts themselves with the traffic on the street, which last assumes the appearance of a tunnel more detrimental to light and business than the effect of two single lines along the curbs.

The other, which we prefer, consists of a single track carried upon pillars set at the curb line, as in the Bowery. It is objected to this that the superstructure and trains pass near the buildings and increase noise, vibration and obstruction to light.

The objections to the former plan are in our judgment, the more serious, and if a single track along the curb line is constructed as hereafter described and shown by drawings submitted herewith, we believe the injury to the street and property falls to a minimum. We may note, in passing, that either plan of construction may somewhat increase the value of second floor windows upon retail streets for display and advertising purposes.

The next question is that of

(5) MOTIVE POWER.

Three modes of propulsion have been suggested. The ordinary locomotive, the cable and the electric motor. The first of these, by its concentration of weight, its smoke and cinders and escaping steam, its lateral vibration caused by the reciprocal motion of its pistons, and its rush and roar in passing, would seem inadmissible and out of date, even if recent statistics did not show that it cannot compete in economy with electricity. The cable system is better, but here again the street car experience of the last few years indicates that advantage of economy and ease of operation rests with the electric motor. Some of your committee have had much experience with electricity, both for stationary and motive power, and unhesitatingly recommend its employment.

(6) ROLLING STOCK.

After determining upon a belt line, with cross lines, situated preferably upon the aforesaid streets, with a single track on each side of the street, elevated upon posts at the curb line, the trains upon opposite sides of the streets to move in opposite directions, it remains only to determine the character of rolling stock and motive power to be employed. Two modes of operation were presented for our consideration: The first, the ordinary method of short trains, of from two to five cars moving between a few blocks apart with a space or headway between trains, determined by the volume of traffic and the dangers of collision; the other a new method of continuous trains, covering the entire length of the belt line, moving continually at a uniform moderate speed of about six miles per hour, identical with or similar to that used for the so-called movable sidewalk at the World's Fair. It consists, roughly speaking, of three platforms, one fixed, one moving at about three miles an hour and a third at about six miles an hour, all parallel and close to each other, so that a person can step without danger from the fixed platform to that moving at three miles an hour, and from the three-mile platform with equal ease to that moving six miles an hour, without stopping the train or lowering its speed. Or it may be operated with three different speeds for greater case of access.

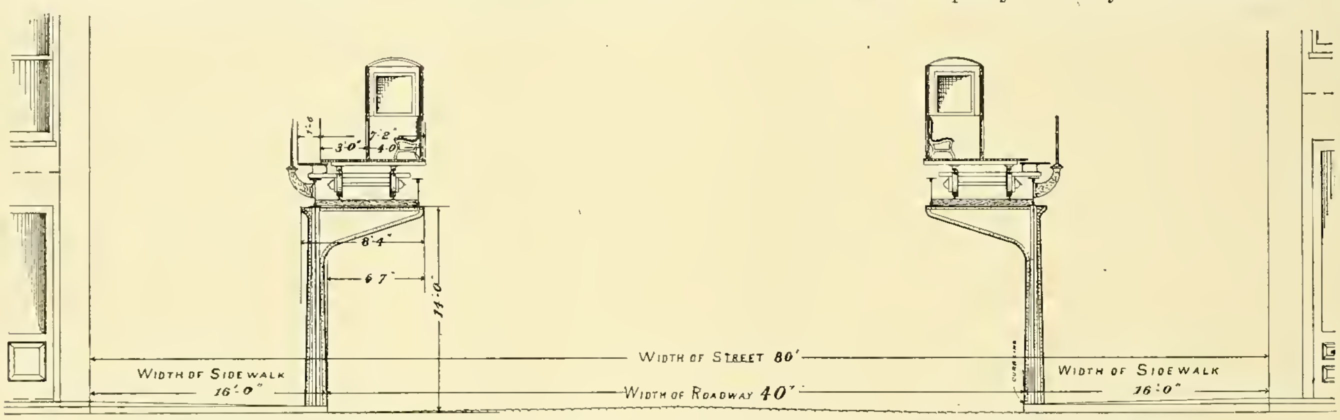
In our judgment, the continuous moving platform has decided advantages over the ordinary system, which may be summarized as follows: A uniform low axle speed, equal to about one-eighth of the average full speed of the ordinary elevated train; a continuous and uniform motion in one direction, devoid of starting and stopping thrust, and almost free from lateral vibration; the employment of numerous light motors distributed along the continuous train in such a manner as to spread the load evenly over the entire structure, instead of concentrating most of it at a given point, as in the case of the locomotive or motive car. Granted these advantages, our engineers advise us that noise and vibration may be reduced about in proportion to the square of the axle speed; that the structure may be greatly reduced in size, weight and cost; its extreme width can be reduced, except at landing platforms at street intersections, to eight feet. A light and graceful design can be adopted, as indicated by the drawings herewith submitted. Posts can be set thirty to sixty feet apart, and the superstructure bracketed out over the roadway, so as to leave the sidewalk clear. Light construction will permit the use of paper wheels, wooden tires and rubber deadeners, thus further reducing noise and vibration. If investigation does not indicate too great expense, inclined passenger lifts on the principle of the endless belt may be used to elevate passengers from the sidewalk to the fixed platforms.

No station houses are required, merely a landing and stairs, or a lift, at each street crossing; thus removing a fruitful source of difficulty in elevated railroad construction, viz: the location of stations, which benefit the ground floor property near by, and tend to injure the more remote property; while the necessary waiting rooms and long platforms required for the ordinary trains increase the darkening of the street and the injury to adjacent second floor property. Under the moving platform system all property owners are treated alike.

More important than the above considerations, however, are these: That noise and vibration are reduced to a minimum, ringing of gongs, escape of steam and compressed air absolutely dispensed with, and collisions rendered impossible. Most important of all is the character of the service offered. It is instant and continuous, there is no waiting for trains, passengers are taken substantially *from* any point *to* any point rapidly and safely, high out of the crowd, out of danger of being run over by horses and cable cars, and out of the mud and dirt of the street. The carrying capacity of the system is enormous. As many passengers can be seated upon a single seat running lengthwise of the train as can be crowded into the existing cable trains hanging on to straps and platforms, and in addition twice as many more can comfortably stand, or walk in the direction of the motion. By doing the latter the passengers' speed may be increased to 9 miles per hour.

(7) NOVELTY AND FEASIBILITY.

Inasmuch as a moving platform system, as applied to the transportation of passengers, in cities, is entirely new, your committee several times personally examined the plant upon the pier at the World's Fair, and also have the written opinion of many eminent engineers and specialists upon it—among them men of such authoritative standing as Messrs. Alexander Siemens, George S. Morrison, William Sooysmith, S. G. Artingshall, C. L. Strobel, L. E. Cooley, E. L. Corthell and D. L. Barnes, consulting engineers, William Forsyth and F. A. Delano of the C. B. & Q. Railway and W. F. White of the Atchison, Topeka & Sante Fe Road, all of whom without exception, unhesitatingly state that there is no serious mechanical difficulty to be overcome in constructing and operating this system regularly and efficiently; and that there is no physical difficulty in stepping from a fixed platform to one moving at a low rate of speed, which will not yield to even slight experience, except in the case of infirm persons or cripples, who can never largely patronize elevated roads, and may be left out of consideration. Among your committee and among the persons consulted there are men of widely varying ages, weights and physical activities, but to none was the use of the movable sidewalk at the World's Fair attended with apparent danger or inconvenience. Indeed, the experience of that plant, which moved nearly a million passengers



CROSS SECTION OF MOVABLE SIDEWALK AS PROPOSED FOR CHICAGO STREETS. (*From The Economist, Chicago.*)

during the summer with but a single accident is to us conclusive upon this point. Men, women and children from city and country alike were carried without difficulty or danger.

(8) CONCLUSIONS.

As above intimated, your committee considers it of great importance to adopt a system which shall not only easily and quickly gather up and distribute passengers for the elevated roads, but shall also provide means to reach the steam railroad stations, the hotels, theaters and other places of amusement, and accommodate those who desire to go from one part of the business district to another, with comfort and safety. It therefore recommends a system of elevated belt lines, preferably on Wabash Avenue, Fifth Avenue, Polk Street, and South Water Street, with cross lines, say on Madison or Washington Streets, and perhaps Adams or Van Buren, consisting of continuous moving platforms, driven by electric motors and supported upon single-posts at the curb line; moving in opposite ways on opposite sides of the street; provided with convenient bridges and platforms for the transfer of passengers from one line to another: a single fare to cover any number of such transfers. The details of construction and operation, housing in from the weather, etc., and the question of rates of fare, relations with connecting roads, etc., are under the consideration of your committee, and are being worked out with great care, necessarily requiring time. It is not advisable, in our judgment, to wait for them before presenting the substance of this report to property owners, whether members or not of the Central Construction Company, as the committee believes it goes far enough to enable each owner to determine for himself whether he assents to or opposes an undertaking of this general character.

There is one other important question which will affect their judgment or action, viz.: the question of

OWNERSHIP AND CAPITALIZATION.

The double track system recommended is the equivalent of eight miles of single track or platform. While we have not made exact estimates, it is evident that it can be constructed for a moderate sum per mile. We believe that it should be capitalized as nearly as possible at actual cost; no bonus to be issued, but the capital provided by sale of the necessary amount of stock at par; and that the privilege of subscribing for this stock should be offered to assenting property holders upon some equitable basis.

CONTROL EXERCISED BY STATE RAILROAD COMMISSIONERS OVER STREET RAILWAYS.

The STREET RAILWAY GAZETTE recently sent a letter of inquiry to each of the state boards of railroad commissioners of the 32 states in which such boards exist, asking for information concerning the control and regulation exercised by its members over street railway corporations. From the 28 replies received it appears that in 19 of these states the commissioners have no jurisdiction whatever over street railway companies. These 19 states are:

Kentucky, Missouri, Minnesota, Iowa, Illinois, California, Kansas, Ohio, Virginia, Nebraska, Vermont, North Carolina, South Carolina, Alabama, Arkansas, Georgia, Indiana, Texas and North Dakota.

Of these North Dakota has no street railway lines, but the state constitution gives the commission such control over street railways—when constructed—as the legislature may provide. Vermont has only two street railway companies—one each at Burlington and Rutland. In nine other states the commissioners exercise more or less jurisdiction over street railway corporations under laws enacted by the legislatures. These nine states are:

New York, Massachusetts, Maine, New Hampshire, Rhode Island, Connecticut, Michigan, Pennsylvania and Wisconsin.

It will be noticed that only two western states are included in this list. A brief synopsis of the laws by which the commissioners are guided in these nine states is given herewith:

CONNECTICUT.

The Connecticut statutes relating to railroads prior to the acts of 1893, refer to street railways only when they cross railroad tracks. No grade crossings are allowed except on the approval of the railroad commissioners. The "Act Concerning Street Railways" passed in 1893 caused considerable comment at the time it was under discussion in the General Assembly. Stripped of the legal verbiage the act requires that a new street railway company desiring to lay tracks or an existing company wishing to lay additional tracks or to change its motive power must proceed to make a plan of its proposed route going into detail in regard to track, motive power, etc., and present it to the local authorities. The latter on notice are to proceed to a public hearing and within sixty days after the presentation of the plan shall notify the company of their decision.

The local authorities are given exclusive jurisdiction over the location of tracks, wires, conductors, fixtures, etc., including the relocating of the same. Every company must comply with these orders at its own expense, and in case of its failure the necessary orders may be executed by the municipality and the expense collected in an action. Except in the case of bridges, terminals and curves in turning from one street to another, and turnouts and switches for a distances of 150 feet, the wrought part of a street suitable for travel shall not be less 12 feet in width measuring from the outer rail, unless permission is obtained of a judge of the superior court. It is further provided that a company shall not be obliged to change the grade of that portion of the streets on which its tracks are located after the grade in the street has once been located.

Another provision of the law states that if the company discontinues the operation of its railway on any streets, or if having laid tracks it fails to operate the line within a reasonable time, the local authorities may order the company to operate the road. On its failure to comply with the order the company's right to the street shall cease, and if it fails to remove its tracks the town, city or borough may do the work and recover the expense by action.

Street railway companies are required to keep in repair that part of the street occupied by its tracks, and for a distance of two feet on each side of the outer rails, but they are not to be compelled to use better pavement than the city uses in the rest of the street.

Street railway companies are not allowed to transport merchandise other than such small bundles as are carried by passengers except in accordance with regulations prescribed by the superior court upon the application of the company or any interested person or town or city.

No street railway company shall be extended from one town to another so as to parallel any street railroad or steam railroad unless authorized by special charter prior to January 1, 1893, until the company obtains from the superior court a decision that such a construction is necessary. The act contains provisions relating to damages caused by defects on streets which companies are bound to keep in repair, to the alteration of orders made by local authorities, and stipulates that the latter may make regulations regarding speed from which their shall be no appeal, but in no case is the speed to be greater than fifteen miles an hour on any street or highway.

All companies are obliged to make annual reports to the railroad commissioners. One section is devoted to the provisions in accordance with which bonds may be issued.

The superior court is empowered to authorize a street railway company to run its cars over the tracks of another street railway for a distance not exceeding half a mile. When the town or city is approached, however, by a bridge or causeway the court may direct the new company to use tracks of an existing company from a point where the two roads meet to some central location in the town, provided that the track thus used is not of greater length than that actually owned or operated by the company which wishes to use the tracks. The manner of use of tracks and the matter of compensation are to be fixed by the court.

It is provided that the act shall be an amendment to all street railway companies' charters and that a majority of the directors of companies shall be residents of the state.

NEW HAMPSHIRE.

In New Hampshire the word "railroad" is held to cover street railways and the jurisdiction of the railroad commission is the same as in the case of steam railroads. It extends to construction, operation, fares and, in fact, to nearly every factor in their business. The statutes as they stand do not refer specifically to street railways with the exception of providing that if a street railway company permits its cars to cross the track of a steam railroad without coming to a full stop before crossing it shall be fined $100 for each offense.

At the last meeting of the legislature a resolution was adopted providing that as so many street railway charters were sought, the railroad commissioners should be requested to report what general legislation was required in reference to the powers to be conferred upon or exercised by railroads operated by power other than steam.

RHODE ISLAND

The railroad commissioner of Rhode Island writes that it is generally understood that the jurisdiction of the railroad commissioner extends to street railways, but that the jurisdiction "does not amount to much." A perusal of the railroad laws of the state does not reveal any specific allusion to street railways.

MAINE.

E. C. Farrington, clerk of the department of railroads of the state of Maine, in sending a copy of the law relating to street railroads, writes: "In the interests of street railroad projectors a distinction is made between the steam and street roads, and in location, right of way, etc., the general law gives privileges not accorded to the steam roads. However, they are under supervision and are examined annually and have to secure a certificate of safety before they commence operations."

The first part of the act refers to the matter of organization. It is then stated that before beginning construction the corporation must present to the railroad commissioners a petition for the approval of its route, with a map showing the location, with the written approval of local authorities and a report of an engineer. If, however, the municipal officers fail to act within thirty days, if they refuse the route, or if the route which they approve is not accepted by the company the matter is to be taken into court.

The following provision is made in section 11.

Street railways shall be constructed and maintained in such form and manner, and with such rails and upon such grade as the municipal officers of the cities and towns where the same are located may direct, and whenever in the judgment of such corporation it shall be necessary to alter the grade of any street, town or county road, said alterations shall be made at the sole expense of said corporation with the assent and in accordance with the directions of such municipal officers. If the tracks of a street railway cross any steam railway and a dispute arises in any way in regard to the manner of crossing, the board of railroad commissioners shall, upon hearing, decide and determine in writing in what manner the crossing shall be made, and it shall be constructed accordingly.

Municipal officers are given the power to make regulations as to the mode of use of tracks, the rate of speed and the removal and disposal of snow.

Persons who obstruct street railways are subject to a fine not exceeding $200 or imprisonment for 60 days.

On written application the municipal officers may authorize a company to discontinue the operation of cars during a portion of the winter upon such terms as they may determine, and the company may appeal from their decision to the railroad commissioners who, after a hearing, may give a final decision.

MICHIGAN.

Street railways are under the jurisdiction of the commissioners of railroads in the State of Michigan only in cases where they cross railroad tracks. An act adopted in 1893 prescribes the way in which such tracks may be legally crossed. The approval of the commissioners must be secured, and it is provided that grade crossings shall be avoided as far as possible. When at grade the commissioner shall prescribe the safeguards. It is stated that in no case shall the height of any wire crossing a railroad be less than twenty two feet above grade.

PENNSYLVANIA.

Isaac B. Brown, deputy secretary of internal affairs writes as follows: "There is no railway commission in Pennsylvania, and no power is given to the secretary of internal affairs to exercise immediate control or supervision over street railway companies. The companies are required only to make annual reports to this department [Internal affairs] and the only special authority given the secretary is to see that they do not transcend the powers given to them by the law and their charters and that when any act is committed in violation of the constitution it is his duty to certify such violation to the attorney general for his action."

WISCONSIN.

There are four sections relating to street railroads in the Railroad laws of Wisconsin, but none of these are of special importance.

MASSACHUSETTS.

The general laws of Massachusetts relating to street railways are so extensive that it will be out of the question to attempt any general summary. Some of the more interesting provisions however may be noted. In accordance with Section 3, of Chapter 113, the gauge of each street railway shall be the standard of 4 feet 8½ inches. The amount of capital stock of a company shall not be less than $10,000 per miles unless the line is wholly located outside of a city in which case the amount may be not less than $2,500 per mile.

Somewhat detailed conditions are imposed regarding meetings, officers, capital stock assessments, etc. Section 19, prescribes that no company shall begin the construction of its line until it has filed in the office of the secretary of the commonwealth a sworn certificate that its capital stock has been subscribed for, and that 50 per cent. of the par value has been actually paid in cash. If the company does not build some portion of line within 18 months after the date of its certificate of establishment its corporate powers shall cease. The aldermen are given the power to make regulations regarding speed, the manner of using tracks and removal of snow.

A street railway company may use such motive power as the local authorities may permit. When a railroad track is crossed the street railway shall cause as little damage as possible and shall not insert frogs or cut the rails without the consent of the directors of the steam road. At grade crossings cars must be stopped within 100 feet of the crossing. No street railway company shall sell or lease its road unless authorized to do so by its charter or permitted to do so by special act of the general court. Every company must keep its books in a manner prescribed by the board, and make annual reports.

In 1886 acts were passed providing for the weekly payment of wages, authorizing actions of tort, and authorizing street railway companies to use the cable system as a motive power.

The acts of 1887 and 1888 contain nothing of general interest.

In the acts of 1889 appears a provision prohibiting companies from allowing minors under the age of ten years to enter cars for the purpose of selling papers or other articles.

In 1890 the well-known act was passed providing that all cars propelled by power other than horses shall be equipped with fenders and guards as required by the railroad commissioners. A company that for more than six months after being notified operates a car not so equipped is subject to a fine of $50 for each offense. By Chapter 366 of the acts of 1891 this law was repealed.

In the same year acts were passed permitting railways to use the Meigs elevated system and authorizing the West End Street Railway Company of Boston to build elevated railroads.

In 1892 the legislature adopted a resolution requesting the railroad commissioners to investigate apparatus designed to deaden the noise attending the operation of electric cars.

The most important law of 1893 was an act making ten hours in twelve consecutive hours a day's work for certain employes of street railway companies. This measure led to the form of agreement framed by the West End Company and published in the STREET RAILWAY GAZETTE January 6. The provisions contained in the agreement growing out of the law caused a great deal of dissatisfaction among the conductors and motormen, and a strike was at one time threatened.

The foregoing is the briefest kind of synopsis of some of the acts relating to street railways. The general laws occupy about forty large book pages.

NEW YORK.

The provisions regarding street surface roads are contained in Article IV, Sections 90 to 110 of the railroad law of New York. The preliminary sections relate to general provisions, securing the consent of property owners and local authorities, condition upon which consent shall be given, and sale of the franchise Section 93 contains the following regarding the last named subject:

The consent of the local authorities in cities containing twelve hundred and fifty thousand inhabitants or more, according to the last federal census or state enumeration, must contain the condition that the right, franchise and privilege of using any street, highway, avenue, park or public place shall be sold at public auction to the bidder who will agree to give the city the largest percentage per annum of the gross receipts of such corporation, with a bond or undertaking in such form and amount and with such conditions and sureties as may be required and approved by the comptroller or other chief fiscal officer of the city for the fulfillment of such agreement and for the commencement and completion of its railroad within the times hereinafter designated, according to the plan or plans and on the route or routes fixed for its construction. Whenever such consent shall provide for the sale at public auction of the right to construct and operate a branch or extension of an existing railroad such consent shall provide that but one fare shall be exacted for passage over such branch or extension and over the line of road which shall have applied therefor, and, further, that if such right shall be purchased by any corporation other than the applicant, that the gross receipts from joint business shall be divided in the proportion that the length of such extension or branch so sold shall bear to the entire length of the road which shall have applied therefore and of such branch or extension, and that if such right shall be purchased by the applicant, the percentage to be paid shall be calculated on such portion of its gross receipts as shall bear the same proportion to the whole value thereof as the length of such extension or branch shall bear to the entire length of its road.

In case property owners do not consent to the building of a street railway Section 94 provides for the appointment of commissioners. When after a public hearing they determine that a road shall be built, this decision shall, upon confirmation of the court, be taken in lieu of the consents of property owners.

Section 95 makes provisions for the payment of a percentage of gross receipts to muncipalities or villages.

Section 97 defines the conditions upon which the tracks of one company may be used by another.

The following section states that a company must keep in repair the street between its tracks and a space two feet in width on each side of the tracks. If the companies fail to make the repairs the local authorities may do so and charge the expense to the former. Local authorities may make reasonable regulations as to the rate of speed, manner of using tracks, removal of ice and snow.

The provision regulating motive power is as follows:

Any street surface railroad may operate any portion of its road by animal or horse power, or by cable, electricity, or any power other than locomotive steam power, which may be approved by the state board of railroad commissioners, and consented to by the owners of one-half of the property bounded on that portion of the railroad with respect to which a change of motive power is proposed; and if the consent of such property owners can not be obtained, the determination of three disinterested commissioners, appointed by the general term of the supreme court of the department in which such railroad is located, in favor of such motive power, confirmed by the court, shall be taken in lieu of the consent of the property owners. The consent of the property owners shall be obtained and the proceedings for the appointment and the determination of the commissioners and the confirmation of their report shall be conducted in the manner prescribed in Sections 91 and 94 of this article so far as the same can properly be made applicable thereto.

Any railroad corporation making a change in its motive power under this section, may make any changes in the construction of its road or roadbed or other property rendered necessary by the change in its motive power.

Section 107 prescribes that in cities having a population of 5,000 or more, sand may be used between the rails to prevent horses from slipping, and in Section 109 the use of center-bearing rails is prohibited.

The companies are obliged to make reports to the railroad commissioners, and in the bulky volumes published by the latter 260 pages are occupied with street railway statements.

Prof. Barrett and the Love Conduit System.

Prof. J. P. Barrett, city electrician of Chicago recently made the following statement regarding the Love conduit system as it is operated in Washington. The opinion is radically different from that expressed by Mr. Stetson in his paper before the American Institute of Electrical Engineers published in the STREET RAILWAY GAZETTE last week.

"This Washington line approaches the city as an overhead trolley line. At the city limits the trolley is placed underground and continues so for a distance of three miles. The system is a perfection of the one now in use on the North Side in this city, but the perfection has made a vast difference. There the line has been run for months without a single breakdown and without any accidents on account of the wires. The entire circuit is completely underground, so there is a minimum loss of power.

"There is no damage to water pipes, sewer mains, and other underground improvements, because of the completed circuit. While I was there the conduit at one time was filled with water, but the cars were run just as in dry weather and with just as much effect. This water ocasionally freezes, but so it does here once in a while, and the cable is frozen in. An electric road would be fully as well off, but with a thorough system of drainage there would be no danger of freezing. I consider the system as nearly perfect as any I have seen.

"I am informed the underground line can be built as cheaply as an overhead line. There is absolutely no danger from crossed wires, for the reason these wires are underground. The system, too, may be easily placed in Chicago. The cable conduits might be used for the purpose with very little change. All that will be necessary will be to drain them a little better and to string the electric wires. This work could be done without stopping the cable service. Then the cars would have to be fitted with electric appliances, and instead of the grip running through the slot an electric arm would be used. The line would then be ready for operation."

EARNINGS OF FIVE ST. LOUIS ROADS.

The National Railway Company which it will be remembered, is a Chicago corporation owning most of the stock in five St. Louis street railway companies, at its annual meeting held this week reported net gains of the several properties to which the company is entitled of $199,947. This is equal to 9.088 per cent on the stock, against 10 per cent earned in 1892. The receipts of the five roads were $1,416,817, a decrease of $20,729, or 1.4 per cent. Operating expenses, which were 60.12 per cent. of the receipts were $851,851, a decrease of $23,118. Net receipts were $554,966; fixed charges, including interest, taxes, and insurance, amounted to $309,683, leaving a surplus gain of $255,282, which compared with 1892 showed a decrease of $21 989. The number of trips last year was 877,302, a decrease of 16,988; car miles, 11,844,031, a decrease of 103,326; passengers carried, 28,313,504, a decrease of 385,329. Gross receipts of cable lines were $1,035,445; gross receipts of horse and electric lines, $381,372. Cable receipts decreased $50,987, horse and electric car receipts increased $30,258. Operating expenses of the cable lines were 59.4 per cent. of the income, and amounted to $607,649; operating expenses of the horse and electric lines were 64 per cent. amounting to $224,201. The total operating expenses in 1893 were 60.13 per cent. of the income, amounting to $851,851, against 60.86 per cent, in 1892, amounting to $874,969, a decrease of $23,118; mileage of the cable line was 9,368,758; mileage of horse and electric lines, 2,475.273. The cost of operating cable per mile was 7.32 cents, and including interest 9.34 cents. The cost of operating horse and electric lines per mile was 11.09 cents, and including interest 13.11 cents. The company paid for damages during the year $36,088, an increase of $9,720. New construction cost $1,201, 356, which is all paid for and leaves no floating debt. The construction included 32.37 miles of new track, 33.20 miles overhead electric construction, 70 motor cars, 12 new trailers, and remodeling of 131 old trailers, engines, electric plant, etc. The balance sheet of the company shows total cost of property $2,184,383, cash on hand $15,616, a total of $2,200,000, against $2,200,000 capital stock. The directors reëlected were: W. T. Baker, E. Buckingham, T. J. Lefens, G. T. Smith, D. G. Hamilton, E. G. Foreman, C. L. Raymond. The roads controlled by the National Company are the Cass Avenue and Fair Grounds Railway Company, including the Northern Central and Union railways; the Citizens' Railway Company, and the St. Louis Railroad Company.

Street Railway Strike at Bridgeport.

The employes of the Bridgeport (Conn.) Traction Company went on a strike on Saturday last, and they succeeded in tying up the system. The strike was declared at three o'clock in the afternoon and the drivers lost no time in deserting their cars after they had been drawn to the barns. The trouble was the result of the discharge of several conductors.

On January 21 the company filled the places of the strikers, and made an attempt to run its cars. One car was stopped by a mob, which overturned it, broke the windows and set it on fire. The yards of the New York, New Haven & Hartford Railroad were raided and railroad iron, ties, coupling pins, boxes and barrels were taken and piled on the tracks at various points. Some of the cars were moved out of the sheds, but were only able to proceed a short distance. The mayor, backed by the police, read the riot act, but the crowd jeered. President Heft turned the road and all its property over to the mayor, asking for police protection.

On Wednesday the executive committee of the strikers announced that the men would go back to work at the company's terms. The terms were that all strikers except the nine ringleaders should be taken back, that the company should recognize no union, and that the men should work on the same terms and conditions that obtained before the strike. The men returned to work but a second strike was declared on Thursday. It seems the men assumed that their union had been recognized and upon a denial by Col. Heft that such was the fact the men ordered another tie-up. The utmost excitement prevailed and damage to property was anticipated, as the strikers had the sympathy of the lawless element in the city.

Vestibule Law Sustained in St. Paul.

In the Municipal Court in St. Paul, January 18, Judge Twohy gave a decision in the vestibule case. Frank Hoskins, St. Paul superintendent of the Twin City Rapid Transit Company was arrested several days previous on the charge of violating the law requiring companies to equip their cars with vestibules, Judge Twohy stated that all the evidence in the case had been submitted by stipulation, and the only question to be decided was the constitutionality of the law. The importance of the question required an examination, which would better be given by a higher court, and, therefore, so far as his court was concerned, he would hold the law constitutional, and impose a fine of $50. The attorneys for the defense asked that the case be certified to the Supreme Court on a bill of exceptions. The court granted the motion and the question of constitutionality will be passed upon by the supreme court.

The defense was compelled to pay the fine, but the amount was paid under protest. The defendant's attorney wanted to deposit the money as security for the fine, claiming that the case could not be appealed if the fine was paid. The court decided, however, that the defendant must pay the fine or go to jail for sixty days, and the former alternative was adopted.

Metropolitan Company's Prize.

The railroad commissioners of New York have submitted to the legislature all the documents relating to the offer of the Metropolitan Traction Company to give a prize of $50,000 for an improved system of street railway propulsion, The commissioners are disposed to act as judges of award provided the legislature is inclined to give authority for them to do so. In its communication to the legislature the commissioners make the following recommendation:

The correspondence with the company upon the above proposition is respectfully transmitted to your honorable body for your examination, and for such instructions or recomendations as to your honorable body may seem proper. This board fully appreciates the demand for more efficient motive power in the large cities of the State, and commends the liberality and unselfish position taken by the Metropolitan Traction Company in making the above offer.

Already many communications have been received from inventors, who have had notice through the newspapers of the action of the Metropolitan Company, asking information on the subject, and the board believes that the legislative assent to the proposition of the Metropolitan Traction Company might be productive of great benefit to public interest. The passing of a resolution giving the required authority is respectfully recommended.

Brooklyn Street Railways.

An eastern financial paper says that the plan of the Long Island Traction Company to absorb the Brooklyn Traction Company has fallen through, although the Broadway line will be absorbed by the Long Island Company. Street railway matters now stand just where they were before the proposed change with the exception of the Broadway Company, The trouble was caused by the Long Island Traction Company stockholders objecting to the plan. It was proposed to exchange the $6,000,000 Brooklyn Traction stock, share for share, for Long Island Traction stock and the stockholders of the latter objected to what they considered an unfair exchange of stock, and, besides, the Brooklyn Traction Company had accumulated a large floating debt which the Long Island stockholders did not want to assume.

The plan for the absorption of the Broadway line is to issue $6,500,000 bonds, $3,500,000 first mortgage 5 per cent. bonds and $3,000,000 second mortgage 6 per cent. bonds to run 35 years. There will be sold to the guarantee fund, which is deposited with several trust companies to secure the 10 per cent. dividends on Brooklyn City Railroad stock, $2,000,000 of the first mortgage bonds. The purchase of the bonds will use all the balance remaining in the guarantee fund, and then the $4,000,000 which was thus set apart will all be invested in bonds of the Brooklyn City Railroad. It is estimated it will cost $1,080,000 to be used in changing the road from horses to trolley, and $600,000 will be used to take up present bonded indebtedness. This is the road which Drexel, Morgan & Co. bought about a year ago for about $1,550 000, and at the end of six months sold to a syndicate composed of H. B. Hollins & Co., J. & W. Seligman & Co., and E. W. Clark & Co. of Philadelphia, for about $2,550,000.

Comments and Views from Contemporaries.

RAPID TRANSIT IN NEW YORK.—It is probably fortunate that the gnomes of the Catskills are not likely to throw a spell over any modern New Yorker such as they did over Rip Van Winkle, for it would be awkward after a sleep of twenty years, during which the city had been solidly built up to Yonkers, to hear the wakened sleeper ask: "Is that the Rapid Transit Commission I see still in session?"—*New York World.*

STOPPING AT FIRST CROSSINGS.—The excellent rule of the Traction Company under which its trolley cars are slowed down as they appoach the street corners and are stopped at the upper corners, is no doubt one of the chief reasons for the relative immunity from trolley car accidents which this city has enjoyed.—*Philadelphia Ledger.*

EFFECT OF RAPID TRANSIT.—A writer in a recent number of the STREET RAILWAY GAZETTE calls attention to some of the advantages of rapid transit in cities, from a sanitary point of view, and emphasizes the opportunity it affords for scattering the population. It is probable that no city in the country is a more apt illustration of this than this town. Its industrial class is very large, and its manufactories are of necessity somewhat centralized. Before the present era of rapid transit there was a decided tendency for workmen to seek homes near their work, with a resulting congestion which had a marked effect upon health as well as comfort. Under the present admirable system of street railways, with the liberal arrangements for transfers, workmen and business men generally have been enabled to remove to the suburbs of the town, and still reach their places of business with ease and in a very short time. The result has been a rapid growth of population in surrounding territory which was but recently regarded as in the country. This territory has been built up with handsome residences and neat cottages. That there has been a corresponding benefit to the general health of the population is conclusively shown by the reports of the office of vital statistics.—*Rochester (N. Y.) Democrat and Chronicle.*

VERY LIKELY THE TRUTH.—When the Scotch-Irish Presbyterians settled in the Donegal and Chickies Valleys, nearly two hundred years ago, they little dreamed that in this year of grace, the trolley would invade their domain.—*Columbia (Pa.) Daily Spy.*

RESULT OF REFUSING FRANCHISES.—It is a novel sight, indeed, to witness the same city council that refused to pass certain street railroad ordinances last summer, which would have given employment to 1,000 men all winter, now asking the legislature to allow the city to bond itself to give away $50,000 to the poor.—*Cleveland World.*

TRANSIT SYSTEMS.—Rapid transit makes transfers from one line to another not only possible but highly desirable. It is noticeable that the question is being widely agitated wherever cable or electric cars have been introduced, and the system has been adopted in many places with good results. * * * We have transfers from one line to another operated by the same company, and the privilege thus granted, while it is highly appreciated, only whets the appetite for a universal system of transfers all over town. In one instance rival companies transfer passengers from one line to the other, and the plan works to perfection so far as the public is concerned, and the belief is quite general that the companies lose nothing and gain much from such an arrangement.—*Baltimore Herald.*

NO FREE RIDING.—As announced in the *Call* last Sunday, free riding in the street railroads will cease after to-day. We believe this change is among the most important reforms yet made in the street railroad management. The pass system has been a system of petty bribery, an attempt to stifle criticism by officials, reporters of the daily press and persons of influence, and without a semblance of honesty in any part of it. There has been a pretty thorough failure to realize the benefits sought from it, and therefore it is abandoned; but it will make railroad management better to have this wretched mode of influencing public opinion finally abolished, unsuccessful as it was.—*Newark, (N. J.) Sunday Call.*

CONFIDENCE IN THE TROLLEY SYSTEM.—A trolley road between this city and New York, while it would be a longer road than any of its kind yet established, and, therefore, something of an experiment, would, we feel confident, be a successful venture in the end, and as a healthy stimulus to trade along its route and as an accommodation to the travelling public is heartily to be desired. —*Philadelphia Bulletin.*

VALUE OF A CHARTER.–The case which is presented by current news,of a company of capitalists taking out charters for an elevated road between this city and Wilkensburg is rather singular for the apparent misunderstanding of the legal value of the charter. The charter is taken out avowedly, according to reports, with no intention of building the road, but simply with the idea that if the time should ever come when such a project will be profitable the owners of such a charter will have a start of other competitors. The city attorney is certainly correct in saying that such a plan will give no advantage. It would be a remarkable condition of law if a paper charter, obtained with no intent of carrying out its professions, could stand in the way of subsequent and legitimate enterprise. As a matter of fact a charter conveys no exclusive privileges. It simply gives the right to capital to associate itself in the corporate form. When a corporation so organized proceeds to obtain franchises and to perform the work in accordance with the terms of the franchises it may gain exclusive rights.—*Pittsburgh Dispatch.*

RAPID TRANSIT IN NEW YORK.—There is a general belief that rapid transit may be obtained through the underground system. It is also widely believed that the money can be raised to build it. It is to be hoped that none of the commissioners has been engaged in discouraging intending investors. There have been sinister rumors afloat, and it is known that some people who proposed to subscribe have been induced to reconsider. Friends of certain commissioners would not like to see those rumors proved. The Manhattan does not need official counsel, but the people do. The underground project must have a fair chance.—*New York World.*

ELECTRIC TRACTION CONDITIONS.—The trolley has as yet by no means reached its limitation, but that limitation to its use exists cannot be denied. While we have no sympathy with the hue and cry against the trolley, we cannot but recognize that, in the larger cities especially, objections against overhead trolley wires in sightly streets have some force. Only overwhelming necessity will permit the adoption of this system in these cases, where but little or no objection would be entertained against a conduit or storage battery system, and either would be eagerly chosen to escape from a threatened infliction of a horsecar road. With the elevated electric road now started on its career, the trolley still unsurpassed for general use, the storage battery system in favorable shape, and the electric conduit system coming to the front, the electric traction industry maybe said to be in excellent condition.—*Electrical World.*

RAILWAY CROSSINGS.—The steam roads generally fight the street railway companies to the last, and while possibly justified in such methods they have often made what appears to us to be a mistake in continuing to place difficulties in the way of electric street railways when it is settled that a crossing shall be made. In some cases they refuse to permit their rails to be cut and regular crossings inserted, compelling the electric cars to go bumping over their tracks. Recently we saw an electric car on such a crossing, the solid rails of which had thrown the trolley off the wire, leaving the car helpless in front of an approaching limited express. The catastrophe was averted only by the motorman on a second electric car seeing the danger and with great presence of mind approaching the crossing at a speed which safely carried his own and the helpless car over the crossing. The collision between the two electric cars was hard on the passengers, but they were thankful to escape with their lives. In case there had been a crash, to what extent would the railroad company be held responsible for it, in view of the fact that it would not allow its rails to be cut for the flanges of the street car wheels?—*Railway Engineering and Mechanics.*

ACCIDENTS ON ELECTRIC ROADS. We venture to state that the old horse car system produced more accidents to the week than the electric system has done per month since its inauguration. When the horse car system was in use, the cry was "rapid transit;" when rapid transit was given, the cry was "too quick," but it is ever thus.—*Canadian Electrical News.*

FINANCIAL DEPARTMENT.

Financial Notes.

Receiver for Richmond (Ind.) Road.—The Union Trust Company, of St. Louis, on January 21, filed suit against the Richmond (Ind.) Electric Street Railway Company, asking judgment on the bonds of the company, amounting to $212,000, and asking for the appointment of a receiver to take charge of the road and operate it under the direction of the court. By agreement the present superintendent, A. D. Titsworth, was appointed receiver. During the past season the plant has been much improved at a heavy expense, which, together with the hard times, made it unable to meet its obligations. As far as possible the assets of the company will be applied on the liabilities, although the amount of the former will cover only a small part of the latter. The Richmond Electric Line was formerly the property of J. C. Shaffer, but about a year ago he disposed of it to Colonel John F. Miller, superintendent of the Pennsylvania lines west of Pittsburg, and Russell Harrison. Mr. Harrison held $60,000 of the company's stock. The line will continue operations for the present.

Broadway and Seventh Avenue Bonds.—The Broadway and Seventh Avenue Railway Company of New York, is offering for sale an issue of first consolidated 5 per cent. fifty-year bonds. The total issue of the bonds will be $12,500,000. Of this amount bonds for $4,850,000 will be held by the New York Guaranty and Indemnity Company as trustee under mortgage. The bonds will be secured by a mortgage, constituting a first lien upon the entire cable road, the power-house properties, the company's realty and the property generally of the Broadway road and that of the other lines under ownership of the corporation. As an inducement to purchase. H. R. Vreeland, president of the Broadway Company, has written a formal letter, saying that the net earnings of the company after deducting all expenses are at present more than two and one-half times the amount necessary to pay the interest upon the bonds. That means that the company is clearing a net profit of $1,000,000 or more annually.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers of this city, said yesterday: "There has been but little activity in street railway stocks here and prices are about the same as last week. Conservative people feel confident that West Chicago Street Railway Company can continue to earn 9 per cent. on its capital and that the natural increase of traffic will offset any inroads the elevated systems make on the surface lines. We look for higher prices. The Philadelphia market to-day in the traction stocks has been very dull. Philadelphia has been without sales and being offered 93¼. Metropolitan traded in lightly at fractional concessions, opening at 102½ and declining to 102. The market is devoid of feature and liable to move either way as it is bare of orders."

Chicago.—Articles of incorporation have been filed with the Secretary of State for the South Side Extension Railroad Company. The proposed railroad is to commence at a point between Harrison street and Peck court, between State street on the west and Wabash avenue on the east, in Chicago, and extends thence northerly to a point at or near to Water street, between Lake Michigan on the east and the south branch of the Chicago river on the west, with a branch commencing at the northern terminus of the main line and running thence westerly and southerly to the southern terminus of the main line. The principal office is maintained at Chicago; capital stock $1,000,000; incorporators and first board of directors, Marcellus Hopkins, William R. Champlain, Edwin L. Lobdell and William W. Curley, of Chicago, and David R Lewis, of Evanston.

London, Canada.—At the annual meeting of the shareholders of the London Street Railway Company, held on January 18, the following gentlemen were elected directors for the ensuing year: H. A. Everett, T. H. Smallman, Greene Pack, E. W. Moore, S. R. Break. The following officers were also elected: H. A. Everett, president; E. W. Moore, vice-president; S. R. Break, secretary-treasurer and general manager. The annual report for 1893 showed gross earnings to be $52,244.60, being an increase of $13,702.22 over the year 1892. The operating expenses for the same period were $40,686.93, leaving the net revenue $11,557.67, being an increase of $1,175.25 over 1892.

Worcester (Mass.) Bond Issue.—The Consolidated Street Railway Company has authorized a $500,000 bond issue to liquidate the floating indebtedness of the company incurred in reconstructing the road for operation by electricity. In an explanatory circular issued by the company handling the bonds it is stated that $900,000 has been expended for reconstruction. The company's bonded indebtedness, including this issue, will be $650,000. The gross earnings for year ending September 30, 1893, were $337,657.32. The net income for year ending September 30, 1893, operated by horse power, was $78,773.76. The total interest on bonded debt will be $32,500.

Sale of Lancaster (Pa.) Railway.—The terms of the sale of the Lancaster electric railway lines by the Lancaster Traction Company to the Pennsylvania Traction Company, at the head of which is ex-United States Senator Patterson, were made known last week. The stock of the Lancaster Traction Company is to be taken at $60 per share, half of which is to be paid in cash and the other half in bonds. The Pennsylvania Traction Company will issue $2,000,000 worth of bonds and will take possession of all the lines early in February.

Record of St. Louis Roads.—The annual reports of the St. Louis street railroad companies were submitted last week to the City Register. During the past year the various lines carried 95,180,550 passengers, as compared with 91,685 555 the previous year. The Missouri Company led with 14,927 415, and the Union Depot came next with 14,795,971, the Lindell taking the third position with 14,500,000. The smallest showing was made by the Baden and St. Louis road, which carried 415,554 passengers.

Washington, Pa.—Hon. Brit Hart, receiver of the Washington Electric Street Railway Company, whose line ceased operation several weeks ago, states that the property will probably be sold in February, and that naturally the new owners will endeavor to start the cars as soon as possible. Many business men are of the opinion that if the road is bought in by persons who have sufficient capital to put it in first-class condition and extend the tracks toward the Tube Works, the enterprise will prove a profitable one. Its bonded indebtedness is $27,000.

The annual meeting of the stockholders of the Swan Lamp Manufacturing Company was held at its offices in Cleveland, Ohio, on January 16. The following officers and directors were elected; S. S. Hamill, president and general manager; B. F. Miles, vice-president and treasurer; S. E. Cox, secretary and superintendent; B. P. Roberts, electrician. The following directors were also elected: W. H. Lawrence, B. F. Miles, L. E. Rogers, Webb C. Hayes and S. M. Hamill.

Coupons Due.—The coupons for interest due February 1, 1894, on the first mortgage, 5 per cent., 50 year gold bonds of the Metropolitan West Side Elevated Railway Company of Chicago will be paid by the Commercial Loan and Trust Company, 115 La Salle street, Chicago, and by the West Side Construction Company, 32 Nassau street, New York City, on and after that date.

Brightwood Road Washington.—President Horace S. Cummings, of the Brightwood Electric Railway, has submitted to the commissioners the report on the condition of his road for the past year The capital stock is placed at $108,500; bonded indebtedness, $350,000; the receipts from passenger traffic, $36,907.45, and the total expenses for the road were $47,868.09.

United Electric Securities Company.—A special meeting of this company will be held at Portland, Me., on January 29, to see if the stockholders will vote to reduce the common capital stock, and to determine the extent of such reduction. A decision will also be reached in regard to the details of issuing such new stock of the reduced par value as may be determined upon.

Denver, Colo.—In the suit of the Investors' Security and Accounting Company of New York against the Denver Tramway Company, to secure $150,000 alleged to be due for breach of contract and damages in connection with the construction of the Eleventh and Thirteenth avenue electric road, a verdict has been returned for the defendant.

Norwalk, O.—The directors of the street railway company have circulated a petition asking the city council to submit to the voters a proposition to bond the municipality for $35,000 to aid in the construction of an electric railway from Norwalk to some point on the Big Four road by way of Fairfield.

St. Joseph, Mich.—The St. Joseph & Lake Shore Electric Railway Company, which will build an electric railway in St. Joseph this year, has been organized with a capital stock of $75,000. The officers are: C. P. Wright, president; J. S. Wolfe, vice president; A. L. Thacher, treasurer, all of Chicago, and secretary, S. C. Rosenberg, of St. Joseph.

The Illinois Steel Company will hold its fifth annual meeting for the election of directors and such other business as may be presented at its office in the "Rookery," Chicago, on February 14, 1894. The transfer books will be closed from January 25 to February 15 inclusive.

The Pullman Palace Car Company's directors have declared a quarterly dividend of $2 per share from net earnings, payable on and after February 15, to stockholders of record at close of business February 1, 1894. Transfer books close February 1, and reopen February 16.

Dividend.—The People's Passenger Railway Company, of Philadelphia, has declared a dividend of $1.25 per share, payable January 31 on common and preferred stock as registered January 19, books closing from January 19 to January 31.

Niles, O.—The valuation of the property of the Mineral Ridge & Niles Electric Street Railway Company, which recently went into the hands of receiver, is given as $54,630 by the appraisers.

More Money for Construction.—The fourth call for 20 per cent. of the subscriptions to the Chicago Metropolitan Railroad Company's bonds has been issued. Payments are due February 21.

Denver Tramway Dividend.—The Denver Tramway Company has declared a dividend of 1 per cent. for the six months ending December 31st. The capital stock is $3,000,000.

NEWS OF THE WEEK.

Ottawa, Ont.—Under a ruling of the Customs Department at Ottawa, steel rails for use on steam railroads may be imported into Canada duty free, while on steel rail for use on electric railroads, a duty of $6.00 per ton is imposed. A deputation of gentlemen interested in electric railroads in various parts of the country, waited upon the Premier and members of the Dominion Cabinet a few days ago, and urged that the ruling of the Department be changed and the import duty on rails for electric roads removed. Sir John Thompson, in reply to the deputation, stated, that while personally he was of the opinion that the act provided for the imposition of the duty, he was free to admit that the clause in the tariff was open to two constructions, and this being the case, the goverment would leave the question to be decided by the courts. In this connection the *Canadian Electrical News* says: "We contend that the growth of electric railroads will do more for the development of Canada than a manufactory of steel rails, and the government in dealing with the matter, should legislate in the interests of the many rather than the few."

Chester, Pa.—The trial trip cars were run over the Chester, Darby and Philadelphia trolley line last week, and the road between Chester and Darby is now opened for traffic. The fare to Darby is 10 cents, with a 5 cent fare to intermediate points. The distance is eight miles, and altogether there are 35 miles in the system, which includes the Media direct and Marcus Hook routes. The road between Darby and Chester will certainly prove a profitable one from every point of view. The country it passes through is of a kind which speedy transportation facilities will tend to increase in value greatly, and building operations throughout the territory named must experience a decided quickening in the near future. This is the beginning of a system of electric railways which in a few years will doubtless form a network throughout the semi-urban districts about this city, and upon close and continuous communication with all the towns within a radius of thirty miles of Philadelphia.

Denver, Colo.—On New Year's Day the Denver Tramway Company provided a bountiful supply of things good to eat and drink at its stations all over the city. At the Northern, Southern, Eastern and Western division stations, and at the Blake street and Grand avenue power-houses a plentiful lunch was served from noon until midnight, and every conductor and motorneer in town was invited to the feast. The trainmen of the Eastern Tramway division testified their good feeling toward J. L. McLean and C. E. Emerson by presenting each of these gentlemen a handsome gold pen. Messrs. McLean and Emerson are dispatchers stationed at the main office of the Denver Tramway Company.

Kansas City, Mo.—At a meeting of the directors of the Merriam Park, Rosedale & Kansas City Electric Railway Company last week at Shawneetown, President A. A Pearson presented a statement showing the estimated cost of building the line to be $19,000. The estimate includes the price of one car. The road will be four and one-half miles long, and a round trip will be made in forty minutes. The power house and machinery at South Park are in good order and President Pearson thinks the operation of the new line will be begun in about four months. More than one-half of the capital stock of the new company has already been subscribed.

Montreal, Que.—The Montreal Park and Island Railway Company, which operates the road connecting Montreal and Sault au Recollet has decided to engage in freight traffic as well as passenger business. The line is so located that produce can be conveniently shipped from the Back River district. Factories have been built on the the road to which coal could be cheaply hauled. The company proposes to operate freight cars between midnight and 5 A. M., so that the regular passenger service will not be interfered with.

St. Louis.—Capt. Robert McCulloch of the syndicate lines has decided to convert the western extension of the Citizens' cable into an electric road, beginning at King's highway. The extension will cover over two miles. All of the contracts for the work have been let and the wires, rails, etc., have been ordered. The cars will be built at once. Work on the extension will begin as soon as the weather becomes settled and it will only take about three months' time to finish it. The cost will be all of $150,000.

Paterson, N. J.—The Grand street electric railway was opened last week for regular traffic. The mail for Little Falls and Singac is carried on the cars. The contract for the construction of the line between Lakeview and the Passaic city line, and also for the double tracking of the line from Passaic to Rutherford, has been awarded to Messrs. Nelson & Cullen. The contractors will begin work on these divisions immediately.

Lewiston, Me.—A new long distance rapid project has been announced. The terminal points are Boston and Portland, which are to be connected by a road on which trains will make the distance in four hours. Hon. Frank Jones, and Arthur Sewall, formerly president of the Maine Central road, are said to be interested in the project. Mr. Sewall is interested in the electric line connecting Brunswick and Bath.

Chicago, Ill.—In condemnation proceedings recently the Metropolitan West Side Elevated Railroad Company was given the right to take possession of property occupied by barns of the West Chicago Street Railroad Company upon payment of $32,000. A stay has been granted unexpectedly, but the Metropolitan company claims that it will not affect the progress of the road.

Moving to Schenectady.—The Lynn papers described the exodus of General Electric employes last week saying that the printing and publishing department, the department for the manufacture of electrical instruments and search lights, the calculating and student departments, besides 20 draughtsmen had all been ordered to Schenectady.

Montreal, Que.—If the city council grants the request of the Montreal Park & Island Railway Company for permission to introduce a night freight service the company will establish a freight station in the center of the city for receiving outgoing shipments and for the distribution of incoming goods. It is not expected that the business will be other than local.

Philadelphia, Pa.—Charles McCaul, contractor for the new car shed and repair shop to be built at the corner of Twelfth street and Susquehanna avenue, for the Electric Traction Company, has taken out the permit. The structure will be of brick and iron, one story in height, and its dimensions will be 81 by 325 feet. The cost of the building will be $40,000.

Chicago, Ill.—Residents of the district nor h of the terminus of the North Chicago cable line recently called upon Mr. Yerkes and asked him to afford them rapid transit. Mr. Yerkes states that under no conditions would he consider an extension of the cable system, but that he would build a trolley if the residents secured a right of way.

Indianapolis, Ind.—The contract for the power house on West Washington street has been let to Jungclaus & Schumacher. The structure will have a frontage of 320 feet on Washington street, and its depth will be 330 feet. The contractors agreed to complete the building by April 1st. The improvement will cost about $125,000.

Omaha, Neb.—The following officers have been elected by the Omaha & Council Bluffs Railway & Bridge Company: Guy C. Barton, president, J. J. Brown, vice-president, Charles T. Stewart, secretary and J. H. Millard treasurer. W. L. Dimmick has been appointed superintendent to succeed A. K. Stone.

Saginaw, Mich.—A local paper announces that the committee on manufactures of the board of trade is corresponding with an eastern manufacturer of street cars with a view to inducing the latter to locate its factory in Saginaw. It is intimated that the removal will probably be made.

Chicago.—The Lake Street Elevated Railroad Company will erect an electric plant at 1137-39 West Lake street. It will be one story and basement high, 40 by 60 feet, brick, stone and iron construction. It will cost about $7,000.

Springfield, Mass.—The street railway company will begin the construction of the new power station on Market street in the Spring. Babcock & Wilcox boilers and McIntosh & Seymour engines will be installed.

Baltimore.—Efforts are being made to compel the street railway companies to comply with the law requiring them to put fenders on their cars. Warrants were issued last week for the arrest of the presidents of the various roads.

Toronto, Ont.—It is stated that eastern capitalists have under consideration a project of building an electric railway from Toronto to Steubenville. Who the projectors are has not been disclosed.

Ann Arbor, Mich.—The Ann Arbor Electric Railway barns burned to the ground on Thursday, only one car being saved. The loss on cars and motors was $20,000, with $11,000 insurance.

Chicago, Ill.—The town board of Oak Park has granted a franchise to the Cicero & Proviso Street Railway Company to lay double tracks on Chicago avenue.

Montreal, Que.—The Church of England Synod has unanimously declared against the running of street cars on Sunday.

PERSONALS.

George Yuille has been appointed secretary and treasurer of the West Chicago Street Railroad Company, to succeed R. C. Crawford, who recently tendered his resignation to engage in business for himself. Mr. Yuille was for many years connected with the Chicago Gas Company. The office of general superintendent of the street railway company, which was also filled by Mr. Crawford, is still vacant. Mr. Crawford has been connected with the West Side road for nearly seven years, and has won for himself an excellent reputation. He leaves for a trip to California, expecting to be absent about five months. On his return he will open a brokerage office in Chicago.

W. A. McGuire, president of the McGuire Manufacturing Company of this city, is absent on a trip to Omaha, Denver, Salt Lake, San Francisco, Los Angeles and other points on the Pacific Coast. Mr. McGuire is accompanied by his wife and daughter and will spend some time at the Midwinter Fair. He will return in about six weeks.

Prof. H. A. Rowland, of Johns Hapkins University has brought suit agaist the Cataract Construction Company for $30,000, the amount of a bill rendered for expert services in designing the plant for the Niagara transmission of power project. The case came up before Judge Shipman in New York City last week.

The Will of the Late William Richardson of Brooklyn. who was long the president of the Atlantic Avenue Railroad Company has been admitted to probate. It bears date May 26, 1887, and ex-Secretary Tracy is one of the witnesses. The entire real and personal estate is valued at $165,980.

Marsden J. Perry, of Providence R. I., at one time president of the National Electric Light Association, has been appointed with Thomas C. Platt as one of the joint receivers of the New York and New England Railroad Company.

E. E. Keller, who had entire charge of the installation of the Westinghouse lighting plant at the World's Fair, both in its installation and operation, has been elected vice-president and general manager of the Westinghouse Machine Company of Pittsburg.

Geo. B. Prescott, a well known electrician whose work in connection with the telegraph and the telephone, was, perhaps, as important as that of any of the large number of scientific men who have dealt with these subjects, died in New York City on the 18th inst.

R. H. Pierce, the electrical engineer in charge of the World's Fair electrical work resigned his position last week, and is now engaged, with Mr. Neiler his assistant in finishing his report. His temporary down-town office is at 501 Manhattan building.

W. S. Dimmick, for seven years the manager of the Postal Telegraph Company at Omaha, has resigned his position to accept the superintendency of the Omaha & Council Bluffs Street Railway Company to succeed A. K. Stone.

Wallace C. Burrill, ex-assistant superintendent of the Belle City Street Railway Company, of Racine, Wis., was seriously injured by the kick of a horse on Saturday last. His recovery is said to be doubtful.

W. H. Preece, well-known on this side of the water as a genial gentleman and an entertaining scientist has been honored by the Queen with an appointment as a Knight Commander of the Bath.

F. Wayland Brown, formerly manager of the Youngstown Street Railway Company has secured the exclusive rights for the United States to sell a patent car sander for street railways.

TRADE NOTES.

The Wallace Electric Company. of 104 Michigan Avenue, Chicago, announces that it has been organized for the purpose of conducting a business in electrical goods as manufacturers and manufacturers' agents. Among other things a full line of electrical street railway appliances and supplies and a few carefully selected specialties will be handled. The officers and management of the company are well known to the trade. The general manager, Mr. J. B. Wallace, has been actively identified with electrical industries from the earliest experimental stages of electric lighting in this country. Mr. Wm. S. Hine, the president, has had a large experience in this business through his connection with the U. S. Electric Lighting Company and the Westinghouse Electric and Manufacturing Company as general district agent. Mr. Max A. Berg, secretary of the company, is well known as the former manager of the street railway department of the Ansonia Electric Company, and Mr. M. M. Wood, whose special devices are rapidly coming into use for street railway construction, will be electrical engineer in this department.

A Handsome Testimonial. — Messrs. Sargent & Lundy, of this city, have hanging in their office a magnificent testimonial just received by Mr. Sargent from the boiler manufacturers whose boilers comprised the World's Fair steam plant. It will be remembered that Mr. Sargent designed and constructed the entire steam plant at the Columbian Exposition, and this testimonial is a recognition of the care with which he designed and carried out his work.

Messrs. Sargent & Lundy, of this city, have moved from their former offices in the Monadnock building to large and desirable quarters on the ground floor in the same building. They are fitting up these new quarters in splendid shape, and will hereafter carry in stock a complete line of Crocker-Wheeler motors and accessories, for the display of which their new storeroom is particularly well adapted.

The Western Telephone Construction Company of this city is receiving inquiries from every section of the United States relating to its telephone system, and say that it will begin filling orders the first of February. It is now completing an exchange at Albert Lea, Minn., which it expects to have in operation within a few days. The company reports that it has a system specially adapted to street railway lines to which it invites the attention of street railway managers.

The Citizens' Gas Company, of Brooklyn, N. Y., has placed the order for an iron roof for its new producer house, with the Berlin Iron Bridge Company, of East Berlin, Conn. The building is 69 feet wide and 151 feet long, with an iron roof covered with slate. The new mill of the Diamond Mills Paper Company at Milbank, N. J., is being put in place also by the Berlin Iron Bridge Company.

The Walker Manufacturing Company of Cleveland, O., expects to put its electric street railway apparatus on the market within a short time, although no date has been fixed. No details have yet been given out regarding the machinery, but to experts who have examined the new machines the designs have seemed highly satisfactory.

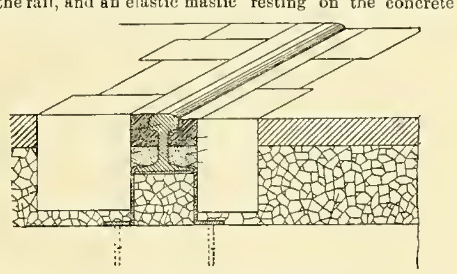
The Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for an iron roof for the boiler and engine room of De Land & Co., at Fairport, N. Y. The roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued January 9, 1894.

512,343. Method of Laying Railway Rails in Paved Streets. George C. Warren, Utica, N. Y. Filed May 5, 1893.

This invention covers the combination of a "T" rail, having a separate or retaining wall parallel with and a little removed from the head rail, a concrete grouting resting in whole or in part on the base web of the rail and partially filling the space between the retaining wall and side of the rail, and an elastic mastic resting on the concrete

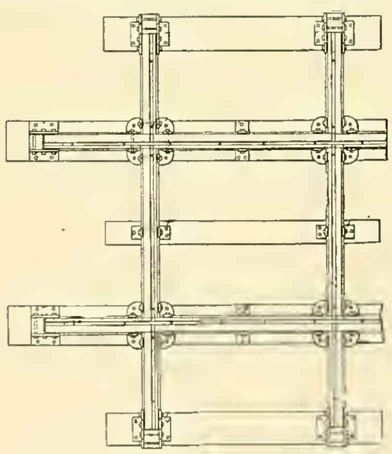


512,343. METHOD OF LAYING RAILWAY RAILS IN PAVED STREETS.

grouting and occupying the space between the side and head of the rail and the retaining wall. (See illustration.)

512,351. Street Railway Crossing. William C. Wood, Brooklyn, N. Y., assignor to the Lewis & Fowler Girder Rail Company, same place. Filed March 31, 1893.

This invention covers the combination, in a street railway crossing, of two box girder rails having substantially rectangular notches in their web extending upwards to the bottom of the top of the rail, and another pair of such box rails having substantially rectangular notches at top extending downward to the bottom of the top of the rail,



512,351. STREET RAILWAY CROSSING.

substantially as herein before specified, whereby the respective rails are supported against tilting or lateral displacement at each intersection. (See illustration.)

512,373. Trolley Cut-Out. Melancthon Hanford, Maldeo, Mass. Filed September 22, 1893.

This is an automatic safety cut out for wires for electrical service adapted to form an uninterrupted metallic surface for the passage of a traveling brush, and composed of a hanger of suitable insulating material, two bolts transversely secured in said hanger, and pivotal plates, which form the terminals for adjacent ends of independent lengths of the system, the broken gravity end of a length causing its plate to rock and be detached from the hanger bolts. (See illustration.)

512,387. Railroad Cross Ties. Reuben R. McClerg, Roanoke, Ala. Filed July 13, 1893.

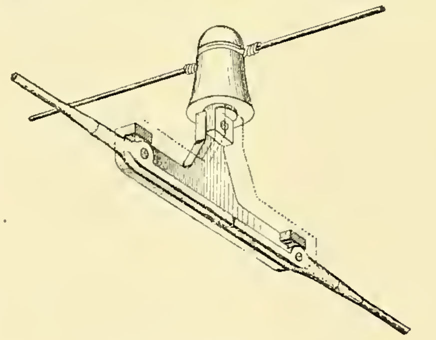
This tie has a solid piece with flange near each end to grasp the outer flange of the rail. The longitudinal center piece has flanges to work in the recesses of a cross piece, the whole being adapted to clamp and hold in place the railway rails.

512,414. Railway Transfer Ticket. George Truesdell, Washington, D. C. Filed February 9, 1892.

This is a transfer ticket composed of subdivisions arranged across the ticket, from side to side, said subdivisions containing respectively the stations, the name of the company, with the word "transfer," and the serial and date number; and having also on the upper edge a series of numbers, and on the lower edge another series of numbers, the one indicating hours and the other fractions of hours.

512,424. Alternating-Current Dynamo. James J. Wood, Fort Wayne, Ind. Filed June 23, 1893.

The first claim of this patent reads as follows: In a separately-excited dynamo having a multipolar field-magnet, the combination of two pairs of binding-posts on opposite sides of the field-magnet, with the field-magnet coils connected in two series, one including the upper coils and



512,373. TROLLEY CUT-OUT.

terminating in two posts on opposite sides and the other including the lower coils and terminating at opposite sides in the two remaining posts, whereby either pair of posts may be bridged by a wire and the other pair connected to the wires from the exciter.

512,425. Connection Between Separately-Excited Dynamos and Their Exciters. James J. Wood, Fort Wayne, Ind. Filed Oct. 17, 1893.

The first claim of this patent reads as follows: The combination, with a separately-excited dynamo having an adjustably mounted surbase, of an exciter for said dynamo adjustably mounted on a movable base, and a rigid connection between the surbase of said separately-excited dynamo and the movable base of said exciter, whereby the latter follows the movements of the former and the tension of the driving belt between the two is preserved. (See illustration).

512,444. Closed-Conduit Railway. Charles J. Kintner, New York, N. Y. Filed June 22, 1893.

This conduit has an insulated current main, pivoted switch levers located in the slotted conduit and wholly enclosed in switch box, actuating levers therefor pivoted on opposite sides of the conduit and having movement independent of that of the switching levers but in the same direction, in a combination with branch circuit connections from the current main, through the switch levers, to a trolley carried by the car.

512,480. Sand Box for Cars. George A. McKenzie and Andrew T. Brock, West Bay City, Mich. Filed August 29, 1893.

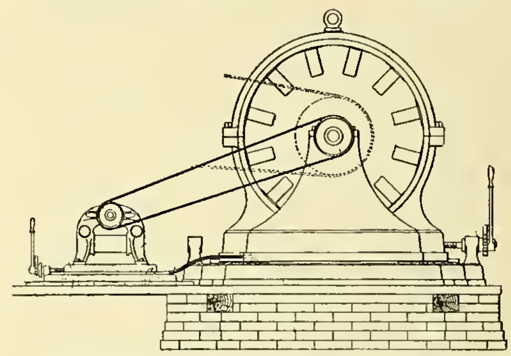
A sand box is placed within the car, which is of drum form, provided with suitable bearings upon which it may turn, and stops to regulate its rotation; a delivery spout is provided and a hole in the bottom of the car allows the sand to be distributed upon the track.

512,515. Overhead Switch. Arthur L. McCreedle, Sydney, New South Wales. Filed March 29, 1893.

A switch block is journaled between the main track sections and has grooves in its upper and lower faces and in its lateral extension. A branch block has a stop shoulder for the inclined extension and another block is bolted to the end of one track section and is provided with a shoulder.

512,535. Electric Railway Current Collector. Eben M. Boynton, West Newbury, Mass. Filed October 12, 1893.

The second claim of this patent reads as follows: In an electrically propelled bicycle car, the combination with



412,425. CONNECTION BETWEEN SEPARATELY EXCITED DYNAMOS AND THEIR EXCITERS.

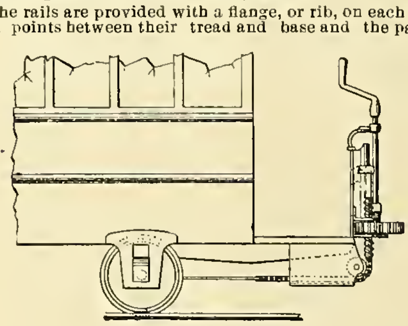
the guide wheels of one or more current collectors, guided and carried by the frame work of said wheels and capable of motion in a vertical plane, substantially as set forth.

512,539. Railway Car Seat. Emery B. Cushing, Laconia, N. H. Filed May 22, 1893.

This is a railway car seat comprising in its construction a reversible seat bottom pivoted to plates on the frame work of the seat, bolts in the seat bottom adapted to engage one of the said plates and thereby lock the seat-bottom, a rotatable rod extending through the seat proper, and eccentrics on said rod and connected with the said bolts.

512,566. Street Pavement. Bedford P. Thiebaud, Springfield, O. Filed May 9, 1893.

The rails are provided with a flange, or rib, on each side, and points between their tread and base and the paving



512,588. CAR BRAKE.

blocks are provided with recesses into which fit the flanges of the rails.

512,569. Street Pavement. Bedford P. Thiebaud, Springfield, O. Filed May 9, 1893.

This method is similar to that described in the preceding patent except that the blocks are provided keys which may be inserted into the matching recesses of the blocks, or of the blocks and the rail.

512,588. Car Brake. Harry Thompson, assignor to himself and John F. Ambrose, New York, N. Y. Filed October 24, 1893.

The combination, with the brake levers and brakes of a car, of a screw of quick pitch capable of being slid without turning, an internally threaded pinion arranged to turn on the screw but prevented from sliding thereon, a spur wheel and a crank shaft for operating the internally threaded pinion, and the brake connections.

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CONTENTS.

Midwinter Fair Street Car Traffic. The traffic on the San Francisco street railways on Saturday last when the Midwinter Fair was opened was the greatest ever recorded for a single day in the history of the city. During the eight hours from 9 a. m. to 5 p. m. the consolidated lines carried 8,000 persons hourly to the park, and during the same time the Metropolitan electric road transported 2,000 passengers every hour. The number of cars in service was about double the number ordinarily in operation. The crush occurred in the afternoon when the sight-seers left the park. From 5 to 6:30 o'clock the facilities were taxed to the utmost, but the crowds were transported quickly and safely. No mishaps of any importance are chronicled in the San Francisco papers in connection with the street railway service at the opening of the Fair; an accident in which several persons were injured occurred in San Francisco on Saturday, but not on a line leading to the Fair grounds.

Car Speeds and Accidents. It has been contended for a considerable time in Brooklyn that cars were operated at too high a rate of speed, and reports of actual tests would seem to justify the contention. An expert in a recent communication to the mayor stated that he had learned by actual measurement that motor cars had attained a speed as high as nineteen and a half miles. No one would claim for a moment that such a rate was consistent with safety except far out in the suburbs. In St. Louis an investigation by a local paper went to show that rates were even higher than those reported in Brooklyn. The latter tests are probably decidedly inaccurate and no conclusions are to be drawn from them. The high speeds noted in Brooklyn, assuming that the measurements were correct, are certainly by no means as common as the daily press is inclined to assert. It is interesting to note in this connection the casualties that may be considered chargeable to high speeds in the classified list of street railway accidents which appears elsewhere in this issue. Out of a total of 137 accidents 75 might possibly have been prevented if the cars had been moving at a slow rate of speed, though this is of course a matter of assumption. The greater number of these, however, could have been prevented had cars been equipped with a reliable form of fender, and a more powerful and more quickly acting brake. Both these devices are urgently needed in the street railway field, and we hope to see developments along this line during the year.

Electricity on Elevated Roads. During the last few months rumors that Chicago elevated railway companies had decided to use electricity and dispense with their locomotives altogether have frequently been published. Inquiry, however, has developed the fact that the reports were by no means accurate. Within the last few days it has been stated positively that the executive committee of the Metropolitan company, whose line will be opened within a year, had after an extended investigation decided to discard the locomotives which it had ordered and to substitute electric motors. This statement is certainly premature. Like all the elevated railroad companies in Chicago the Metropolitan has been investigating electric traction, but the absolute statement is authorized at the office that no decision has yet been reached. A great change has taken place among those in charge of elevated railroads within the last eighteen months. While they formerly considered electricity as wholly out of the question as far as their lines were concerned, they are now very seriously studying the problems that must be solved in substituting an electrical transmission system for the steam locomotives. The necessity of reducing expenses has been a great incentive in the case of the Chicago companies Their business is not sufficiently profitable to enable them to pay operating expenses and the interest on their bonds. This condition is due partially to the business depression and in part to the fact that their downtown terminals are too far from the business center. With receipts too small to meet the demands it is not surprising that the companies have turned a willing ear to the electrical representatives who promise them substantial economies in the department of operation. They are now engaged in the investigation of the matter, and it certainly would not be surprising if all the companies adopted electricity within a comparatively brief time.

Electrolytic Action. We begin the publication in this issue of an exhaustive article on the electrolytic effects of the return currents in street railroad systems. The author of these papers undertook the study of the subject nearly a year ago for the purpose of making a report to the manager of a prominent street railway system who desired the fullest possible information upon this important topic. Mr. Smith carefully investigated the question while connected with the electrical department of an important road, and his articles will be found to cover, in great detail, the causes of the corrosion of gas and water pipes by street railway currents and the deterioration of track bonds and other track wiring. This is a subject but little understood and Mr. Smith's articles will doubtless go a long way toward placing it upon sound basis. If managers and electrical engineers will contribute any additional facts that have been discovered in the course of their own experience we feel confident that much interesting and valuable information would thus be rendered accessible. Street railway companies that have had trouble with their return circuits have been too backward about imparting this information to others. In this connection it may be well to mention that one of the subjects announced for discussion at the Washington meeting of the National Electric Light Association is the "Electrolytic Effects of Return Currents." Another paper to be read at the same convention is on the importance of complete metallic circuits for electric railways, by J. H. Vail, a well recognized authority on all problems connected with electric railway engineering. This topic is closely allied to the one dealt with by Mr. Smith as the best way of avoiding electrolytic effects is to secure as nearly as possible a perfect metallic return circuit.

Needs of Street Railways. An exceedingly interesting contribution to our columns this week is the symposium by more than twenty street railway managers and engineers upon the immediate needs of street railway systems. These contributions also deal with what was developed during the year 1893 to meet these needs as well as with the present requirements. The questions submitted, printed in full elsewhere, covered three points: (1) The development of 1893; (2) the line of probable progress in 1894; and (3) the improvement most urgently demanded to make the present methods of operation safer, more economical or more satisfactory. It is interesting to note the great variety of opinions held by managers and engineers in regard to these questions. Out of more than twenty we have only four agreeing upon the most important advances of the year 1893—four selecting the Intramural railway, four the direct connected generator, four the type K. series parallel controller—while all other opinions are scattered from the circuit breaker and the rail bond to the Liverpool Overhead railway and the decline of cable roads. One writer is of the opinion that the adoption of more stringent rules to prevent accidents was the most marked advance of the year. Upon the second question opinions differ even more widely than upon the first. Four engineers agree that the greatest advance will be in the development of an alternating current motor for street railway service; three others think, or at least hope, that the more general use of accumulators will be a feature of the year's progress, while three others look for the greatest improvement in the electric conduit railway. Greater development in direct connected generators, further reduction in the weight of motors, better line construction, more satisfactory fenders, better training of motormen and a simpler control of the car are a few of the improvements that other contributors believe will receive the greatest share of attention during the present year. To the third question seven replies specify that either an improved brake apparatus or the car fender is the improvement most urgently demanded either by the public or by street railway companies. This is certainly to be taken as a significant expression of the opinion that safety devices, whether in the form of fenders, improved brakes or better methods of controlling the car, are regarded as a much needed improvement. This opinion is amply supported by the weekly records of the patent office, which show that more inventors are working along this line than in any other direction for the improvement of existing street railway apparatus. Upon this question, however, the replies suggest a number of ways in which improvements might be made. A careful consideration of these opinions will amply repay any thoughtful manager who is desirous of securing the best possible results in the operation of his road.

STREET RAILWAY ACCIDENTS.

The monthly classified list of street railway accidents is presented herewith. The number of accidents during January was slightly greater than during December and November, when the records were respectively 126 and 117. During the month accidents were noted in the principal cities as follows: New York 16, Chicago 5, Philadelphia 8, Brooklyn 8, St. Louis 8, Baltimore 4, New Orleans 3, Jersey City 6, Denver 2, Kansas City 3, Milwaukee 2, Toledo 3. The January list is as follows:

Number of places in which accidents were noted	64
Total number of accidents	137
Accidents to electric cars	105
Accidents to cable cars	27
Accidents to horse cars	5
Number of fatalities	36
Fatalities due to electric cars	27
Fatalities due to cable cars	7
Fatalities due to horse cars	2
Number of persons injured	116
Persons seriously injured by electric cars	46
Persons seriously injured by cable cars	5
Persons seriously injured by horse cars	None
Persons slightly injured by electric cars	52
Persons slightly injured by cable cars	8
Persons slightly injured by horse cars	5
Number of passengers injured	32
Number of employes injured	16

CAUSES OF ACCIDENTS.

Attempting to cross in front of cars	37
Alighting from a car	9
Collision with vehicles	26
Collision of cars	9
Collision with horse cars	2
Collision with sled	1
Attempting to board car	6
Fell from cars	4
Runaway horses	2
Breaking of platform gate	1

CAR SPEEDS IN BROOKLYN.

Mayor Schieren of Brooklyn last week summoned to his office representatives of the street railway companies in order that the matter of car speeds and accidents might be discussed in conference. There were present, among others, President Norton, of the Atlantic Avenue Railroad Company's system; Col. John N. Partridge, representing the DeKalb avenue system; Thomas A. Moore, counsel of the Broadway Railroad Company; Secretary Bogardus, of the Brooklyn City Railroad Company. Mayor Schieren called attention to the report of Prof. George W. Plympton, published in the last issue of the STREET RAILWAY GAZETTE, in which he asserted that cars in Brooklyn attained speeds as high as 19½ miles per hour. In response to a question of the mayor Secretary Bogardus said that ten miles an hour was the speed at which the company's men had been instructed to run the cars, and that if the cars were run faster it was in disregard of the instructions and the time table. "Our time table does not call for any rate over ten miles an hour," said Mr. Bogardus; "we punish the motorman who violates this rule if it is reported to us. We commenced the system with new men and some of the accidents were due to their carelessness. But then many of the accidents are due to the fact that the people are ignorant of the system."

The mayor wanted to know why the inspectors did not report cases of too rapid speed of cars. The inspectors did so, Mr. Bogardus answered, and a number of motormen had been discharged in consequence. There were seventy or eighty of these inspectors, whose duty it was to report infractions of the time rule.

When asked if it would be an idea to examine the motormen as engineers are examined Secretary Bogardus replied in the affirmative, but thought the city should assume the responsibility.

Colonel Partridge said that the people wanted speed with safety, and the time tables were arranged so that only ten miles an hour should be run. "When this rate is exceeded," said the Colonel, "it is due to deviltry and cussedness on the part of motormen."

Mr. Mumford blamed the truckmen for most of the excessive car speed. These people, he said, seemed to take pleasure in annoying the motormen, and causing them to lose time, which they had to again make up. He thought the trucks should not be allowed to use the car tracks.

Joseph McDonald, chairman of the Employes' Assembly of the Brooklyn City Railroad Company, said:

"If your Honor would investigate, you would find out that the impossible is expected of the motormen. If you don't make up your time table it's a crime, and nine times out of ten you are discharged. The principal annoyance to the men is the standing time at the end of the road. This standing time is not long enough.

"I run a car from Fulton Ferry to Fort Hamilton," he added; "the running time is fifty-seven minutes down, and fifty-eight minutes up. It takes fully a minute to make a stop. On the outskirts of the city the cars run very fast. If we make five or six stops on the outskirts, we cannot make our running time, and if we don't make it we don't remain on the road long."

At the conclusion of the conference the mayor was given an assurance by the representatives of the companies that their instructions regarding speed would be obeyed by the men.

Decision Against the Citizens' Company, Detroit.

Judge Taft, of the United States Circuit Court, on January 21, handed down a decision in the protracted litigation between the City of Detroit and the Detroit Citizens' Railway Company. The court's finding was an unqualified victory for the city. The action was a suit in equity to compel the company to cease running its cars and to remove its tracks from the public streets. In the former opinion Judge Taft had held that the City of Detroit could not give nor the street railway company receive a franchise for a period extending beyond May, 1893, when the street railway company's charter expired by constitutional limitation. The property and franchises are now, however, and have for four years past been held by companies succeeding the original grantee, whose charter period extends beyond the term of the franchise granted in the streets, and it was held that the city, in dealing with these companies under the ordinance of extension, was estopped from invoking the law against them.

Judge Taft's final decision is that there is no estoppel, and that the companies are out of the possession of the streets. The amount of property affected by the litigation is $4,500,000, of which $1,500,000 is in stock interests and the balance is first and second mortgage bonds.

The decree is that the company has no rights in the streets of the city except upon the Baker street and the Cass avenue lines, and that it is to be enjoined from running cars after three months upon any of the prescribed lines. He says he fixes the time at three months for one reason—that it may afford opportunity for an adjustment of the controversy, so that a new grant may be given the company upon reasonable terms, or that the plant may be sold at an appraised value to some new company. He assumes that the city will not take unconscionable advantage of the company's practically helpless condition, and that it may be seen that it is for the city's reputation that a compromise be made, whereby the company can obtain an adequate return for the large cash investments it has made in good faith.

The railway company's attorneys announced that they would follow the course laid down in the opinion and appeal within the twenty days. They were unable to say just what steps would be taken in the matter. Compromise was mentioned to some of them, but they seemed averse to talking in any shape on that subject. One or two of them ventured the prediction that the Citizens' company would be running its cars under the 1879 ordinance for fifteen years to come.

DULUTH-MINNEAPOLIS ELECTRIC RAILWAY.

M. B. Ridgway, of Minneapolis, has made public a plan for the electrical operation of the proposed railway from Duluth to Minneapolis. Those interested in the line, for which a survey has already been made, have planned to use locomotives, but Mr. Ridgway has made estimates which lead him to believe that power transmission by electricity could be adopted to great advantage. According to his scheme power stations would be located every 12 or 15 miles, and the power for generating the electricity would be the immense water powers of the state now not utilized. The line of the road as proposed by Mr. Ridgway is somewhat as follows: It would run from Minneapolis directly to the valley of the St. Croix river and thence along the course of that river to Kettle River Falls in Pine county, thence it would cut across the land to the head waters of the Nemadji river, following down the latter to St. Louis river and into the head of the lake cities.

The first water power would be located at Minneapolis and the next in the St. Croix river. In the latter body of water, at intervals of 10 or 12 miles, there are falls, which, by the construction of small dams and slight improvements, could be made useful. At Kettle River falls the water power is considerably greater than at many of the other points and a large power station would be located for the purpose of furnishing the power to drive the motors to the Nemadji river. In the headwaters of the latter the power to be derived from damming up the river is considerable also, and this could be used in sending the rolling stock across the country to the St. Louis river.

Mr. Ridgway, who has looked into the matter, figures that freight rates, if such a line of road as proposed was in operation, would be reduced from one-third to one-half less than those charged at present, and that Minneapolis and St. Paul would practically be put on a basis as a distributing point that would be far ahead of either Superior or Duluth.

Mr. Prouty Accepts the Metropolitan Company's Proposition.

Mr. E. Prouty of 334 Dearborn street, Chicago, the inventor of the "Prouty independent grip car" system of operating street railways, has offered to accept the proposition of the Metropolitan Traction Company of New York, and will furnish under certain conditions, which he specifies in his letter published elsewhere in our columns, one of his cars for a test, which he claims will show that his system is superior in many respects to both the cable and the overhead trolley. The claims made for it over these two systems are in point of economy, in point of public safety, public accommodation, and public taste. It obviates the necessity of a cable power house, conduit, etc., and of an electrical power house, poles, wires, etc. It is guaranteed that the total cost of motive power to propel two cars geared at a speed of 15 miles an hour will not exceed $1.60 for 16 hours. Every car or train, it is claimed, is absolutely under the control of the driver at all times, and the speed may be carefully regulated from the maximum down to less than 100 feet per hour. Track brakes are used. Power is generated on the train. Mr. Prouty specifies that his car shall be given a careful test extending over three months, and it will be seen by his letter that he does not care for the $50,000 reward so long as he is given a fair opportunity to prove the superiority of his system.

Evansville, Ind.—The Cumberland Telephone & Telegraph Company has sued the Evansville Street Railway Company for $60 damages for the alleged burning and destroying of the plaintiff's property in the exchange caused, it is averred, by faulty construction of defendant's trolley wire on Third street, near Washington, one of the telephone wires coming in contact with the trolley,

NEEDS OF STREET RAILWAYS.

WHAT HAS BEEN DEVELOPED TO MEET THEM AND WHAT IS STILL REQUIRED.

Opinions of Managers and Engineers Concerning the Improvements of 1893 and the Outlook for the Immediate Future.

Anticipating the desire of its readers to secure such information, the STREET RAILWAY GAZETTE recently solicited replies to the questions printed below from a large number of street railway managers and engineers. The replies to these questions have been exceedingly satisfactory and show that managers and engineers have taken an active interest in the subjects mentioned.

It will be noticed that the replies indicate a very wide difference of opinion as to the most important developments of the past year as well as to the most urgent demands of the present systems of operation. The questions submitted were these:

(1) What, in your opinion, was the most important discovery, invention, improvement or development in the street railway industry during 1893?

(2) Along what lines do you look for the greatest progress and improvement in 1894?

(3) What new street railway invention, or what improvement in existing apparatus, do you consider most urgently demanded at the present time?

The replies to these inquiries have been condensed into brief tabular form and are here given in the order of their frequency, each reply being followed by the name of the manager or engineer who made it:

ANSWERS TO QUESTION I.

Direct connected generators	Smith, Field, Bickford, Badt
Intramural railway	Chapman, Jackson, Henry, Mottram
Type K, General Electric controller	Sullivan, McLean, Foster, Cahoon
G. E. 800 motor	Sullivan, Foster
Underground railway conduit	Shepardson, Pope
Rail bonding	Smith
Reduction in weight of motors	Field, Henry
Snow plows	Shepardson
Liverpool overhead railway	Jackson
Construction of large generators	Parshall
Decline of cable roads	Hering
Adoption of stringent rules to prevent accidents	Hering
Separately excited generators	Badt
Improved series multiple controller	Hunter
Development of surburban electric lines	Brown
General improvement of motors and generators	Field
New General Electric circuit breaker	Sullivan

ANSWERS TO QUESTION II.

Alternating current motor for railway work	Shepardson, Badt, Hunter, Leonard
More general use of accumulators	Smith, Shepardson, Hering
Improved conduit railway	Pope, Hering, Brown
Reduction in weight of motor	Smith, Field
Gradual development of direct connected generators	Field, Parshall
Better system of bonding	Cahoon
Elevated roads	Hering
Better line construction	Henry
More satisfactory feeder	Chapman
Improved long distance service	Foster, Mottram
Brakes that are more easily repaired	McLean
A return to conservatism	Sullivan
Gearing of single motor to both axles	Smith
More careful management	Shepardson
Better training of motormen	Shepardson
Systematic inspection of equipment	Shepardson
Careful study of braking question	Shepardson
Use of electricity on city rapid transit systems	Jackson
Special use of motor cars or locomotives to haul trains	Leonard
Gradual developement of motors and power house machinery	Bickford
Better and simpler control of car	Leonard
Reduction in amount of power required to start a load	Leonard

ANSWERS TO QUESTION III.

Improved brake apparatus	Pope, Shepardson, Cahoon, Henry, Mottram
Conduit railway system	Sullivan Field, Badt
Improved accumulators	Smith, Hering
Satisfactory method of connecting one motor to both axles	Chapman, Smith
Alternating current railway motor	Hunter, Leonard
A preventive for power station accidents	Sullivan
General improvement to a higher standard	McLean
Perfect rail joint	Foster
Reduction of weight of motors	Smith
Elastically suspended motors	Anderson
Better adhesion by some electro-magnetic device	Shepardson
Car fenders	Bickford
Satisfactory long distance service	Bickford
More durable armatures	Parshall
Reduction of the effect of load fluctuations	Hering
Constantly running armatures	Henry
Improved return circuit	Henry
Motor that can be freely used as a source of brake power	Brown

The full replies from which the above tabular statement is made are here given:

P. F. SULLIVAN,

General Manager, Lowell and Suburban Street Railway Company, Lowell, Mass.

(1) *A.* The most important discovery, if it should be called such, is that street railway companies are arriving at the conclusion, or have discovered that "well enough" is "not good enough;" that to produce the best results they must "choose everywhere, and at all times the best," whether men, material or apparatus, and at the same time coöperate with and supplement the work of the manufacturers by study, logical action and comparison of results.

B. The most important inventions or improvements appear to be chiefly in apparatus or equipment, among which may be classed type K. controller, G. E. 800 motor, and the new circuit breaker and resetting device of the General Electric Company.

C. That development is and has been going on in the lines mentioned above.

(2) Paradoxical as it may appear, I look for the greatest progress, and by greatest I mean best, along lines which are conservative. Even the very best companies, those supposed to be best informed, those chiefly which changed from animal to electric motive power, did not do so along the best business lines. I grant that they acted according to the light they had, but such light was as the candle of the past to the electric light of the present; therefore they should try to get the best with the tools they have. They strained their financial system by the enormous effort put forth; they should try to regain it before another effort.

(3) *A.* Some substitute for trolley wires is desirable and the one to be preferred is the conduit system. He who will surmount the obstacles to the latter system so that it can be generally used will deserve a little halo.

B. The improvement in existing apparatus most urgently demanded is something which will prevent accidents such as happened in Brooklyn, Lowell, Cincinnati and other power stations. Such accidents can hardly be coincidental. It isfor our common interest to look for the cause and remove it quickly.

THOS. H. MC LEAN,

General Manager, Citizens Street Railroad Co., Indianapolis.

(1) The direct coupled generator passing from an experimental to a practical stage, and the series parellal controller having come into general use, the above having greatly increased the efficiency of the electric railway.

(2) Construction of railway machinery from the standpoint of maintenance whereby brakes can be more readily repaired with less skill required.

(3) The railway machinery will be brought up to the highest standard electrically and mechanically, and we hope, if not this year, in a few years, to see electricity generated direct from heat.

JAMES R. CHAPMAN,

Vice-President and General Manager, Consolidated Street Railway Company, Grand Rapids, Mich.

(1) The successful adaptation of the electric railway to the moving of large masses of people on an elevated structure as demonstrated by the Intramural at the World's Fair.

(2) Progress toward a satisfactory fender or life guard for the peculiar conditions existing on electric roads.

(3) Some satisfactory device for driving both axles or both trucks of an electric car by means of one motor suspended from the car-body without the use of bevel gears.

E. C. FOSTER,

General Manager, Lynn & Boston Railroad Co., Lynn, Mass.

(1) I consider the General Electric Company's G. E. 800 motor and type K. controller one of the best improvements for street railways in 1893, so far as my knowledge goes.

(2) I look for great improvement in the long distance service of street railways.

(3) I think that which is the most urgently demanded is a perfect rail joint. Of course, there are many things which might be mentioned, as the system is far from perfect.

CLEMENT C. SMITH,

Engineer, La Crosse City Railway Company.

(1) Improvement in rail bonding and a general better understanding of the subject, securing good return circuit, and prevention of electrolysis; the rapid increase of use and improvement in direct connected generators.

(2-3) More general use of accumulators in stations to maintain balance in power, and prevent enormous variations in load being thrown, as now, directly on machinery; improvement in accumulators for this purpose, and possibly in this way an acceptable storage battery for motors; perfection in gearing single motors to both axles, thereby increasing efficiency and lessening repairs; and an all-around reduction of weight in motors—following lines of G. E. 800.

GEO. W. BAUMHOFF,

Superintendent, Lindell Railway Co., St. Louis, Mo.

My experience during the past year would not warrant me in replying to your first and second questions, and there have been so many discoveries and inventions in connection with street railways that it would be difficult to state what could be best introduced to improve the various systems. I do not look for any great improvement in any direction during the coming year.

A. A. ANDERSON,

General Manager, The Youngstown Street Railway Co., Youngstown, Ohio.

With reference to your inquiries will say that, having been out of the street railway business since June 1 last and only having returned to it recently, I do not feel that I am in a position to answer questions 1 and 2.

As to question 3 will say, that in my judgment one of the most important improvements to be made at the present time in electrical appliances for the propelling of street cars is in the direction of elastically suspended motors.

GEO. D. SHEPARDSON,

Professor of Electrical Engineering, University of Minnesota.

(1) It is difficult to pick out any one among so many inventions and improvements in the street railway industry. If the conduit used at Coney Island last summer has the unqualified success which Mr. Stetson claims in his recent paper before the American Institute of Electrical Engineers, I should class it among the first. I would give high rank to the discovery that seems to have been made by a number of roads at the same time, viz., that snow plows require a large amount of power for successful work in severe storms. Any one of several snow plows might lay justly claim to a high rank among the improvements of the year.

(2) During the coming year I look for progress in the management of the roads in several particulars, such as the better training of motormen, a more careful and systematic inspection of equipments and a more careful study of the braking question. I confidently expect the appearance of a successful alternating current railway motor that will make possible the economical operation of long interurban roads. I hope also to see further improvements and commercial success in storage battery roads.

(3) One thing badly needed is some method for getting better grip on the tracks in slippery weather. Neither salt nor sand seems sufficient for preventing many accidents when the tracks are slippery with cold snow. This, of course, is closely connected with the braking question. I

look for some successful method of obtaining adhesion by some electromagnetic device.

D. C. JACKSON,
Professor of Electrical Engineering, University of Wisconsin.

(1) The construction and operation of the Liverpool Overhead and Intramural railways.

(2) Applications of electricity to city rapid transit systems in tunnels or in elevated structures.

C. J. FIELD,
Consulting Engineer.

(1) As to the question of the most important discovery, invention, improvement or development in the street railway industry during 1893, I do not know as it can be considered that there was any startling or pre-eminently important invention or development. I consider that the general progress and detelopment during the year have been, especially in the motors and generators which are used on electric railway work, such as to bring this apparatus into what may be called a standard commercial condition. The present type of motor, both as regards economy, durability, weight, etc., is far superior, and far in advance, of anything previously attempted or put on the market, and we believe that the next few years will see only minor detail changes in regard thereto. The large introduction of direct driven generators has, beyond question, been the most marked improvement in the power station and everything connected with it. It has brought us something which has long been looked for, and which will do more than anything else, in connection with an economical steam plant, to reduce to the lowest possible point the operating expenses and maintenance of a power plant, which has been developed in this line since the introduction of electric traction.

(2) In station apparatus we believe we have fully answered this question. It will only be a gradual development of the present types of direct connected generators. We look for more marked improvement as regards the reduction in the weight of motors than in any other line we can think of relative to electric railway apparatus. One especial factor which will assist in this development and reduction of weight and improvement in details will be more active competition by the entrance into the field of several new companies, with ample capital, resources and energy in the direction of electrical apparatus.

(3) This question is really a double one. In answering it, I am going to change the question slightly; not as to what is most urgently demanded, but rather as to what will be demanded or required in the streets of our larger cities throughout the country. I believe, with the present rapid and large extension of electric traction in our larger cities, Philadelphia, Boston, New York, Chicago, etc., that during the next year or two the cities and public generally will demand some strong and radical improvement in the system of overhead construction, or else the introduction of underground trolley conduits on the same basis as cable traction. Large railway companies, in the past, have not been warranted in going to the expense, in general cases, entailed by the introduction of conduits, but I believe that during the next few years they will be warranted in this expense in some cases. Such a conduit I believe to be entirely feasible and practical, both from an engineering basis and mechanical standpoint. It means simply a liberal expenditure of money wisely carried out, and the more simple the details and form of the conduit the better.

J. H. BICKFORD,
Consulting and Constructing Electrical Engineer.

The questions are very broad and I think one would hesitate somewhat in expressing an opinion. From an engineer's standpoint I would answer your first question as follows:

(1) The development of the multipolar generator seems to be as important an improvement in the street railway industry as any other one thing. Of course it would be well to couple with this the development and improvement in the steam engine to operate the generator in question.

(2) Answering the second question I cannot, at the present time, name any one thing which will claim extraordinary attention during the coming year. It seems from all appearances that there will be a continuation in the development of power house machinery and also the street car motor.

(3) Judging from what we see in the daily press, the answer to the third question would be, car fenders. This may be considered of minor impotance in the minds of some, but the large number of accidents would seem to warrant the attention of inventors and manufacturers to this part of the apparatus. Another very important thing which is surely demanded is long distance transmission for railway work. The extension of city lines into the suburbs, in some instances 10 miles or more, becomes a problem when such lines are to be operated from a central station.

H. WARD LEONARD,
Electrical Engineer and Contractor.

(1) I do not know of any practical development of great value to electric railways in 1893.

(2) I look for the greatest improvements in 1894 along the following lines:

(*a*) The operation of electric railways from a source of alternating current.

(*b*) A reduction in the amount of power required to start the load.

(*c*) Better and simpler control of the car.

(*d*) The use of special motor cars or locomotives to pull trains rather than to have each car equipped.

(3) The invention most urgently needed to-day is a method of operating railways by means of alternating current and with a single trolley.

FRANKLIN L. POPE,
Electrician and Electrical Engineer.

My practical knowledge of the conditions and requirements of the street railway service is hardly sufficient to warrant me in expressing any very decided opinions upon the subjects mentioned in your questions, and hence my views must be taken for what they may be worth.

(1) I am inclined to think that the most important development of the past year was the demonstration of the practicability of maintaining the insulation of the conductors of a conduit system, to a sufficient extent to avoid serious loss of energy while operating the cars, made by Albert Stetson and his associates at Coney Island, N. Y.

(2) I look for the most important developments during 1894, in the same direction; that of perfecting and improving the conduit system of distribution.

(3) I consider that the thing most urgently demanded at the present time is an improvement in the brake apparatus which shall enable a heavy car to be stopped more quickly than it now is, when an emergency occurs.

H. F. PARSHALL,
Electrical Engineer and Designer.

(1) The most important improvement or development in the street railway industry in 1893 was in connection with the 750 and 1,500 K. W. railway generators. Nine of the larger size and six of the smaller are already in operation or under construction, and are found upon trial to be satisfactory without modification.

(2) I look for the greatest progress in the general adaptation of direct connected machinery in railway central stations, during the coming year.

(3) The greatest improvement that can be effected in existing apparatus is to make the armatures more durable. While those constructed to this time will undoubtedly run for a number of years without requiring any renewals, it is found necessary to occasionally turn down commutators, which is expensive, looked at from either the standpoint of labor or cost of material. The above improvement can be made when the shops have had greater experience in the construction of these commutators, and the designs are so fashioned that there is absolute freedom from sparking at the commutator.

CARL HERING,
Consulting Electrical Engineer.

(1) The most important improvement was the adoption of more stringent rules to lessen the frequency of run-over accidents and collisions; also the decline of the cable roads.

(2) In the development of electric conduit, elevated and accumulator roads; the overhead trolley is already developed.

(3) The rounding off of the peaks of the current curves due to the starting of the cars; also a strong accumulator which need not be accompanied by a trained nurse and a physician.

J. B. CAHOON,
Electrical Engineer and Inventor.

(1) I consider the development into a practical working piece of apparatus of the series parallel controller of the General Electric Company as the leading improvement or development during the year mentioned, inasmuch as by its use the old wasteful method of rheostatic control of street railway motors is done away with, and a piece of apparatus substituted which saves about 30 per cent. of the current formerly required with rheostatic control; and anything which can do this and thereby bring about such an increase in economy of coal consumption should stand at the head.

(2) I think I may safely say that the greatest progress will probably take place in the construction of a proper road-bed and track with a proper system of bonding, using double bonds of sufficient size to bring the resistance of the rail return to a very low figure, and a greater reliance upon the rails themselves to return the current, and thus do away with the grounding of the rails to gas and water pipes, putting a stop to the corrosion that is now giving such trouble in many larger cities.

(3) There are several inventions which seem urgently needed. Perhaps the chief of these is the necessity for some form of electric braking apparatus, something which will be easily handled, thoroughly reliable, and will act on the track and not on the wheels. This, it seems to me, is something that must come, as the present system of hand brakes in connection with electric cars belongs rather to the period of the Pharaohs than to the present time, and it is questionable whether public opinion will not rise up and assert itself on this question unless something is done very shortly.

F. B. BADT,
Electrical Engineer and Inventor.

(1) In my opinion the most important improvement in street railway service during the last year has been the adoption of large direct coupled electric generators. I also notice with great satisfaction that a number of stations adopted a system of separate excitation of the generators, the exciters being driven by independent prime movers. Such a method eliminates at least 50 per cent. of the fluctuations which may occur in the external circuit as the field of the generators can in no way be affected by the rise or fall of the potential. On the other hand, the prime movers of the exciters, having always a steady load, send a perfectly uniform current through the shunts of the fields. This method had been suggested by me in various instances over six years ago and proved a great success in various places.

(2) I look for the greatest progress and improvement in 1894 in applying alternating or multiphase motors to street railway service. Such a system, of course, would allow of great economy in the wires, employing high tension mains and feeders and low tension motors, making the system both more economical and safer as far as accidents to living beings are concerned.

(3) I consider most urgently demanded, at the present time, the perfection of the conduit system for electric street railways, or the adoption of a system in which surface conductor rails convey currents of low potential in connection with the apparatus mentioned under (2).

R. M. HUNTER,
Mechanical and Electrical Expert and Engineer.

(1) There was nothing of importance developed in the year 1893 in practical street railway work. The trolley work is about the same as the previous year. The practical tests with the conduit roads in Chicago and Washington are perhaps the most striking new departures, and even these are only rehabilitated from the former work, extending many years back. As for new inventions in railway work, I have seen none of importance, which were developed in 1893, unless it be one which I have made for the General Electric Company, as a substitute for my former patented invention of the series multiple system of street car regulation, which is now so extensively in use on all cars. That system required two motors and was capable of only sudden changes in speed. In my present improvement I may employ only one motor (or more if desired) of the ordinary series type and yet regulate by counter electromotive force so as to make that motor or motors assume any speed desired. There is absolutely no waste of current.

(2) I look for greatest progress in 1894 in the alternating system applied to electric railway work.

(3) I consider that an alternating current motor, adapted to variable load and capable of starting with great torque, to be the most urgently demanded.

JOHN C. HENRY,
Electrical Engineer and Inventor.

(1) The development of the Intramural railway at the Chicago Exposition and the decreased weight of street car motors.

(2) More underground feeders; a trimmer line construction, based on the diagonal system.

(3) A track brake and constantly running armatures on all motor cars; also a supplemental conductor connected to the track rails and located in an exposed position.

J. STANFORD BROWN,
Consulting and Constructing Electrical Engineer.

(1) The wonderful development of suburban electric lines.

(2) Electric railway conduit system.

(3) A street railway motor which can be freely used as a source of brake power without danger to itself.

W. T. M. MOTTRAM,
Sales Agent, Curtis Electric Mfg. Co.

(1) The Intramural railway.

(2) Interurban work.

(3) A good brake for motor cars.

The General Electric Company has secured its share of the street railway car equipment contracts awarded during the last ten days in Philadelphia. Of 250 contracted for by the People's Traction Company, 125 equipments with the G. E. 800 motors and type K. controllers were purchased from the General Electric Company, while the remaining 125 were allotted to the Sperry Company of Cleveland. Of 80 equipments required by the Electric Traction Company, of Philadelphia, 70 will be furnished by the General Electric Company. The People's Traction Company had already contracted for three of the 1,500 K. W. General Electric generators. The General Electric Company has also secured contracts during the past week, covering 25 car equipments for the Union Railroad Company of New York; 20 car equipments for the Steinway Railroad Company of Long Island; one 700 H. P. generator for the Steinway Railroad Company of Long Island; eight M. P. 300 K. W. generator for Cincinnati, O.; 10 car equipments for St. Louis Street Railway Company, St. Louis, Mo.

ELECTROLYTIC EFFECTS IN STREET RAILWAY RETURN CIRCUITS; THEIR CAUSE AND PREVENTION.

BY W. NELSON SMITH.

(First Article.)

Electrolysis is defined as follows in Gore's "Art of Electric Metallurgy:" "When a current of electricity passes through a suitable liquid, it produces a chemical change. The conditions are that the substance must be a liquid, a compound body, and a conductor of electricity and be traversed by a current. Electrolytes in general are composed of two substances, one a conductor and one a non-conductor. A liquid composed of two conductors or two non-conductors is not usually affected."

The single overhead trolley system of electric railways necessitates the use of the track and earth as one side of the circuit, usually the negative. Although the earth is very largely used for this purpose by the telegraph and telephone systems, it does not necessarily follow that the same use can be made of it for much heavier currents, with equal advantage. The possibility of electrolytic effects from these heavier currents seems, in the earlier street railway engineering practice, to have been left out of consideration; but comparatively recent developments have demanded, in no uncertain way, that it be given the serious attention of electrical engineers and managers of electric railways.

The amount of moisture in the earth surrounding the ground connections placed along the line and at the power house of an electric railway has generally been taken as a fair measure of the conductivity of that portion of the circuit. But the fact appears to have been overlooked, that the more current that may be invited by the presence of the water that helps it traverse the soil, the greater will be the amount of water electrolytically decomposed at the earth plates, because it so easily fulfills the definition of an electrolyte. Water is here given first consideration, because, whether comparatively pure or not, it is present in the soil in infinitely greater quantity than any other liquid.

Electrolysis, whether of water or of some organic or inorganic acid or salt, is always manifested at the points of entrance and exit of the current to and from the liquid; that is, at the electrodes. The point of entrance is called the anode; that of exit the cathode. When water is electrolyzed, the hydrogen *follows* the current, and is liberated at the cathode; the oxygen is set free at the anode. Oxygen is about the most active, chemically, of all the elements and is particularly so when in its "nascent state," i. e., at the moment of its separation from whatever element it may previously have been combined with. So that when liberated at an anode of easily oxidizable material, that material will be quickly attacked by it. Iron, in any form, rusts very rapidly when exposed to such action. Copper is not so likely to be corroded, unless there be also present carbon dioxide in considerable quantity, or other active chemicals, which attack it when set free by the passage of the current.

Knowing these fundamental facts, it is easy to account for the frequently observed effects due to a heavy electric current traversing a waterpipe or gaspipe underground, and then leaving it in order to take a path of still less resistance back to the power-house.

As to the rate of corrosion it is a law of electrolysis that the quantity of an element liberated at an electrode in a given time is proportional to the strength of the current and to a certain known constant called the "electrochemical equivalent." To illustrate: In electrolysis of water a current of one ampere will in one second liberate .00008286 grammes of oxygen. But it is not the intention to discuss quantitative measurements further than to remark that even though the total amount of oxygen liberated is dependent on the current and on the time, it does not follow that the amount of iron turned into rust at any given anode in a railway circuit during a given time could be predicted or even guessed at, even if the current were actually measured. The relative amount of moisture in the soil about the electrodes is a large factor in the operation, and this is extremely variable from time to time. Except in unusually moist localities, a heavy current would probably decompose the adjacent water faster than it could naturally be supplied under ordinary circumstances, and the rate of decomposition would vary with the fluctuations in the supply of moisture. Moreover, it would seem that while the rate of corrosion might be rapid at the start, it would become slower and slower as the outside layer of rust increased in thickness, supposing it were not displaced by some mechanical disturbance. But given two electrodes, separated by a stratum of moist earth and with a potential difference between them of only $1\frac{1}{2}$ volts, and electrolysis will be set up; dependent on current intensity, time, and amount of water, it will continue to exist as long as these three conditions prevail, even though its effects, year by year, be scarcely perceptible.

So far, water is the only electrolyte whose presence about underground conductors has been considered. In soils composed of comparatively inert chemical substances (sand, for instance), water is about the only compound likely to become injurious to whatever oxidizable conductors there are underground. But the soil that surrounds the water, gas and sewer pipes, telephone cables, and rails, in a city street, contains so many extraordinary chemical compounds that simple electrolysis may be but the beginning of a sequence of more or less complicated chemical reactions. Nitrates, such as saltpeter; chlorides, such as common salt (particularly when used in large quantities to melt snow in winter); ammonia in plenty; illuminating gas, and decomposing organic matter in general, are freely distributed in close proximity to the masses of metal that may act as conductors. The soil is usually moist, and many of these chemicals in solution make better electrolytes even than water, and when once their acid constituents are set free by electrolysis, not only are iron conductors corroded, but the copper bond wires connecting the rails are also attacked. Particularly is this the case when, because of too high resistance or poor connection, the bonds force part of the current into the ground at every joint, its copper does not oxidize as readily as iron, its destruction seems to point to the active agency of some of these other chemicals, probably nitrates, chlorides and carbonates. Iron bonds are sometimes used in cheap construction, and it has been noticed that alkaline soils have hastened their destruction as well as that of the waterpipes so surrounded. This seems to coincide with the fact that in electroplating with iron use is made of a strongly alkaline solution, the double chloride of ammonia and iron, in order to get the best results. In this reaction the ammonia does not play any active part, but the reaction is facilitated by its presence. The akaline soils of Salt Lake City and Los Angeles, Cal., have been cited as examples of this character. Whether the fixed alkalies are present in quantities or not, it is probable that ammonia forms compounds that when electrolyzed may become injurious to whatever metallic conductors they may come in contact with. In this connection a qualitative analysis of samples of soil taken from places where corrosion of pipes, bonds, telephone cables, etc., has occured would be of great interest, and might throw some light on the matter as viewed from the chemical standpoint. It might result in the discovery of some chemical method for retarding or preventing the effects herein considered.

Nothing has yet been said of the conditions that compel the electric current to leave a metallic conductor and to traverse a stratum of moist earth on its way back to the generator. The fundamental reason is the poor conductivity of the return circuit which, if metallic, may be of comparatively high resistance in itself, or else it may contain so little metal, besides the rails, as to force the current to depend absolutely on the earth as a conductor for a considerable part of the distance.

The metallic return circuit, as usually laid down, consists, in the first place, of the track. To improve the electrical connection between the rails they are united at every joint by copper bond wires. Sometimes a continuous wire, called the "supplementary," is laid between the rails for the entire length of the track, and a part or all of the bonds connected to it. It is usually connected to the ground plates along the line, and sometimes, if within a convenient distance, it is connected with the power station. Frequently more reliance is placed in the ground connections than in a direct power-house connection. If there are two tracks, they and their supplementaries are cross-bonded at frequent intervals. At the power-station large masses of iron or copper plates are sunk in the ground and connected to the generators. Wherever possible moist spots are sought out for the location of these grounds, both at the power-house and along the line. Sometimes they are made in large bodies of water, rivers, lakes or ponds as may be convenient. Oftentimes connections are made directly to the water pipes. Cheaply constructed roads often do without the supplementary wire altogether, and are content to use almost any kind of wire for rail bonds. Such roads depend absolutely on the earth for the return circuit, unless the power-house happens to be so close to the track as to make a connection easy and inexpensive.

In some of the very best roads, however, the possibility of there being some resistance in the return circuit has not been ignored to the extent that the foregoing description would indicate. Such roads have "track feeders" running from the power station to various points along the line, where they are tapped directly into the track or the supplementary wire.

Excepting the last, these methods are haphazard at best, yet they represent the practice of an overwhelming majority of the electric railways now in actual operation. It seems to have been assumed that the current, in returning from any point on the line, would confine itself strictly either to the track and supplementary wire or to a straight line path through the earth, regardless of the distribution of moisture in the earth and of any buried metallic conductors.

As a matter of fact, however, the current will always take the path of least resistance, or if there are several paths it will divide itself up among them in proportion to their conductivity. The track and its connections are frequently of such unelectrical construction as to introduce considerable resistance. On the other hand, the earth's resistance is an extremely uncertain and intangible quantity; but both rail and earth must somehow form a path for the return of the current. In cities and towns of any considerable size, there are always water and gas mains beneath the streets. They are metallic from end to end, and of ample cross-section, so their conductivity is excellent, and is not, moreover, affected by external conditions of weather, temperature, etc. They are always in proximity to the tracks, and usually pass near the power house, and so it is but natural that they should often constitute the path of least resistance for a current that would otherwise have to choose between the earth and a badly bonded track. Lead-covered telephone cables, even though laid in specially prepared ducts, act as conductors in the same way.

(To be continued.)

Leavenworth, Kan.—The electric railway equipped by Newton Erb is now in operation.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Fifth Article.)

We have now discovered one radical difference between the flow of water in pipes and the flow of an electric current in a conductor. In the case of water, its flow within a pipe produces absolutely no external effect, but in the case of electricity we find that its flow produces quite a marked influence within the space surrounding the wire. In the case of the coil by which we magnetized the needles none of the current could possibly have gotten to the needles, first because the wire of which the coil was composed was carefully insulated with cotton thread which effectually prevented the escape of current from the wire and second there were several thicknesses of paper between the needle and the coil, and dry paper is one of the best electrical insulators known. We might have enclosed our needles in India rubber or glass before inserting them in the coil as a further protection against the current but the result would have been the same exactly. We have also shown that if a wire in which a current is passing is held either above or below a compass needle the influence of the current upon the needle is manifested by a deflection either to the west or east of its normal north and south direction, and further that we can not only thus tell whether a current is flowing in a wire or not, but we can tell in which direction it is flowing.

We have seen that if a current flows from north

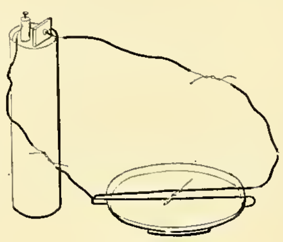


FIG. 5.

to south *over* the needle it deflects it to the east and that it also deflects it to the east if it flows from south to north *under* the needle. If therefore we form a loop of our wire, in the center of which we place our saucer of water and needle so that the current flows first from north to south over and then from south to north under the needle (Fig. 5.) the effect of the one current is just doubled. If two loops are made so that the current passes over the needle twice from north to south and twice under the needle from south to north, the effect of the current will be multiplied four times. By increasing the number of loops in this way we are enabled to produce quite perceptible deviations with such feeble currents that they could scarcely be detected in any other way. We have, in fact, actually made a *galvanometer*. As winding the wire above the needle in many turns would hide the needle so that we could not see its deflections, it is more usual in making galvanometers to wind the wire in a flat coil and place it under the needle. While the multiplying effect of a coil thus arranged is not as great as in the arrangement described, the instrument itself is much more convenient to use. To make such a coil cut out a piece of cigar box or other lumber of about that thickness, about 2 inches wide and $2\frac{1}{2}$ long (Fig 6). Cut away a seat on both ends for the wire and at diagonally opposite corners bore a small hole about the diameter of a pin to hold the ends of the wire. Into one of these insert the end of the wire from the spool and pull it through about 5 or 6 inches and plug up the hole with a piece of wood so as to hold the wire tightly in place. Then wind on tightly eighty to a hundred turns of the wire and end it off through the other hole, plugging it up and leaving an end of about 5 or 6 inches as before. Now place the coil under the saucer and its floating needle and you have a very delicate galvanometer by which currents that would otherwise scarcely be suspected can be detected. Connect the two ends of the coil with the battery wires and the deviation of the needle will be found to be much greater and more rapid than in the previous experiments.

It must be borne in mind that the tendency of a current passing either above or below a compass needle is to place that needle at right angles to the direction of the current. The strongest current will therefore only cause the needle to take up a position at right angles to it—it will never cause it to deviate further or to reverse itself.

THE SOLENOID.

Now let us return to our first coil of wire (Fig. 2). A hollow coil of wire such as this is called a *solenoid*, and it has some very peculiar properties which it will be necessary for us to understand before we can thoroughly understand either the dynamo or motor, and as we now have all the apparatus necessary to investigate these properties, we will begin at once.

Take one of our magnetized needles and suspend it at its middle point by a very fine thread so that the needle will hang horizontally and be free to move. Now connect up the solenoid with the battery and present first one end of the solenoid and then the other to, say, the north pole of the needle. It will be found that one end attracts and the other repels this pole just as would a real magnet, and that the end that repels the

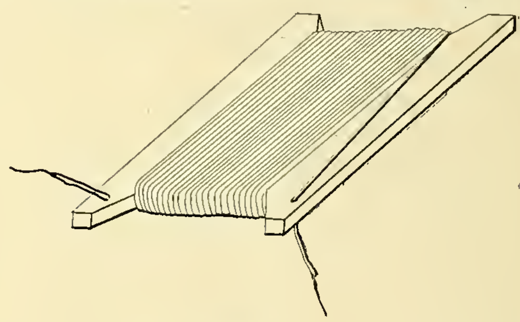


FIG. 6.

north pole attracts the south pole. In fact although there is no iron or other magnetic material in the solenoid it acts exactly like a magnet, and *is* one so long as the current flows through it. If the pole of the needle which the solenoid attracts be properly directed, the solenoid will suck the needle almost entirely within itself, and if the needle be reversed and pushed inside of the coil, it will be expelled again as soon as the fingers are removed from it so as to permit of it. Thus it will be seen that a solenoid has a north and south pole just as has a steel magnet so long as a current is passing through it. Now detach one of the battery wires from its binding post so that the current can no longer pass through the solenoid and repeat these experiments. It will be found to be entirely inert and will neither attract nor repel either pole of the needle. The magnetic property of the solenoid is therefore evidently entirely due to the current which is passing through it.

The phenomenon of sucking in or expelling a magnetized needle may be better illustrated perhaps by partly inserting the needle in the solenoid while one of the battery wires is disconnected and then suddenly closing the circuit by touching the binding post with the disconnected wire. Thus far we have been experimenting with a highly tempered hard-steel needle. We have found that when it is once magnetized it remains a magnet permanently. Now let us repeat our experiments using a short piece (two or three inches long) of soft-iron wire. Before we attempt to magnetize it, let us try it with our compass needle. We find that it attracts both ends equally well. There is under no conditions any repulsion because it is not magnetized. Place it in the solenoid as we did when magnetizing the needle and while still in the solenoid, test it with the compass. We find that one end attracts and the other repels either end of the compass needle just as did our permanently magnetized needle before and even more strongly. Remove the wire from the solenoid and try it again. We find it repels neither end but attracts both as it did before it was magnetized. Suspend the wire in the middle and approach the solenoid to it. The latter will attract both ends equally well and suck in either end with equal facility. The soft-iron wire is no longer a magnet. It was a stronger magnet while in the solenoid than the needle was, but immediately it is taken out or the current in the solenoid is broken, it loses its magnetism. This may be more clearly illustrated by causing the wire while in the solenoid to pick up another small piece of the same wire, and then detaching one of the battery wires from its binding post. Immediately the current is broken the wire will drop its load and it will remain incapable of picking it up again until the current is started in the solenoid.

There is therefore this very great difference between hard tempered steel and soft annealed iron, that the former when once magnetized retains its magnetism permanently, while the latter loses it at once the encircling current is stopped.

There are also other minor differences, among which may be mentioned the following: Tempered steel requires an appreciable time to magnetize, whereas soft iron seems to assume the property instantaneously. It is somewhat difficult to change the direction of magnetism of steel; that is, after having magnetized a steel bar so that one end is north and the other south, to demagnetize it and magnetize it again so that the ends which were formerly north and south will become respectively south and north, while with soft iron the change is made with the greatest facility. A given current flowing through a solenoid of a given number of turns will make a much stronger magnet out of a soft iron bar than it will out of a steel bar of the same dimensions.

Within certain limits the amount of magnetism that can be imparted to a bar of iron or steel increases with the number of amperes of current passing through the solenoid and the number of turns in the coil. A limit is finally reached, however, beyond which neither an increase of current, nor an increase in the number of turns or windings in the solenoid will materially increase the magnetism. With tempered steel this limit is much sooner reached than with soft annealed iron. For this reason, of two magnets of iron and steel of exactly the same size, the one of soft iron can be made by far stronger than it is possible to make the one of steel. Cast iron, which partakes more of the nature of steel than of soft or wrought iron, is also inferior to the latter for magnetic purposes and loses its magnetism less readily. In fact the purest wrought iron that has been rolled, or drawn and not subsequently softened again by annealing processes, posesses the property of retaining some of its magnetism for quite a while and is less suitable for magnetic purposes, especially where it is desired to have the magnetism undergo rapid changes either of direction or intensity. All of these points have an important bearing upon motor and dynamo construction and will be referred to again, later on.

Another point which has also a bearing upon a subject to be taken up in a subsequent chapter may be referred to here.

As everyone knows, a knife or a piece of steel may be magnetized by rubbing it against another magnet. It may also be more slowly magnetized by laying the two side by side for some time even without touching each other. Now the earth itself is a huge magnet with a north and a south pole just like the small magnets we have made, and it is the attraction of the earth's north pole for the compass needle that causes the latter to point always to the north. Since two north or two south poles never attract each other, but repel, the end of the needle that points to the earth's north pole is really a *south* pole and should not be called a north pole at all—this is the reason that when it was first referred to in these articles, particular care was taken to call it the "*north seeking pole.*" It is, however, usually called the north pole because it points toward the north and will hereafter be referred to by this name. But to return to our subject. If the earth is really a magnet we would expect bars of iron lying approximately parallel with the line joining its two poles to become in time magnetized and as a matter of fact they do. Bars standing in a vertical position seem to become magnetized more rapidly perhaps than those lying horizontally, but those lying in a north and south direction inclinging downward toward the earth at such an angle as to point directly toward the north pole, become magnetized still more quickly and the the magnetization is rendered almost instantaneous if the bar while held at this angle is smartly struck on either end with a hammer.

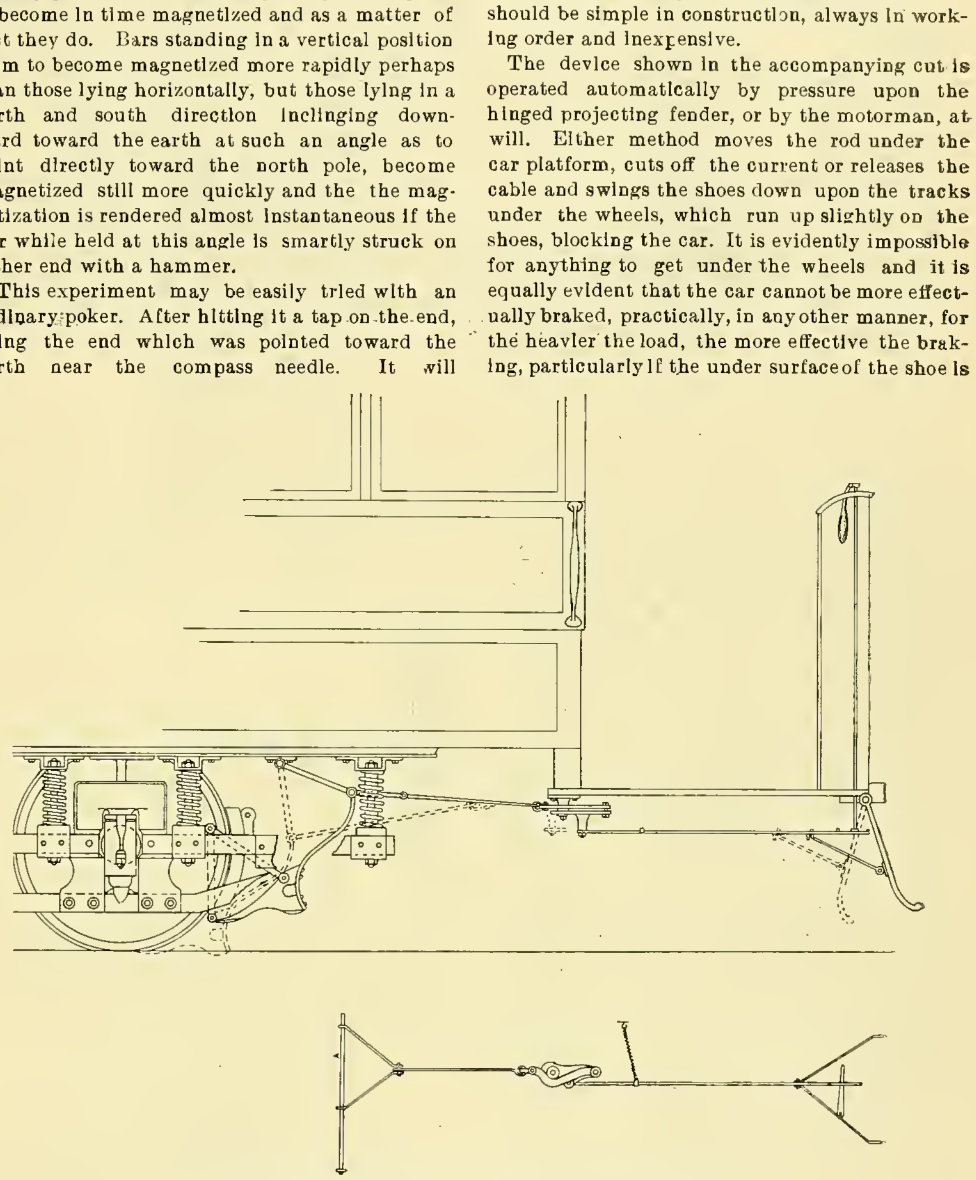
This experiment may be easily tried with an ordinary poker. After hitting it a tap on the end, bring the end which was pointed toward the earth near the compass needle. It will smartly repel the north pole and attract the south pole. Reverse the poker and hit it another tap and test it with the compass; the polarity will be found to have been reversed. The end which at first repelled the north pole will now attract it and repel the south pole. Now there is a curious thing that we can do. We have literally knocked magnetism into the poker in the first place, and we have by reversing the poker and striking it again knocked a north pole out of one end into the other, and now we can knock the magnetism entirely out of the poker if we know how to do it. Hold the poker, which we will say is already magnetized, horizontally in an east and west direction and hit it one or two smart raps on either end. Now test it with the needle and it will be found to attract either end equally well, thus proving that the magnetism has entirely disappeared.

New York, N. Y.—The last section of the Third avenue cable was successfully laid last week. The rope measures 36,859 feet and weighs sixty-two tons. Eighteen pairs of horses were employed to stretch the cable from the Bayard street power-house to the postoffice and return.

Automatic Stopping Device for Electric and Cable Cars.

The accompanying illustration shows a combination of different inventions, due to D. McFarlane Moore of New York, intended to perform automatically and at the proper time all that the motorman is usually depended upon to perform. Such a device should cut off the source of power which propels the car, apply the brakes in the most effective manner, and absolutely prevent anything from being crushed beneath the car. It should be simple in construction, always in working order and inexpensive.

The device shown in the accompanying cut is operated automatically by pressure upon the hinged projecting fender, or by the motorman, at will. Either method moves the rod under the car platform, cuts off the current or releases the cable and swings the shoes down upon the tracks under the wheels, which run up slightly on the shoes, blocking the car. It is evidently impossible for anything to get under the wheels and it is equally evident that the car cannot be more effectually braked, practically, in any other manner, for the heavier the load, the more effective the braking, particularly if the under surface of the shoe is slightly roughened, and for this purpose the shoe may preferably be constructed so that the roughened surface bears upon any desired part of the rail to prevent excessive wear. The shoes on either side of the car may be connected with a light wire fender, to keep anything from getting under the body of the car, or if preferred the usual board fender may be fastened directly upon the shoes.



AUTOMATIC STOPPING DEVICE FOR CABLE AND ELECTRIC CARS.

The mechanism at the point directly under the front of the body of the car, where the rod running from the hinged fender connects with the rod running to the shoes, separately shown in the cut, is a simple lever, for the purpose of obtaining greater movement and of throwing the weight of the shoes upon a dead center, where it is kept by the light spring shown in the cut. This arrangement keeps the shoes in their proper position when raised, offers a ready means of adjustment both as to movement of parts and delicacy of action, and prevents any operation except in the desired manner.

The shoes may be lowered as already stated, or raised by the motorman by means of the lever upon the platform. The handle of this lever is hinged so as to drop into a slot to prevent it from being turned accidentally, and this does not interfere with the operation by the hinged fender, automatically.

It is not claimed that each distinct part of this device is new. It was put forth simply as a combination of well known mechanical devices, for the accomplishment of obvious purposes. It is claimed that it is effective and inexpensive; that it cannot get out of order, and that it is not cumbersome or unsightly.

THE NEW "CHICAGO" TRUCK.

The accompanying illustrations show a side view and a cross section through the car axle of the new "Chicago" truck for electric cars, just

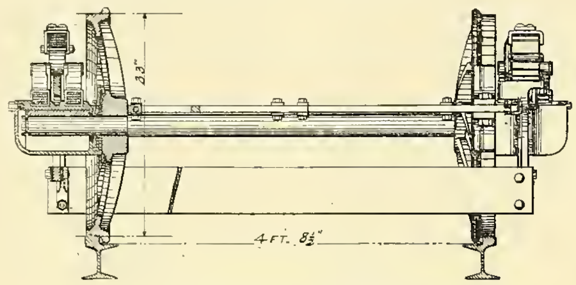


FIG. 2. CROSS SECTION OF THE CHICAGO TRUCK.

placed on the market by the Chicago Electric Truck Company, of 1436 Monadnock Block, Chicago. The truck will be made in five styles under the patents of Geo. H. Graham of this city. The truck shown in Fig. 1 is designated style "A." In its design the inventor has kept in view the varied requirements and conditions of electric railway service, and has aimed to produce a truck that would be simple in construction, economical in operation, and at the same time be sufficiently durable to meet all demands.

The new truck has a forged steel frame with long cantilever extensions. It has no castings and very few bolts. It permits of easy access to motors and ready removal of wheels. The main springs are each composed of three half-elliptics, two of which are placed upon the axle box at a sufficient distance apart to permit the side frame to pass over the axle box between them, while the third spring is inverted over the frame and in such a position that its ends are brought between the ends of the lower springs, where they are held by the same pins or bolts. Two links or hangers, acting as washers to separate the adjacent ends of the three half-elliptic springs forming the group, are suspended from these pins and carry the upper bar of the main side frame, as shown in Fig. 1.

The entire weight of the truck and car is cushioned on axle boxes by the springs, thereby

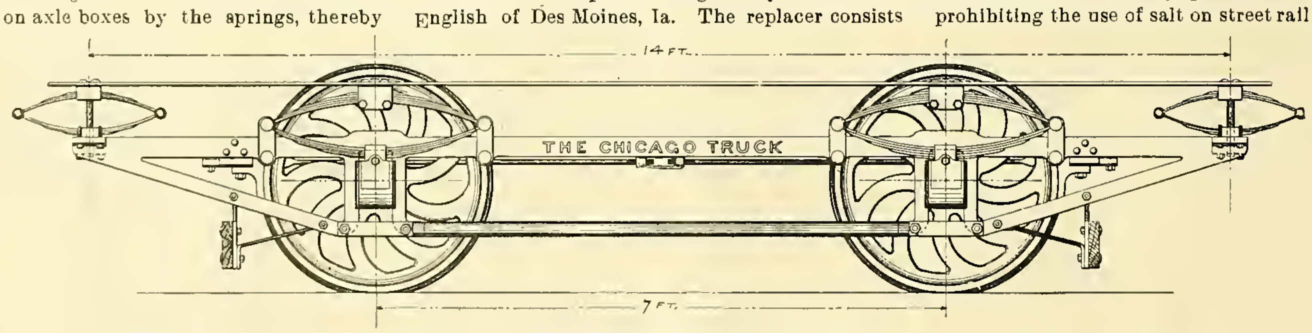


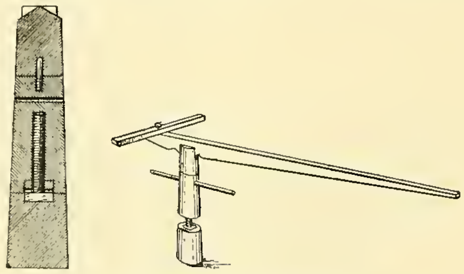
FIG. 1. LONGITUDINAL VIEW OF THE CHICAGO TRUCK.

adding greatly to the life of both rolling stock and permanent way.

The makers claim that it will carry a longer car without oscillation, or the same car with less oscillation, than any truck on the market, because the frame, instead of being cushioned on the axle boxes by spiral springs which would allow it to rock or oscillate from the box as a fulcrum, is suspended from half-elliptic springs, which gives it an extended support, so that a fifteen-footspring base can easily be used with a seven-foot wheel base.

The weight of the car-body and load does not come on the truck frame (except the portion taken by the end elliptic springs) but is transmitted directly to the axle boxes through the combination springs, thereby preventing strains and allowing the use of a lighter frame.

It is further claimed for this truck thatoscillation is destroyed right where it begins, by the arrangement of these combination springs. When the wheel passes over an obstruction or uneven rail joint, and is forced upward, the lower half-elliptic springs, from which the frame is suspended, are compressed, and therefore lengthened in relation to the frame, and the upper half-elliptic springs, being on the same pins, are also lengthened, which would cause their centers (where the car-body rests) to be depressed. This is compensated by the slight rise at the ends of the springs, due to the upward pressure of the lower sprngs, so that, in fact, the car-body remains practically in the same relation to the rail vertically, and the tendency to oscillate is overcome.



ENGLISH'S CAR REPLACER.

These springs are so constructed that this action does not interfere with the independent vertical movement of the car-body and truck frame, except when the motion is imparted by the wheels as above described.

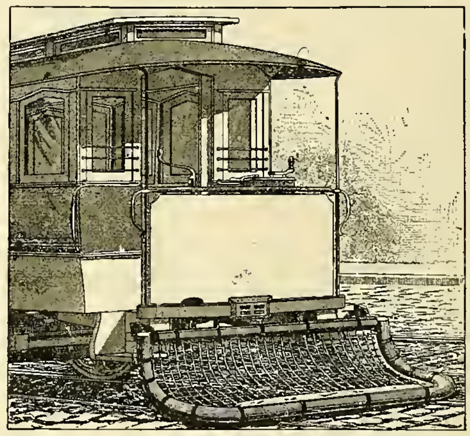
Car Replacer.

The device shown in the accompanying illustration is a car replacer designed by Dr. R. G. English of Des Moines, Ia. The replacer consists of a jack-screw with a swivel at the top, and a lever. With the end of the car resting on the lever the length of the fulcrum is raised by the screw. The weight then can be turned to the right or left by a sweep of the lever.

Brockton, Mass.—The Brockton Street Railway Company will begin, as soon as the frost is out of the ground, to construct three roads—one to Bridgewater by way of West Bridgewater, another to Elmwood through East Bridgewater, and another to Stoughton.

Leonhardt Pneumatic Car Fender.

The characteristic feature of the Leonhardt car fender shown in the accompanying illustration is the pneumatic tubing used in its construction. The frame is of strong iron of a cradle shape extending the full width of the car and is hooked to the platform,as shown in the cut. The edges are bound with three-inch rubber tubing filled with air, and a pliable rope net is stretched across the frame. The height of the front edge of the fender, above the street level is adjustable, and ordinarily is from 2½ to 3 inches. Owing to the rocking motion (up and down) the fender when struck by an object drops to the



LEONHARDT'S CAR FENDER.

ground and is held there by a self-locking device until released by the motorman. A person who is struck drops or rolls over into the netting and remains there until the car is stopped. The motorman by placing his foot upon a treadle can press the fender down and lock it at the same time. When the fender is thus down two rollers, attached to the under side, run along the track, preventing the fender from wedging itself under the car. It is claimed that the blow struck by the pneumatic tubing is more yielding than that of any material that can be used. It is stated that at public tests, in Baltimore and Washington, a number of men and boys were run down, in various positions, and picked up by the fender, without the least scratch or bruise, while the car was running at a speed of from 8 to 12 miles an hour. The fender is manufactured by the Leonhardt Pneumatic Safety Car Fender Company of Baltimore, Md.

Salt Ordinance Void in Minneapolis.

An ordinance recently passed in Minneapolis prohibiting the use of salt on street railway tracks has been declared void by the municipal court in that city. It was held that inasmuch as it prohibited no one but the street railway company from sprinkling salt, the measure was class legislation and therefore unconstitutional. The test case was accordingly dismissed.

Freeport, Ill.—A company has been organized by C. E. Loss & Co. to construct an electric railway. The company is capitalized at $100,000 and it is stipulated that $25,000 must be subscribed by residents of Freeport.

BAY STATE CAR FENDER.

Perhaps no subject is receiving more attention at the present time than that of car fenders. The managers of electric roads in various parts of the country are considering the adoption of some sort of fender for electric cars which are run at a high rate of speed through crowded streets. Many styles of fenders have been brought out and placed in either actual or experimental use.

The accompanying illustration shows one form

BAY STATE CAR FENDER.

attached to an electric car on the Wakefield & Stoneham Street Railway Company's road in Massachusetts, for which we are indebted to Mr. E. P. Shaw of that company. Its operation will be readily understood from the illustration. It will be noticed that it differs quite materially from a number of other fenders; the so-called "scoop" is entirely underneath the car platform.

The illustration also shows a form of adjustable step used on this car which is shown, in this case, in its position when not in service.

TESLA'S ENGINE AND MULTIPHASE ELECTRIC GENERATOR.

BY CHAS. DESMOND.

When Nikola Tesla delivered his lecture before the Electrical congress in Chicago, last summer, he described a new engine of his invention designed to operate an electrical generator or oscillator by which currents of any number of periods per second could be produced. As no detailed description has yet been given of the experimental engine and generator, or electrical oscillator, as it might more properly be called, the accompanying illustrations may, perhaps, give a clearer insight into the principles and construction of the machine than has yet been obtained by many. The original apparatus was on exhibition at the World's Columbian Exposition in the space occupied by the Westinghouse exhibit, in Electricity building, but was shown as the personal exhibit of Nikola Tesla. In this apparatus the generator is an annular electromagnet with consequent poles, but is separated into two parts, being divided through the center. The two magnets thus produced are separated a sufficient distance to admit of a thin, bar-like armature being introduced which contains recessed spaces into which flat coils of wire are laid. The arrangement is such that the engine for operating the generator is placed in the center between the magnets; rubber tubes being used respectively for live and exhaust steam. This was the device as originally produced and used in the early experiments which fully demonstrated the practicability of the apparatus.

The object of such device was to enable the experimenter to study the nature and affects of alternating currents to determine the least number of changes of direction per second that could be utilized and also study the effects of higher rates of alternations than had heretofore been considered practicable or had been the subject of careful study by other investigators.

The experimental machines served the purpose for which they were designed, and other machines

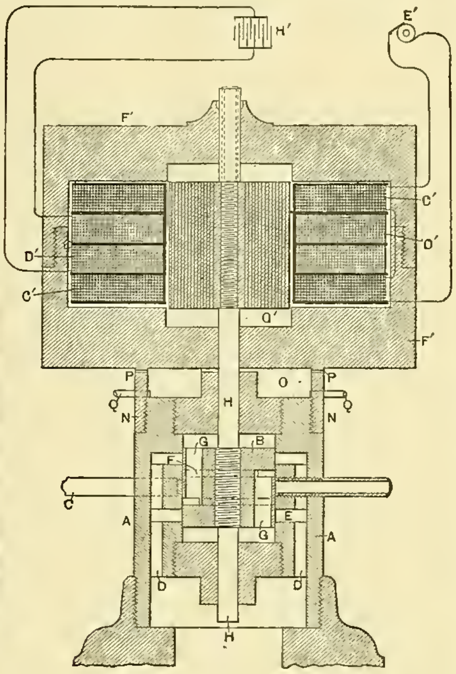


FIG. 1.

in which both factors of the combination have been considerably improved and put in more practical form have since been built. Two forms are shown in Figs. 1 and 2, in one of which the engine is fitted with an automatic governor. These two illustrations are taken from the *Electrical Engineer* of recent date.

The details of the engine may be described as follows with reference to Fig. 1. The cylinder is represented by the reference letter *A*, the piston

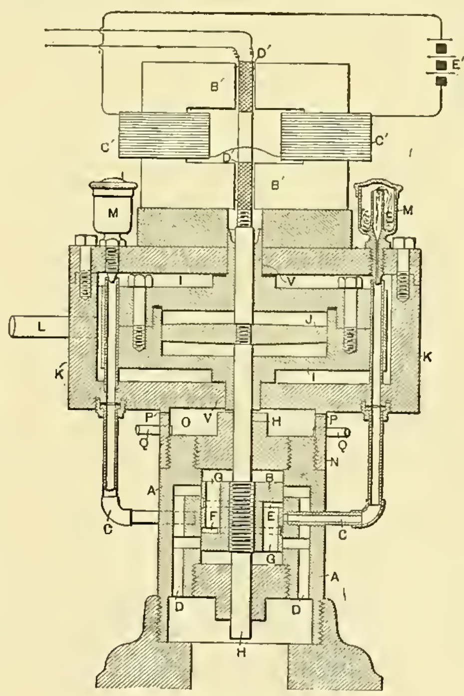


FIG. 2.

by *B*, the inlet ports being shown at *C C* and the exhaust passages at *D D*.

The engine has no valves, properly speaking, the inlet and exhaust ports being connected to the steam supply and to the exhaust by channels in the piston, thus making the piston serve the purpose of steam valves, as is the case in some kinds of steam pumps; but in this engine the idea is carried out in a more complete manner, by which the piston can be caused to make any desired number of strokes per minute. The ports are shown in outline on the piston by the letters *E* and *F*. Steam enters the cylinder through the pipes *C C* and makes exit through the exhaust openings *D D*.

The engine as a whole is quite simple and contains no delicate parts that are constantly liable to get out of adjustment through the wear incident to constant operation, no matter how great the duty it may be required to perform. It will be noticed that full pressure of steam is applied directly to the piston at all times, as there is no governor to produce a throttling effect or determine the point of cut-off, these things not being necessary with this design of engine.

An ingenious arrangement has been devised to obtain results similar to those produced by the use of the governor with which modern engines are fitted and which consists of an air cushion in an auxiliary cylinder containing a piston of greater area than that in the steam cylinder. The governing apparatus, as shown in the illustration, is located in the interior of the case *K K* which forms a steam jacket. The air cylinder proper is shown by *I I*, and the piston which works within it, by *J*. This cylinder contains confined air, usually at atmospheric pressure, which serves as a spring or cushion to intercept the momentum of the moving parts of the engine and generator, although the weight of the latter is of little consequence in this respect.

During the compression of the air in the governing cylinder considerable heat is generated and after a time the cylinder becomes quite hot, so much so that it becomes an object to utilize the surplus heat, which is done by causing it to superheat the steam used by the engine. The main steam pipe enters at *L* and circulates through the jacket around the air cylinder and is then carried to the engine cylinder through the pipes *C C*.

The oil cups shown at *M M* on top of the casing surrounding the air cylinder are for supplying lubrication to the engine. These are located directly above the opening of the steam pipes.

At first glance this engine would not commend itself for economy to the average engineer because there is no apparent means of utilizing the full expansive force of the steam; but when it is remembered that the engine is practically without friction or leakage and that the steam is superheated by work done by the engine itself, and that the supply can be regulated as may be required, it may be inferred that it can be operated as economically as the average engine, when working under ordinary conditions; and the fact must not be overlooked that it serves a special purpose beyond the capacity of any other engine at present in use.

In the combination shown by the illustration, Fig. 1, the generator *B B* is located on the top of the chamber surrounding the air cylinder and is of somewhat different form from that employed in the original device. With this arrangement of machines the motion of the engine is constant during any changes of load on the generator and the speed can be easily regulated to any desired degree by varying the pressure of steam or that of the air within the air cylinder, or by both. From this it will be seen that the device is all that is required for experimental purposes with rapidly changing currents, as the number of phases produced can be changed to any required degree and the speed will remain practically constant under any variation of load.

In this arrangement the pistons of the engine, the air cylinder governor and the armature of the generator are all attached to a single rod. Leakage of steam and air is provided against by properly arranged stuffing boxes which serve also as bearings or guides to the rods. In the construction of the cylinders, pistons and ports the only unusual point introduced is that the exhaust ports are made much larger than is common in other engines, so that any resistance due to back pressure will not be experienced.

The generator, being designed for alternating currents, is separately excited, the current is taken from the reciprocating armature by contact pieces in the form of springs, forming terminals of the armature circuit and serving also as guides to maintain the armature in a position centrally between the pole pieces.

The illustration, Fig. 3, shows a different kind of generator, the air governor being omitted. In this generator the armature, or inductor rather, is represented at *G* and consists of laminated plates; the exciting coils are wound to produce consequent poles in the magnetic casing and is supplied by currents from an external source as shown at *C*. The secondary coils are shown at *D*.

Cincinnati Car Barns Burned.

The Avondale street railway car sheds and machine-shop burned Friday morning, entailing a heavy loss. The car shed is 250 feet long and one and a half stories high, with a basement. There were ninety or more cars in the sheds, ncluding thirty motor cars. In the basement were the machine shop and boiler room. The origin of the fire is not known. The insurance is about $150,000. Mr Bert. L. Baldwin wired us yesterday that the frame car barn was a complete loss, and that 30 double motor equipments and about 90 closed and open car-bodies were destroyed, the total loss amounting to about $200,000.

Comments and Views of Contemporaries.

Uses of Trolley Lines.—The electric ambulance is only the stepping stone to the general use by the municipal authorities of the electric roads. When the full advantages of these roads are realized, perfectly clean streets wherever the tracks are laid will become possible. A street sweeper attached to a specially constructed motor could clean half the street going one way and the other half returning, when it would sweep it so hard that not a particle of dirt would remain. This could be done during the night when there is little traffic, or the sweeper could follow the last regular car. The electric railroads have solved the problem of snow plowing, and dirt could be removed just as easily. For sprinkling purposes the trolley cannot be equaled. Sprinklers could be so attached as to sprinkle the entire street, and the valves could be so arranged that the flow of water could be regulated to a hair. Passenger carrying is only one of the uses to which the trolley electric lines ought to be applied.—*A. T. Pickett in the St. Louis Globe-Democrat*

A Cause of Accidents.—The attention of the police should be given to some points on the electric railroad lines for the prevention of so-called "accidents" to children. There seems to be a spirit of recklessness among boys living near the electric lines which leads them to trifle with their own lives. A dozen cases were noticed by one passenger last week where boys deliberately passed in front of an electric car, or waited for its advance in the middle of the track, tempting an awful fate out of pure recklessness When the motorman brought his car to a halt to avert the apparent danger, the boys would jeer him, and it was not difficult to see that the motorman might privately determine that next time he would let the youngster escape as best he could. It need not be said that the passenger who sees this performance repeated a few times is worked into a state of nervous indignation which makes him sympathize with the motorman. The public demand is that motormen shall be held to strict accountability, and that the companies shall be punished for the failure of their servants to exercise proper care. But when the conditions are complicated by the small boy's malicious daring, it becomes impossible to hold either corporation or servant to their duty, and fatal injustice follows. The police should make examples of a few boys who play this perilous game.—*Newark Sunday Call.*

Small Bells Wanted.—Why a surface railroad company, whether cable or trolley, should go to the expense of putting in large gongs with apparatus to ring them with when a simple jingle-bell fastened to the axle is so much cheaper and more effective for warning pedestrians is difficult to comprehend. The jingle-bell makes a continuous noise, which attracts attention without startling, and which grows louder as the car approaches and less obtrusive as it recedes, so that a man who is not looking may know when a car is drawing near. The sudden loud clang of a gong causes a nervous start in nearly everybody, and often paralyzes activity instead of stimulating it.—*New York World.*

Short Line Competition—The first evidence that the trolley road can knock out the regular steam roads in short line competition comes from General Passenger Agent Hancock, of the Reading road, who, when asked whether his road would lower passenger rates from Philadelphia to Germantown, Wayne Junction and other points also covered by trolley roads, said competition with trolley roads for nearby business was impossible.—*Pottsville (Pa.) Journal.*

Refunding Fares.—When for any cause the Broadway cable cars are hindered the rule is that the conductors shall offer to return a nickel to each passenger who prefers not to wait for the cable or the cars to start up again. It is interesting to watch the behavior of the passengers at such a time. They cluster around the conductor until they find that each man or woman must give his or her name and address in order to receive the nickel. At that all the stout, well-dressed men abandon their nickels. But the women and the boys wait patiently and go through the ordeal cheerfully.—*New York Sun.*

Immediate Need of Rapid Transit.—We are weary unto faintness of the impossible and complicated plans presented to the enchanted and somnolent circle of the Rapid Transit Commission. We want quick trains, on many tracks, on both sides of the city, from the Battery to Harlem, and we want them at once. It will not take three weeks to fix upon the most practical of all the East and West Side routes, and to start the work. There never was a more favorable time than the present, when tens of thousands of arms are outstretched in appeal for work, and when the money paid to the owners of these idle arms for toiling on city improvements will help them to tide the crisis over. Enough of phrases, of red tape, of fiddle-de-dee! Let us have a system of our own, put through at high pressure speed, and managed by people responsible to us. Elevated or depressed, four-tracked or two-tracked, let us build it now. —*New York Journal.*

Horse and Trolley Car Accidents. — One thing is noticeable in connection with the trolley car in New York and Brooklyn. When one of them kills a pedestrian a great hullaballoo is raised and particulars are stretched to the extent of a column, with display headlines. But when an antiquated horse car provides work for the coroner the fact is dismissed with fifteen or twenty lines of mention.—*Rochester (N. Y.) Herald.*

Conductor's Presence of Mind.—It takes considerable presence of mind to successfully run an electric car. The conductor whose car balked on Broadway yesterday and tried to ascend the stoop of a dwelling is evidently an accomplished official. When the people of the house rushed to the door to inquire the cause of the disturbance, the conductor touched his cap and suavely asked: "Did you order a car, sir?"—*Troy (N. Y.) Times.*

Boston Rapid Transit.—There is only one way in which rapid transit can be secured for Boston in a practicable, effective and economical manner, and that is by a well-planned, scientifically constructed and skilfully operated system of elevated roads. The experience of other large cities conclusively proves this. Tunnels are expensive, are not adapted to this varying climate, and are opposed to the wishes of the people. Elevated roads may now be constructed at a moderate expense and after a pattern not disfiguring to the appearance of the business or less desirable residence thoroughfares to which they will necessarily be relegated. They can be operated by electricity, thus avoiding a large part of the dirt and noise incidental to steam roads. Flying to and fro on these structures, trains can carry the vast and rapidly growing population with ease, safety, comfort and speed.—*Boston Beacon.*

LEGAL NOTES.

Charler and Franchise. In New Jersey. Act April 9, 1866, (P. L. 1866, p. 1068,) incorporating the Paterson & Little Falls Horse & Steam Railroad Company, conferred upon the company the right to construct its railroad from some point in the city of Paterson, and also along any street in said city. The Supreme Court decides, that, although the act also contained some provisions usually inserted in railroad charters, it authorized the company to construct and operate a street railroad in said city. The court also rules, that (a) A street-car company which has placed an overhead wire along a street with out the consent of the board appointed under Act March 10, 1892, is not entitled to an injunction restraining people from cutting said wire. (b) An ordinance consenting to the laying of "horse-railroad track or tracks" along certain streets does not restrict the use of such tracks to cars propelled by horses. (c) A municipality may by ordinance authorize a street-car company to propel its cars by electricity. (*Paterson Ry. Co. v Grundy*—26 Atlantic Reporter—788).

Personal Injuries.—The Supreme Court of Alabama lays it down, that where an action for personal injuries is brought August 2, 1890, against defendant railroad company, on the theory that after the injuries were received, and before suit, the negligent corporation was consolidated with several others, forming defendant, which latter assumed the liabilities of the negligent corporation, and plaintiff introduces the deed executed by the negligent corporation to defendant on September 30, 1890, which recites the consolidation and the creation of defendant at some time, not specified, before its date, and also the act of the legislature authorizing such consolidation, while the evidence does not show precisely whether the consolidation took place before or after suit was brought, yet, with the admission in the pleading that defendant was a corporation, it constitutes competent evideuce of the alleged consolidation bsfore the suit. The court also holds, that in an action for personal injuries, brought against defendaut railroad company on the theory that after the injuries were received, and before suit, the negligent corporation was consolidated with several others, forming defendant, which latter assumed the liabilities of the negligent corporation, pleading the general issue, while admitting the capacity in which defendant is sued, does not admit the merger of the wrong doing corporation by consolidation, into defendant. (*Zealy v. Birmingham Ry and Electric Co.*, 13 Southern Reporter—118.)

It is held by the Supreme Court of Georgia that it is not per se negligence for a person, with an umbrella in one hand and a handkerchief in the other, to attempt to board an electric street car while it is in the act of stopping to receive passengers, and before it has come to a full stop. (*White v. Atlanta St. Ry. Co.*, 17 Southeastern Reporter—672.)

Electricity for Motive Power.—In Pennsylvania the Supreme Court decides, that a motion for a preliminary injunction to enjoin a passenger railway company from using electricity for motive power was properly refused where the question involved is whether a passenger railway company, incorporated with authority to use only horse power for traction of its cars, can be converted into an electric railway company by the action of the municipal authorities of the city in which the company's road is; such question never having been passed on by the Supreme Court, and being of too serious a character to be passed on without a hearing of the case on all its facts. (*Fritz v. Erie City Pass. Ry. Co.*, 26 Atlantic Reporter—653.)

Right to Lay Tracks.—The Supreme Court of Maryland holds, that a city which has by ordinance granted to a street railway company the right to lay tracks on one of its streets may revoke such grant by repealing the ordinance, even after the track has been laid, when, in the judgment of the city council, the public safety and convenience, and the proper regulation of the use of the street require it. The Court also decides, that the repeal of an ordinance granting a street railway company the right to lay tracks on a street gives the company no right to compensation, when the track was laid after it had notice that the mayor would recommend the passage of the repealing ordinance as soon as possible. (*Lake Roland El. Ry. v. City of Baltimore*, 26 Atlantic Reporter—510.)

Regulation by Ordinance.—In Michigan, the Supreme Court rules, that an ordinance providing that the company shall, for the accommodation of the public, keep tickets for sale on its cars, does not destroy or unreasonably impair the right and franchise of the company, within the meaning of How. St. c. 91 § 3527, prohibiting the city authorities from making any regulations whereby the rights or franchises granted shall be destroyed or unreasonably impaired. The court also decides, that (a) A reservation, in an ordinance granting a franchise to a street railroad company, of the right by the city to make such further regulations as may be deemed necessary to protect the interests of the public, includes the right to enact an ordinance providing that the company shall, for the accommodation of the public, keep tickets for sale on its cars. (b) An ordinance requiring a particular street railroad company to sell tickets on its cars does not contravene the principle that the ordinances shall be general and impartial in their operation, since that principle does not apply to ordinances by virtue of a reservation in a franchise, which p takes of a character of a contract. (c) A reservation, in an ordinance granting a franchise, of the right to impose further conditions, involves the right to provide for the enforcement of such conditions by fine for its disobedience. (*City of Detroit v. Ft. Wayne & B. I. Ry.*, 54 Northwestern Reporter—958.)

FINANCIAL DEPARTMENT.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn Street, this city said yesterday: "The attention of traders during the past week has been largely taken up with breaking the Elevated railway stocks, leaving the cables almost wholly neglected. The market seems bare of orders, and the few there are seen to be speculative ones, and the only trading is for the account. The stock seems to be in good hands in the case of West, and especially so in case of North Side; with the former at 136 and the latter at 239 there is a very good rate of interest for the investor. We see an increasing commercial activity, though only in a small way as yet, but we think it ought not to take long for it to spread when it gets well started. We look for higher prices in cable stocks; not so much for the speculator as for the investor. In Philadelphia all the transactions continue to be very dull and more or less in sympathy with the general market. There are very few orders either way in these stocks and the odd lot dealers make the quotations. As there has been very little pressure to sell either Philadelphia and Metropolitan the prices of these two stocks have advanced somewhat, Philadelphia selling to-day at 92½ and Metropolitan at 103 and 102½. An attempt has been made to depress Baltimore on repeated rumors that the lines in that city were fighting and that the fare had been reduced to three cents. This, however, lacks reliable confirmation. Electric Traction has declined on the announcement and call for all unpaid installments on this stock, but the stock was so dull that it is hardly worth while quoting it. A few hundred People's changed hands every day at about 27½. Consol. Traction fives are selling at 86¼ and Newark fives at 92. Hestonville, the last of the street car lines to change from horses to electricity, has declined to 35, and although the insiders are declaring that their scheme is underwritten and their money is assured the price of the common stock falls to confirm this by a good many points. When the general market becomes strong an advance all along the line will be looked for in the traction stocks."

Chicago, Ill.—The Chicago North Division Elevated Railroad Company has been incorporated. The proposed road is to be constructed from a point south of the main branch of the Chicago river and north of Congress street, between the south branch of the Chicago river and Lake Michigan, in the city of Chicago, running thence northward across the Chicago river to the city limits, with a branch running west to Western avenue and thence northward to the city limits. The capital stock is $10,000,000, and the first board of directors consists of Marcus Pollasky, L. O. Goddard, William Sooy Smith, Frederick W. Gardner, James L. Hall and Andrew McNally of Chicago, and W. W. Tracy of Springfield.

Milwaukee, Wis.—The formal transfer of the West Side Street Railway to the Milwaukee Street Railway Company was made January 29, when the last payment of $325,000 was made to Washington Becker. The deal for the transfer of the road was made a year ago, but the financial crisis delayed the payment. Mr. Becker received for the road $1,000,000, the purchasers also assuming an indebtedness of about $500,000. The Milwaukee Street Railway Company now controls all of the street railways of Milwaukee.

Stock Secured.—It has been announced that the Consolidated Traction Company has secured all the stock of the New Jersey Traction Company save one share held by each of the directors to keep the corporation alive. The Consolidated assumed control of all the lines in Newark except the South Orange, the new line from Jersey City to Newark, all the Jersey City and Bergen and Elizabeth lines except the North Hudson and Union County.

Milwaukee Line to be Acquired.—The West Side street railway, known as the Becker line, will passed into the complete control of the Milwaukee Street Railway company February 1. With the final transfer of the Becker road every street car line in Milwaukee will be under the management of the Milwaukee Street Railway company.

Receivership Denied.—Judge Pardee, in the United States circuit court at New Orleans, has denied the application for a receivership for the Atlanta Consolidated Street Railway Company, of Atlanta, Ga., argued before him on Friday of last week.

The United Electric Securities Company has declared a semi-annual preferred dividend of 3½ per cent. payable February 1 to stockholders of record January 29. Books closed January 29 and re-opened February 2.

Newburgh, N. Y.—The property of the Newburgh Street Railway Company will be sold at auction on February 6.

NEWS OF THE WEEK.

Washington, D. C.—A project is under consideration to connect Washington with the battle-field of Bull Run by an electric railway. The road if constructed will extend from the town of Manassas, about twenty-five miles southwest of Washington, eastward through Fairfax Court House on to Falls Church and thence on to Washington, crossing the Potomac on the piers of the aqueduct bridge at Georgetown. A bill to charter this road is now before the Virginia Legislature. It seems to be the object of the company to purchase the land upon which the first and second battles of Bull Run were fought and to inclose, improve, and beautify them for excursion and picnic grounds.

New York, N. Y.—Among those who propose to compete for the $50,000 prize offered by the Metropolitan Traction Company is said to be Mr. E. H. Johnson of the Interior Conduit and Insulation Company. Associated with Mr. Johnson is Robert Lundell. Their experiments have been conducted in a large vacant lot at Sixty-ninth street and First avenue. Persons in that neighborhood have been surprised to see a brown car shoot around the lot at a high speed, but all information as to the new method was refused.

Chicago, Ill.—The South Side Rapid Transit Company has decided to operate additional trains during rush hours in order to popularize the line. From Forty-seventh street to the terminal trains are run every six minutes from 7 to 9:30 A. M. Through trains run every six minutes, so that during the busy hours a three-minute service is provided for those living below Forty-seventh street.

St. Louis.—The house of delegates has passed a bill to compel all street railway companies in the city to station watchmen at all street intersections in the city where two or more lines cross each other at these points. It provides that the watchmen are to be at their posts from 6 o'clock a. m. until 8 p. m. and that the wages shall be paid pro rata by the companies whose lines cross each other at the intersecting streets.

Leavenworth, Neb.—Placards have been placed in the motor cars bearing legends to this effect: "Gentlemen will please not smoke nor spit tobacco juice in this car. One is offensive and the other disgusting." Another which is also to passengers, reads: "Don't pull the bell cord when you desire to get off, but notify the conductor; he is hired for that purpose."

Chicago, Ill.—Judge Tuthill has dissolved the injunction granted the Chicago, Burlington & Quincy Railroad and the Pittsburg, Cincinnati, Chicago & St. Louis Railroad, restraining the West Chicago Street Railroad Company from crossing tracks belonging to the former at points on the west side.

Rumored Consolidation in Baltimore.—It has been rumored that a project is under consideration to consolidate the Baltimore Traction Company, the City Passenger Railway Company, the City and Suburban Railroad Company, the Central Railway Company and the Lake Roland Elevated Railway Company, with a capitalization of $12,-000,000.

The Chicago Electric Storage & Equipment Co. has been incorporated with a capital stock of $250,-000. The incorporators, R W. Applegate, Oliver R. Stratton and H. Bartlett Lindley, hold the entire stock, none of which is to be placed on the market. The business of the company is the manufacture of storage batteries.

Springfield, Mass.—The Wyman-Lea Electric Railway Company has been organized to build an electric railway from Springfield to Holyoke. It has been intimated that this will be the first branch of an extensive electric railway system.

Cincinnati, O.—The Cincinnati Street Railway Company this week awarded contracts as follows: Twenty motor equipments, General Electric Company; twenty trucks, Peckham Motor Truck & Wheel Company; twenty car bodies, La Clede Car Company.

Allentown, Pa.—The Slatington Street Railway Company has been incorporated with a capital stock of $30,000. The incorporators are R. W. Mosteller, president; Henry Bittner, John W. Balliet, H. W. Hankee and Morris Hoats, directors.

Minneapolis, Minn.—Dow S. Smith, superintendent of the Twin City Rapid Transit Company, charged with violating the law providing that cars must be vestibuled, has been fined $75 by Judge Mahoney.

Dover, N. H.—The Consolidated Light and Power Company has been placed in the hands of W. F. Brewster of Boston as receiver. The General Electric Company holds a claim of $60,000.

Memphis, Tenn.—Dr. E. H. Batte of Memphis has been awarded a verdict of $20,000 against the Citizens' Street Railway Company for damages sustained in a street railway accident.

PERSONAL.

Nelson W. Perry, the author of the series of articles we are now publishing on "Electric Motors," has been awarded the John Scott medal by the Franklin Institute of Philadelphia for the most meritorious invention during the past year. The invention consists of a series electric traction system for street railways. Mr. Perry is well known as a street railway engineer and is well qualified to design an efficient system.

F. S. Terry has severed his connection with the Ansinia Electric Company and will hereafter give his entire time and attention to the Sunbeam Lamp Manufacturing Company, of which he has been elected secretary.

Resignations.—Mr. Bevis, treasurer, and J. H. Herrick, third vice-president of the General Electric Company, have resigned their positions.

TRADE NOTES.

The Standard Paint Company has just completed arrangements with the Metropolitan Electric Company, 186 and 188 Fifth avenue, Chicago, to act as general western agents for P. & B. electrical compound, armature and field coil varnish and P. & B. tape. The Metropolitan company has placed an order for a stock of those products, which it intends to push extensively throughout the West, and will at all times carry a large supply of P. & B. goods on hand. The Metropolitan company, through its president, Mr. Wm. H. McKinlock, is so well known to the trade everywhere in the West that it is believed this arrangement will be of great benefit to those who wish to take advantage of the opportunity to purchase these products in Chicago. The Standard Paint Company has re-opened its Chicago office at 871 The Rookery, which will be in charge of Mr. William Weierbach who has been one of the company's eastern representatives for the last seven years, and is therefore thoroughly acquainted with all of its goods.

The Charles Munson Belting Company, of 36 South Canal street, Chicago, is sending out a postal card to purchasers of leather belting which reads:

When ordering belting, see that you get a pure oak tanned 4 ft. 2 in. lap belt (including the lap). If you do not get it, we claim you get the poorest kind of a belt, at a high price in the end; any piece of leather in a belt, longer than 4 ft. 2 in., contains shoulder stock, and that is a poor grade of leather. Write us and we will be glad to give you full particulars.

The company also says that every belt manufactured by it is guaranteed to be strictly short lap and purchasers are instructed to examine each belt to see that no piece of it is more than 4 feet 2 inches long. How this particular limit of length affects the quality is a subject upon which the company will gladly furnish information.

Stokers for Important Plants.—Messrs. Swift & Co., the well-known packers of Chicago, after having had one of the Jones under-feed mechanical stokers in operation at their plant for about ninety days, have placed an order for fifteen additional stokers with the Jogada Furnace Company, the manufacturers. This company is at present installing five of its stokers in the plant of the Lindell street railway at St. Louis.

Change of Name.—The Star Electric Lamp Company, Chicago, manufacturer of the Sunbeam lamp, has changed its name to The Sunbeam Lamp Manufacturing Company. The policy of this company is to furnish lamps superior in quality. Recently some discoveries have been made, as the result of the extensive experiments, which it is claimed will greatly improve the quality and add to the value of the lamp.

Dermagluline pinions are reported by the manufacturers, A. Groetzinger & Sons of Allegheny, Pa., as being in greater demand than ever, and the statement is made that the trade during the month of January exceeded that of any month in the history of the business. The February trade is expected to be even better.

RECORD OF STREET RAILWAY PATENTS:

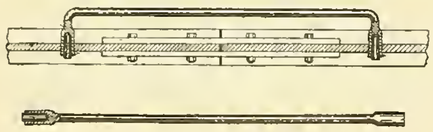
Patents Issued January 19, 1894.

512,682. Apparatus for Feeding Boilers. Nicholas Clute, Schenectady, N. Y. Filed May 21, 1891.

Combined with the boiler is a standpipe having water and steam connections, the feed pipe entering the standpipe and so set as to deliver the inflowing stream of feed-water into the water connection. Means are provided for regulating supply of feed-water, whereby the standpipe is supplied with fresh feed-water unmixed with the sediment of the boiler.

512,711. Rail Bond Connector for Electric Railways. Herbert R. Keithley, Chicago, Ill. Filed February 27, 1893.

This is a rail bond, or connector, composed of a rod, bar, or wire having tubular, or thimble shaped, terminals and



512,711. RAIL BOND.

secured to electro-conductors by having the tubular terminals permanently expanded by stretching of the metal compassing them into contact with holes in the conductors. (See illustration.)

512,733. Rail Joint or Coupling. Charles E. Miller and Philip M. Haas, Youngstown, O.; said Haas assignor of one-fourth to said Miller. Filed March 23, 1893.

This rail joint has a chair in each rail at, or near, the contiguous ends of the rails. These chairs are provided with beveled cheeks and a wedge-shaped fishplate is interposed between the beveled side of the chair and the adjacent side of the rails; thus the fishplates engage the head and bases of the rail.

512,749. Car Truck. James T. Robinson and Charles M. Robinson, Altoona, Pa. Filed October 22, 1893.

The first claim of this patent reads as follows: In a car truck, the combination with the wheels and axle; of a frame bar of the truck supported on the wheels, a side bar arranged above the former bar, springs interposed between the opposite extremities of the lower and upper side bars, and an adjustable support on one of said bars for supporting one of said springs, said support consisting of a stationery section rigidly secured to said bar, and a movable section secured to and movable lengthwise of the former section.

512,774. Electric Switch. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed December 1, 1891.

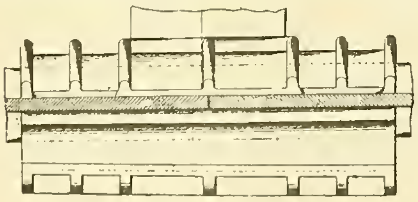
A switch block is adapted to slide between one pair of contact plates, which are let into slots and securely fastened to the blocks on which they are mounted. It is also adapted to enter between the members of a second pair of contact plates and a stop is provided on the switch block for limiting its movement.

512,781. Rail Joint. Clarence L. Wheeler, Marion, Ind. Filed May 1, 1893.

This is a cable roadway joint, having a chair provided with a solid, or jointless, seat for the rail ends to rest upon and constructed with an opening intersecting the seat from below to receive the end of a yoke, or girder; in combination with a draw clamp adapted to be applied to the upper face of the chair. (See illustration.)

512,797. Electric Heater. William J. Bowen, Norwalk, Ohio. Filed April 14, 1893.

The first claim of this patent reads as follows: In an electric heater, the combination with a casing and the partitions therein, of the series of vertical air-tubes supported between said partitions and each provided with an



512,781. RAIL JOINT.

insulating jacket, the heating coil around said jacket of each tube and having its terminal confined by the clamps, the insulator blocks, and the connectors supported by said blocks and having the clamps and the conductors fastened electrically thereto. (See illustration.)

512,806. Feed-water Heater. Edward G. T. Colles, Chicago, Ill. Filed February 15, 1893.

This invention covers the combination, with a water-drum, or tank, having steam inlet and outlet, of a perforated steam diffusing plate located between the water and the inlet and outlet mentioned, and a baffle plate interposed between the inlet and the outlet.

512,807. Combined Feed-water Heater and Receiver. Edward G. T. Colles, Chicago, Ill. Filed February 15, 1893.

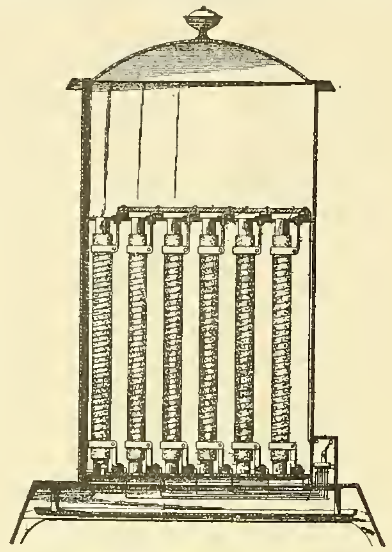
This invention covers the combination, with independent chambers for steam and water, of a water supply pipe, or boiler pipe, and the return pipe for water of condensation connection with said water chamber, and a system of valve-guarded by-pass pipes between the pump and water chamber and the boiler pipe and pump.

512,820. Motor Generator. John C. Henry, Westfield, N. J. Original application filed April 29, 1892.

This is the combination of suitable field magnets, two armatures carried by a single shaft, and a single support for said shaft between the armatures.

512,826. Means for Setting up Journal Boxes. Charles W. Hunt, West New Brighton, N. Y. Filed May 29, 1893.

In combination with a journal there is, at its back, a cavity containing balls of different sizes. Suitable



512,797. ELECTRIC HEATER.

mechanism is provided for acting against the balls to press upon the journal and transmit motion to the device to be adjusted.

512,836. Life Saving Device for Tramways. Louis Martineau, La Roche, France. Filed February 28, 1893.

In this device clasping arms are arranged so that they are normally held in an extended position. A releasing device is provided so that the arms may be brought together when desired.

512,843. Dynamo Electric Machine or Motor. Howard S. Rodgers, Hartford, Conn. Filed January 31, 1893.

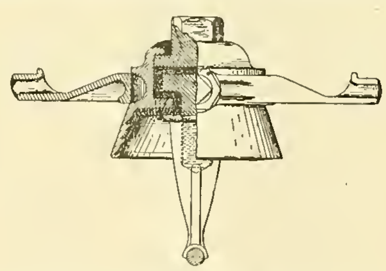
The field magnet guards are provided with pole tops and horns lying within planes bounding the external surface of the guards whereby the field magnet may be put in position, or removed without removal of the guards.

512,850. Belt Tightener and Shifter. Theodore F. Van Degrift, Shelbyville, Ind. Filed July 22, 1893.

This is a combination of pivoted hangers upon which the counter-shaft is mounted, arms upon said hangers, a rock shaft having arms, or cranks, mounted in said arms, links connecting the rock shaft to fixed points and a lever whereby the rock-shaft may be rocked and the hangers thus swung on their pivots, thereby tightening or slackening plates.

512,851. Rail Joint. Clarence L. Wheeler, Marion, Ind. Filed May 1, 1893.

This rail joint has a chair with a solid, or jointless, seat, corresponding in width to the full width of the bases of the rail ends which rest upon it and constructed in its upper face with longitudinal groove, in combination with a



512,888 TROLLEY WIRE INSULATOR.

draw-clamp, having upon its lower face a rib. This chair and clamp are constructed to press upward upon the webs of the rail ends and downward upon their bases.

512,852. Rail Joint. Clarence L. Wheeler, Marion, Ind. Filed May 1, 1893.

This joint is composed of two longitudinal members coupled together on the draw principle below the bearing of the rail ends and each having a depending trough extending throughout its length below the bearing, and below the line on which they are coupled.

512,853. Commutator and Connection for Dynamos. Gilbert Wilkes, Detroit, Mich., assignor to Hugh McMillan, same place. Filed October 2, 1893.

The first claim of this patent reads as follows: In a dynamo-electric machine, the combination of a slotted armature having a number of grooves which may be represented by (N+1), N being a number divisible by the number of poles, a number of coils equal to the number of slots and lying therein, a commutator having a number of bars or segments twice the number of coils, and suitable cross-connections for the segments.

512,888. Trolley Wire Insulator. Henry H. Luscomb, Hartford, Conn. Filed October 18, 1893.

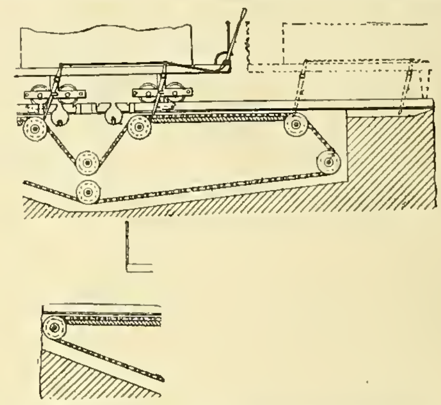
This is an insulator comprising a connection within said case, insulating material surrounding said connection and insulating the same from said case, a cap within said case having recesses therein and projections on said case which are bent over said cap and received in the said recessest herein.

512,907. Battery System for Electric Railways. Leslie B. Rowley, Ashland, Wis. Filed February 15, 1893.

This consists of a main circuit, including in multiple two or more independent sets of batteries, a working circuit, and means for automatically switching the sets of batteries bodily or individually from one circuit to the other.

512,910. Cable Car Transfer Device. John T. Schweizer, Wilmington, Del., and Jacob H. Burger, Philadelphia, Pa. Filed May 20, 1893.

This consists of a combination, with a cable beneath a railway track, passing below a transverse cable, and a chamber beneath the lowermost cable, of an endless



512,910. CABLE CAR TRANSFER DEVICE.

sprocket chain, idler wheels supporting the chain which is depressed below the transverse cable, mechanism in the chamber driven by one cable and actuating the sprocket chain, and two spaced pivoted arms on the side of the car that may be set to engage the sprocket chain.

512,921. Signal Light for Street Cars. James A. Trimble, New York, N. Y. Filed December 7, 1892.

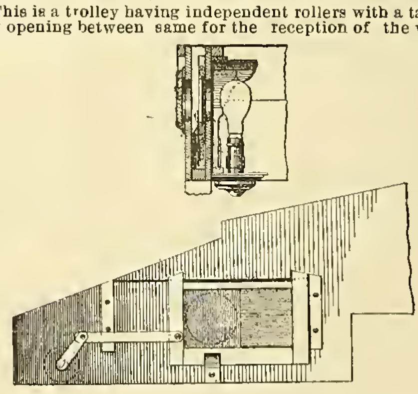
The construction and operation of this device will be readily understood from the accompanying figure. (See illustration.)

512,923. Electric Railway Trolley. Walter Van Benthuysen, New Orleans, La. Filed March 24, 1893.

This is a trolley wheel made in the form of a cone, with a concave flange, of smaller diameter than the cone, formed on its smaller end.

513,023. Electric Railway Trolley. George W. Mackenzie, Beaver, Pa., assignor of two-thirds to Moses B. Sloan and Thomas C. Sloan, same place. Filed April 5, 1893.

This is a trolley having independent rollers with a tapering opening between same for the reception of the wire,



512 921. SIGNAL LIGHT FOR STREET CARS.

said rollers having anti-friction bearings in their interior journals.

513,033. Car Brake Handle. Austin B. Collett, Lynn, assignor of one-half to John S. Baker, Beverly, Mass. Filed November 10, 1893.

The last claim of this patent reads as follows: "In combination with a brake handle, having a socket in its lower end, a clutch therein to engage the brake rod when the handle is turned in one direction, and move freely upon said rod when turned in the other direction; a chambered collar secured to the handle and loose upon said rod beneath the clutch members, and a packing within said chamber."

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CONTENTS.

Bonding of Rails. At their regular meetings the members of the Massachusetts Steel Railway Association incline to the consideration of practical, everyday questions, the solution which from the necessities of the case must be attempted by every company. The subject at the last meeting was "Rails and Rail Bonds," and from the discussion several suggestions may be gained. One speaker inclined to the belief that the use of copper for bonds was questionable for the reason that the metal was so soft that it was likely to be injured. The perusal of the discussion, which is summarized elsewhere in this issue, certainly leads to the conviction that the members thoroughly believe in the best possible track construction, regardless of original cost.

Storage Battery Traction. We print elsewhere in this issue a very comprehensive review of the tests of nine different types of storage batteries that have been tried upon the Metropolitan Railway Company's lines in Washington, D. C., during the last two or three years. We regret that the record shows such a uniformly bad report for all the tests. Omitting four of the worst ones, the other five showed that the cost per car mile varied from 12 to 37 cents—not a very encouraging result, to say the least. Perhaps there are good cells on the market that were not tested at Washington and it may be that the makers of some were not satisfied that the trial was a fair one. We are sure our readers would be pleased to hear "the other side."

The Business Outlook. The topic of greatest concern at the present time to street railway companies and their friends, the supply men and manufacturers, relates to a possibility of a change for the better in the business situation. We have of late solicited the views of a considerable number of persons whose opinions are entitled to some consideration for the reason that their duties require them to visit street railway men in all parts of the country. It is their prediction that a decided improvement in business may be expected in the street railway field in the spring, but at the same time they expect to see every move characterized by extreme conservatism. They are hopeful and they have reason to be encouraged. Those who have followed the news columns of the STREET RAILWAY GAZETTE during the last two or three months have doubtless noticed that there were signs of no little activity, and if half of the enterprises which are to be undertaken "as soon as the frost is out of the ground," actually materialize there will certainly be no reason to complain of a lack of business.

Atlanta Street Railway Convention. Arrangements have been completed for the next convention of the American Street Railway Association in Atlanta, October 17, 18 and 19, and if the predictions of the executive committee and the street railway men of Atlanta are fulfilled the meeting will certainly be most interesting and enjoyable. The program as arranged includes subjects of interest at the present time, but topics which should receive consideration have been omitted. The matter of fenders, it seems to us, should not have been excluded, for it is one which has been very thoroughly investigated during the last few months, and delegates will attend the convention who could make interesting contributions to the fund of information now available on this much discussed topic. It is possible that fenders may be considered in connection with the second topic on the program, but in that case the latter should read "the best method of preventing accidents" instead of "the best method of treating accidents." If the subjects of brakes, electrolysis, conduit railways, repairs on electric cars, fire protection, controllers, and car heaters had been selected, some very interesting and valuable information might be elicited. Several of these subjects are receiving so much thought at the present time that it will not be surprising if they crop out in the discussion despite the fact that they are not included in the program. We thoroughly believe in the discussion of timely topics at conventions, as the sessions then prove far more instructive and interesting than when subjects of merely general importance are under consideration. The visitors in Atlanta will have an excellent opportunity to judge of the street railway systems of the city for the reason that the place of meeting and the hotels are about three miles apart. With free transportation on electric cars, however, this arrangement cannot be considered a grave objection. We understand that an effort is to be made to make the exhibit of street railway apparatus unusually comprehensive and we trust this will prove to be the case. Exhibits of this kind are always attractive, and we are glad to believe that in most cases they prove profitable to those who are compelled to pay the expenses of making them.

Mr. Stetson and His Conduit. Elsewhere we publish this week a communication from Mr. Albert Stetson, the author of a paper on "The Practicability of Electric Conduit Railways," recently read before the American Institute of Electrical Engineers and of which an abstract was printed in our issue of January 20. Mr. Stetson expresses himself as displeased with our editorial remarks upon his paper, in which we took exception (1) to his method of treating the subject by declaring all other systems failures and describing his own as the only conduit worthy of serious consideration; and (2) to the action of the Institute committee on papers in permitting the presentation of a paper of such a character before the Institute of Electrical Engineers. Mr. Stetson, however, has mistaken the import of our criticism. We had no intention of undertaking to establish the fact that any of the systems criticised by him were either on a dividend paying basis or were likely to be in the near future. Certainly no American conduit system of which we have any knowledge possesses any such prospects of commercial success. But granting that we are agreed as to the non-dividend paying character of all other conduit projects, it might be pertinent to ask in what way has Mr. Stetson established the commercial success of his own scheme. He gives no figures as to cost of construction or of operation, and indeed none could be expected since no line has been in actual operation in the hauling of passengers, and all conclusions drawn appear to be based upon the experimental operation of a piece of track less than a quarter of a mile in length over which one car has been operated at such times as its promoters might select. It appears further that any figures based upon the operation of this line would be misleading, as essential parts of it have been abandoned and improved devices substituted. These latter Mr. Stetson does not even describe but simply tells us they "entirely obviate the defects of the first." This statement alone is sufficient to show that the system is still in the preliminary stage of development, and as such it is entitled to the same consideration as half a hundred other conduit schemes upon which inventors are industriously working. So far as we are aware only two serious attempts have been made in this country to operate commercially conduit railways. One of these attempts was made by the Bentley Knight people in Boston and elsewhere and the second is now making an effort to establish its merits at Washington, D. C., where the Love system is in use. Certainly no one who had any knowledge of the actual results of the Boston attempt would care to assert that it was a success either financially or otherwise. What the ultimate result of the other attempt will be remains to be seen. When the conduit system for which Mr. Stetson was once the consulting engineer, or for that matter any other electric conduit railway, is able and willing to furnish facts and figures based upon the results of actual operation in the regular transportation of passengers it will be soon enough to make comparison with working lines. We do not pretend to question Mr. Stetson's accuracy in quoting from other authorities to show how many failures had already been made in the efforts to devise a successful conduit railway, nor do we question his sincerity in the statement that "our road has solved the question of conduit traction," for we sincerely hope it will prove more successful than any of its predecessors. What we did take exception to was the method of clearing the decks by throwing all other projects overboard with only the briefest and entirely inadequate consideration and then endeavoring to set up an undeveloped project, which he designates as "our road"—although he now disclaims any commercial or other interest in it—by unsupported claims of financial success. We grant that had such statements appeared in a promoter's circular we would not have given them any editoral consideration, but their appearance in the *Transactions* of the Institute of Electrical Engineers is a much more serious matter; and it may be that for this offense Mr. Stetson is not to blame, as he cautions us in that part of his communication which we have not printed to "find out all the circumstances under which that paper was read" before passing judgment upon its appearance under the auspices of the Institute.

Atlanta Street Railway Convention.

Arrangements for the next convention of the American Street Railway Association to be held at Atlanta, October 17, 18 and 19, were made at a recent meeting of the executive committee in Atlanta. The following members were in attendance: Henry C. Payne, president of the association, Milwaukee, Wis.; Wm. Stephenson, vice-president, Washington, D. C.; Lewis Perine, Jr., Trenton, N. J.; Thomas H. McLean, Indianapolis, Ind.; W. Y. Soper, Ottawa, Ont.; Wm. J. Richardson, secretary, Brooklyn, N. Y.

The committee decided to make the Hotel Aragon the headquarters and to hold the business sessions and to locate exhibits of street railway apparatus at the exposition building. The distance between the principal hotels and the exposition grounds is three miles, but as cars run to this point and as visitors will be provided with complimentary tickets no great inconvenience, it is believed, will result from this arrangement. Machinery Hall at the exposition grounds will furnish all the space needed for exhibits and it is predicted that the showing will be even better than that seen at Milwaukee last fall.

The committee selected the following topics upon which special committees will be appointed to report:

A Standard of Street Railway Accounts, H. I. Bettis, Atlanta, chairman.

The Best Method of Treating Accidents and Complaints.

Street Car Wheels and Axles.

The T Rail Construction of the Terre Haute Street Railway Company, W. F. Burke, superintendent of the Terre Haute Street Railway Company, chairman.

Can the T Rail Be Satisfactorily Used in Paved Streets?

Suburban Electric Railways.

Mail and Express and Passenger Service on Street Railway Cars.

The subject of "Transfers and Commutation" was made a topic for general discussion. C. K. Durbin of the Denver Tramway Company will be the first speaker. An executive session will be held on Thursday morning, October 18, when delegates will be asked to discuss any subject relating to the operation and conduct of street railways in general and of their own roads in particular. It was also decided that not more than twenty minutes should be given to any speaker. A special committee was selected, consisting of the secretary of the association, and Lewis Perine, Jr., to prepare a report upon "Street Railway Mutual Fire Insurance." It was resolved, in view of the financial condition of the country, that the question of a street railway institute be laid on the table for the present.

T. E. Crossman was appointed official stenographer for the coming year.

It was resolved, if satisfactory arrangements could be made, to make an excursion to Chattanooga on the Friday following the adjournment of the association, where an opportunity could be given the delegates to visit Lookout Mountain and the neighboring battle fields.

In the evening the members of the committee were entertained at a banquet at the Kimball House by the officers and directors of the Atlanta Consolidated Street Railway Co. Several residents of Atlanta who were present pledged the city to give a cordial welcome to the association next fall.

The Atlanta hotels are ample enough in capacity to accommodate all who may attend the convention, and only regular rates will be charged. The headquarters, as already stated, are to be at the Aragon, which is on Peachtree street, at the corner of Ellis, adjoining the finer residence portion of the city, and about five blocks from the Union Depot. This hotel has now 100 rooms, but an addition of 100 rooms will be opened in time for the convention. The rates at this hotel are from $3 to $5 per day, American plan, and from $1.50 to $3.50 per day, European plan.

The Kimball House is the largest hotel in the city, and is located on Pryor street, opposite the Union Depot, and close to the business center of the city. It has 450 rooms, with accommodations for 1,000 guests, and the rates are from $2 50 to $5.00 per day, American plan.

There are also several other hotels at which the delegates can secure accommodation. The principal ones are: The Markham House, the Arlington, the Leland, the Marion, the Albemarle and the Cooledge.

Application for space in Machinery Hall for exhibits may be made to Wm. J Richardson, secretary of the American Street Railway Association, Brooklyn, N. Y. Those who desire to secure rooms in either of the hotels should address Joel Hurt, president of the Atlanta Consolidated Street Railway Company, Atlanta, Ga., or make application directly to the hotels.

NEEDS OF STREET RAILWAYS.

Last week we published a symposium on this subject giving the views of more than 20 street railway managers and engineers on the following set of questions:

(1) What in your opinion was the most important discovery, invention, improvement or development in the street railway industry during 1893?

(2) Along what lines do you look for the greatest progress and improvement in 1894?

(3) What new street railway invention, or what improvement in existing apparatus, do you consider most urgently demanded at the present time?

In addition to the replies printed last week two others have since come to hand and are here given:

MERLE J. WIGHTMAN,
Vice-President and Electrical Engineer, Middletown-Goshen Traction Company, Middletown, N. Y.

(1) In my opinion the year 1893 has not been marked by any specially distinguished improvement or sudden advance in the street railway art. The law of evolution has been constantly at work improving and eliminating weak points, old apparatus and methods, and the year 1893 shows a broad general advance. Examination of net earnings, one reliable thermometer of progress, shows decided improvement over past years on several progressive roads, which results are clearly attributed to reductions in repair accounts and generally to more intelligent management of electric street railway properties and possibilities.

(2) Experiments and practical work inaugurated in the year 1893 looking to improved track construction I believe to be the beginning of a new era in that neglected branch which is the highway to the desired goal. I refer to the process of electric welding of rails as employed by The Johnson Company. I believe that time will prove the importance of the work just initiated so successfully by that progressive company, doing away at one stroke with the pestiferous rail joint, the unreliable rail bond and the increasing trouble from the electrolysis of underground pipes.

(3) I predict for 1894 a great development in improved track construction and think that no other branch of street railway engineering is so much in need of development. The repair account of roads operated with modern motors leaves little to be hoped for in the line of reduction in that direction. The operation of electric roads in the past few years has brought to light in its true importance the item of track repairs, and there is a wide field for the engineer and inventor in overcoming present difficulties and weaknesses.

G. HERBERT CONDICT,
Electrical Engineer, San Francisco, Cal.

(1) In my opinion, the most important development in the electric street railway industry in the past year has been the positive demonstration in Paris, France, on roads operating a large number of cars, and having numerous grades, that storage battery cars can be operated most successfully and at a cost for battery maintenance of not exceeding $3\frac{1}{2}$ cents per car mile.

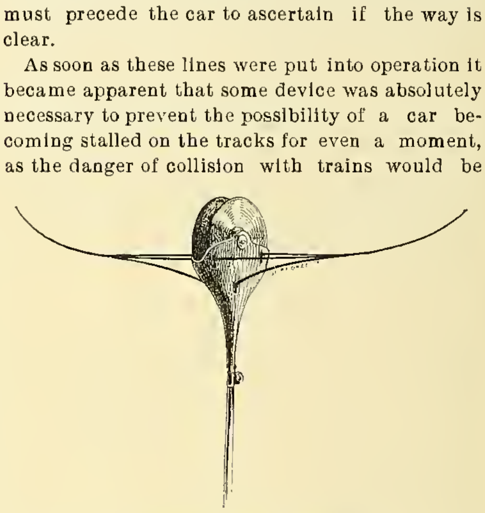
(2) The greatest improvement in 1894 will be the installation of a storage battery plant, as an auxiliary to the generating plant, on trolley lines, either at the power house or out on the line, or both; thus preventing the excessive fluctuations of demand on the generators and by storing up surplus power during light load for use during heavy load, giving greater efficiency to the system.

(3) There is an urgent demand for a simple, durable and efficient form of connection between motor shaft and axle, which will permit an approximately constant speed of motor, no matter what may be the speed of car or demand for power.

AUXILIARY TROLLEY DEVICE.

The motor cars on the Thirty-fifth street and Forty-seventh street lines of the Chicago City Railway Company cross a network of steam railroad tracks at grade. The company was not allowed to cut the rails, but at the same time it was compelled to raise the trolley wire twenty-two feet above the ground. As the cars jolt across the tracks and as the wire is high the trolley wheel is very likely to leave the latter. The conductor is not at hand to replace it, as he must precede the car to ascertain if the way is clear.

As soon as these lines were put into operation it became apparent that some device was absolutely necessary to prevent the possibility of a car becoming stalled on the tracks for even a moment, as the danger of collision with trains would be



AUXILIARY TROLLEY DEVICE.

altogether too great. The officials of the steam railroad companies insisted upon immediate action to prevent accidents but refused to consider a proposition to lower the trolley wire. Experiment demonstrated, however, that the wheel would not leave the wire at the height of twenty-two feet if it were not for the jolting on account of the uncut railroad rails. As these could not be molested it was necessary to devise some trolley appliance which would insure the supply of current to the motors when the wheel left the wire. To meet the necessities of the case auxiliary conductors were added to each side of the harp, forming a pair of "horns," one of which is bound to strike the wire if the wheel slips. Each "horn" is composed of three one-quarter inch iron wires riveted to the harp and they are welded into one piece at about six inches from the tip of the horn. The tips are somewhat flattened and the distance between each tip and the harp is about ten inches. The application of these auxiliaries to the trolley has proved entirely satisfactory, and the danger that a car will become stalled in front of a train no longer worries the officials of the street railway and steam railroad companies. The horns slide easily along the trolley wire and there is no danger that the conductor will slip, for there is a lateral play of ten inches on each side of the harp, and the flattened tips prevent the wire from sliding over the ends. The illustration represents the auxiliary as quite a prominent in appearance, but this is not true when it is in actual service. It would scarcely be noticed at any time, and when the car is in motion it can scarcely be detected at a distance of 100 feet.

York, Pa.—It is announced that the York Street Railway Company will soon build several extensions.

RAILS AND RAIL BONDS.

Discussion at the Monthly Meeting of the Massachusetts Street Railway Association.

The questions of rails and rail bonding were discussed by the Massachusetts Street Railway Association at the meeting at Young's Hotel, Boston, February 1. The session proved to be highly interesting, although the presentation of opinions was for the most part more than ordinarily informal. The following gentlemen were present:

Col. J. W. Cunningham, Plymouth & Kingston Street Railroad Company.
A. E. Butler, Lowell, Lawrence & Haverhill Railroad Company.
E. P. Shaw, Newburyport Street Railroad Company.
C. S. Sergeant, West End Railroad Company, Boston.
J. C. Morse, Rochester Car Wheel Company, Rochester, N. Y.
Maurice Hoopes, Lynn & Boston Railroad Company.
Waterman Stow, Union Street Railroad Company, New Bedford, Mass.
J. A. Duggan and B. J. Weeks, Boston & Quincy Street Railroad Company.
J. A. Shaw, Wakefield & Stoneham Railroad Company.
Gilbert Hodges, Boston, Mass.
R. H. Hapgood, West End Railroad Company, Boston.
E. C. Foster, Lynn & Boston Railroad Company.
Alfred A. Glasier, Lowell, Lawrence & Haverhill Railroad Company.
C. S. Clark, Pennsylvania Steel Company, Boston.
Paul Winsor, West End Railroad Company, Boston.
R. C. Brown, West End Railroad Company, Boston.
F. L. Kenfield, Chicago, Ill.

C. S. Clark of the Pennsylvania Steel Company was called upon to speak upon the subject of rails. After showing a variety of rails made by his company, Mr. Clark mentioned the fact that ten years ago he had spoken with Mr. Breed of Lynn concerning the comparative value of rails of varying weights. The latter favored the use of rails weighing 30 pounds to the yard, but, said the speaker, "I tried to convince him that 35-pound rails would be better. He indorsed the opinion and adopted the heavier rail." As illustrating the wonderful changes that have since occurred Mr. Clark stated that Mr. Breed's company was now using 90-pound rails. The opinions of street railway men differed in many respects, but on one point they were agreed—that street railways should be constructed even better than the ordinary steam railway track. It was a fact that hitherto the street roadbeds had not had the care they ought to have had. The subject of ballasting a road was of supreme importance, and good stone ballast was essential every time. The argument might be advanced that ballast for a road was expensive. It might be so, but yet not so expensive as to maintain as a road having poor alignment. There were many causes for roads getting into poor condition, such as vehicular traffic on the streets, grade crossings, bad joints, etc. Good ballasting would tend to obviate these defects.

There was also the subject of ties to be considered. It was poor economy to lay a road on light or poor ties. They should always be stout, sound and plenty in number. Most important of all, however, were the rails. The samples of rails shown varied from 35 pounds to 75 pounds per yard. They included channel and T rails. The use of chairs had disappeared since roads began to be paved. The troubles with joints had long been felt; thousands of dollars had been spent in efforts to overcome the difficulties and everybody would be thankful if all joints could be done away with. In reference to the wear and tear caused by teams it was better to let them wear out the terms than to wear deep ruts in the paving Of course, in the making of rails there were many of "seconds" quality, and yet he was of opinion that if those to whom he was then speaking could see the "seconds" they would not hesitate to buy them, for they were often as good as the "firsts." There was a difference of $2 to $3 a ton in price, yet very few men could detect any difference in quality. Three years ago when the combination among rail makers was effected, the price was fixed at $30 per ton and 50 pound rails were decided upon. The popular weight was now 58 pound rails. When the West End railroad of Boston began to use that rail the manager declared that every road in New England would soon use it and his words have proved correct. The speaker believed the 58 pound rail to be the best now in use.

In answer to a question as to what proportion of "seconds" was made, Mr. Clark replied that formerly it was as high as 30 per cent. but now only about 5 per cent Yet during the past year there had been quite a demand for "seconds."

E. C. Foster asked if the Pennsylvania Steel Company had rolled rails longer than 30 feet. Mr. Clark replied in the affirmative, stating that while rails 100 feet in length had been rolled they were found clumsy to handle. Mr. Foster remarked that he believed companies would find it economical to buy better rails at higher prices. He thought that a rail six inches deep could be used to advantage even if rolled in lengths greater than 30 feet, for there would be a saving in joints. In reply to a question asked by E. P. Shaw Mr. Clark stated that his company would roll rails 100 feet long if ordered. Mr. Hapgood remarked that the use of rails 60 or 100 feet in length would produce curious results if laid in Washington or Tremont street, Boston.

Maurice Hoopes was called upon for his views on bonding rails. The practice on the road with which he was connected, he said, had been to use channel rails with hard drawn copper wire joints for return current. It had been found, however, that the electrolytic action was very rapid, and it was a question whether copper should be discarded for something else. In the matter of securing the wires into the rails, the practice had been to bond with three holes in each end of a channel rail, threading the wire from hole to hole so as to secure a good contact for the return current. Much trouble had been experienced in bonding charnel rails and the company had been unable to secure just what it needed.

The inclined grooved bond had been first used, but great difficulty was found in applying this form. If there was any vibration at all the wire was certain to break at the head of the bond. The new kind of bond which the company was now using was different from that formerly in use. At present the pin which was employed was slightly larger in diameter than the holes into which it was to be driven. With a bond of proper construction a joint could be made very accurately without spoiling the wire, for when a pin was used the bond was not cut or scraped by the rail. If the wire was weakened by any cut or scratch it would give out sooner or later. The bonding pins were prepared as they were needed, as they were purchased in such form that it was necessary to do some work on them before they were ready for use. Mr. Hoopes stated that he had found it a mistake to cut or scrape the wire in passing it through. It was customary to drive a drift pin into the holes so that the wire would slip in easily. The point of the pin was also applied to an emery wheel so that the ragged edge was removed and it would slip on the wire easily. It had been the practice to drive channel bonds into place by a few hard blows, but the essential point was to have a special tool by the use of which the bending of the pin even in the slightest degree would be obviated. Mr. Hoopes said he had found it necessary to superintend the work closely so that men would not use pins that were improperly prepared, for if so the wire was bound to break.

Mr. Hoopes said he had found a supplementary wire useful when there was a good contact with the bonding wires. He had put in supplementary wires for the reason that if a soft spot should exist at the joints, for instance, there might be a broken bond, and he reasoned that what might break one bond might destroy another and even a third. A tie might be loose and if lying on soft ground might cause the break of a joint. The supplementary was used to avoid that danger. The presence of a weak spot meant a loss and was a menace to traffic. In the construction work which he had done the last year he inclined to the belief that the supplementary wire might have been dispensed with as the track was very stable. In bonding turnouts and curves he simply tipped in the wire to rails while in switches and frogs he departed from the ordinary practice and tipped in a No. 0 wire and made it fit the track right along When such wires carried a much larger current than was intended danger was caused. Insulated wire was used in this case because it happened to be on hand and because it prevented electrolytic action. With such a wire if one got into trouble on one line trouble would not follow on another line. In electrolysis there was always danger. If it were possible to keep the rails from the earth, or if the wires were laid in sand they would last much longer than if they were in damp earth.

The only way to be certain of the condition of overhead wires was to make frequent tests along the line. By means of a private telephone line the company was able to test exactly the losses on the line. He had come to the conclusion after noting variations in the voltage of systems that it was wise to put in larger feeder wires. It might be that there was a loss of 50 volts on an overhead line and 250 volts on the underground line. If the same amount of copper had been used on both the positive and negative sides of the system, the drop in voltage would not be nearly so great. The way to determine whether the loss was on one side rather than on the other was by means of a voltmeter test. In this way the difference between the loss in the overhead circuit and that in the ground circuit could be ascertained and the sum of these two losses should of course equal the total loss. This test indicated where it was advisable to use additional copper in order to avoid heavy losses By means of these careful tests and calculations made from them it was decided upon which side of the circuit to apply the remedy. Old rails were sometimes found to cause trouble by creating an undue resistance. Mr. Hoopes then described his method of testing the circuits as follows: "We start out with a car equipped with a voltmeter, and stop at a turnout to test the voltage. On one side of the turnout we may get 150 volts and on the other side 450 volts. We know then that the trouble is at the turnout. We bridge over the tournout with the voltmeter and find just where the fault is. At times I have found joints where we were losing 40 or 50 volts, and nearly all of these faults were at turnouts or switches. Such defects signify not only the loss of a good deal of energy but involve injury to the track construction in the immediate locality. The escaping current causes electrolytic action and injures the other wires which form the path for the return current. Reverting again to channel bonds I may say there is considerable prejudice against them, which largely is due to the poor work which often attends their application. Some managers think there is a great loss where such bonds are used, but in my opinion such bonds when properly put in cause very little loss. I think if there was much loss there would be evidence of heat or corrosion, but as we find no indications of the kind we realize that there is not much waste going on at the joint. I may say that Mr. Brown has made an invention to prevent corrosion when channel bonds are employed. He uses a taper bond through which there is a hole. The bore is the same diameter throughout. He sweats this on the wire and secures the best kind of electrical contact. There is no question that this method is excellent and better than anything else yet devised. My objection to using anything else would be that the channel bond accomplishes all that we need of it. I think that copper is almost too soft to rivet into an iron or steel rail. I believe it is better to use an iron channel bond, the copper being simply pressed into the holes and not riveted. I used for a time rivets of Norway iron, but we found that by tapping any of them on the head they would show that they were loose. I have never seen one of them that would keep a good contact right along."

In response to a question of Mr. Weeks Mr. Hoopes said he saw no necessity for using overhead wires and tapping them in at every pole. Mr. Weeks mentioned the fact that during the cold weather he had had difficulty from the fact that bonds broke.

E. P. Shaw stated that three years ago after building a railway he did not have time to bond the rails. The cars were run the entire season with the track in this condition. At a turnout horses were used. The earth was quite damp on the line.

Paul Winsor exhibited the rail bond invented by Mr. Brown of the West End Company of Boston, and referred to by Mr. Hoopes in his remarks.

Gilbert Hodges, in a brief address, alluded to the changes which had occurred in methods of street railway construction, illustrating his remarks by having sketches of various types of iron rails which were in use years ago. All railways, he said, had to encounter the same difficulties with joints. The man who should invent a joint that would hold up the track so that it would not be possible to tell where joints were located would be a public benefactor. There were advantages in using long rails, such as had been alluded to; there were also objections, one of which would be the difficulty of securing proper alignment. In building a road too much importance, he thought, was attached to expansion and contraction. He believed that only the very slightest space, if any, should be left between the ends of the rails.

At the next meeting of the association, which will be held the first Thursday in March, the topics "Mutual Insurance" and "Brake Shoes and Car Wheels" will be discussed.

Fender Question in St. Louis.

Of the St. Louis railway managers, John Scullin, of the Union Depot system; Harry Scullin, his son, and Geo. W. Baumhoff, of the Lindell, have been very energetic in trying to discover a fender, says the St. Louis *Globe-Democrat*. They have all traveled extensively with that view, and Mr. Baumhoff, with Gus. Hegeman, one of his lieutenants on the Lindell, has conceived a fender which he thinks will be an improvement on any known. He will try it soon on his road. It is simple and light. When raised the front end reaches just below the projecting drawbar, and when lowered it runs on small wheels on the track rails. The fender is lowered by a small crank, turned about three inches, or one way of the circle, by the motorman. The perfected fender, however, will have no crank. It will be raised or lowered automatically, entirely so, or by a button worked by the motorman with his foot. In cases of accident, or impending accident, this important railway employe needs his hands as well as his wits. When he sees he is going to run into a man he wants to put on his brakes as well as shut off his power. He may have brain and presence of mind enough to work his feet as well as his hands, but he certainly hasn't enough to compensate for two or three of what may be called false movements of the hands.

For the information of inventors it may be stated in safety appliances railway men demand the following qualifications: Lightness, neatness, simplicity, safety, durability, and to be at the same time inexpensive, automatic, yielding, needing no attention, capable of being carried exceedingly close to and conforming with the roadbed, capable of passing over immovable obstructions and unevenness of road, quickly removable and adaptable to any car.

Cleveland, O.—Employes of the Cleveland Electric Railway Company have been arrested on the charge of running cars at a speed greater than that permitted by the city ordinance.

STORAGE BATTERY TRACTION AT WASHINGTON, D. C.

In no city in the country has the storage battery been more thoroughly tested than in Washington, D. C. Here exhaustive experiments have been made upon the lines of the Metropolitan railway, under the direction of Geo. W. Pearson, who has been president and active manager of the road for nine years. A comprehensive review of these experiments by Geo. C. Maynard, giving the results of the trials of nine different types of cells, has just been published in the columns of the *Electrical Review*, from which we are able to give some interesting details of these extended and important trials.

The Metropolitan Railroad (not counting several branches) is a double track road five and one-half miles long. It begins on the hills above Georgetown and ends in the eastern section of the city, a mile beyond the capitol. It runs through the principal business and residence section of the city, and passes the capitol and eight of the principal government buildings. The travel on the line is irregular, and at times exceedingly heavy. There is not a hundred feet of level track in the whole road. The grades range from two and one-half to five per cent., and there are 42 curves, many of them very sharp. The sharpest curves are on the heaviest grades.

In the summer of 1889 Mr. Pearson and his associates determined not to add one more to the long list of trifling experiments, but to operate their road with storage battery cars if it were possible. At the outset they engaged the services of the well-known electrical engineer, Mr. C. O. Mailloux, of New York, who had made a special study of accumulators ever since their introduction, to design a suitable plant and superintend its construction and operation. With him came Mr. F. H. Chamberlain, a practical electrical expert, who had had a long and varied experience in work of this character. He has had charge of the Metropolitan power house and all the details of the work during the entire time it has been going on.

An inspection of the Metropolitan Company's power house and facilities for operating the battery cars clearly evidences the seriousness and determination with which Mr. Pearson undertook the work. The buildings are substantial, spacious structures erected especially for the work. The boiler house is 50x60 feet, and contains three Campbell & Zell's 200 horse power boilers set with Murphy's mechanical stokers and provided with appliances of the most approved and efficient character. The engine and dynamo room is 65x85 feet. There are three Wright tandem compound non-condensing engines of 230 horse power each in place, with foundations laid for a fourth engine of the same size. The principal dynamos are Thomson-Houston 160 kilowatt machines, capable of developing a current of 220 volts and 800 amperes, and a number of auxiliary machines provided with ingenious appliances for coupling them in various combinations afford facilities for supplying any desired current. The station is equipped with an exceedingly complete outfit of the best Weston testing and measuring instruments.

The battery house is 85x122 feet, two stories high. The floors are built of cement, laid on heavy iron supports, and are thoroughly acid proof. The arrangements for convenient and rapid handling of the batteries are most complete. This building faces the street along which the main track runs, while the engine and boiler houses are in the rear. By a loop from the main track the cars are run through the building, stopping on a platform, on each side of which is an elevator operated by two Thomson-Houston 15 horse power motors. The batteries arranged in racks, after being charged in the upper story of the building, are lowered to the side of the car, where the exhausted cells are quickly drawn out and the fresh ones put in. This equipment affords facilities for handling 180 sets of accumulators, and the building has space enough for twice that number. The plant, in its present condition, can easily charge 60 sets of accumulators at one time. In addition to the extensive and substantial character of the buildings above described, an item on the company's cash book of $387,000, expended in constructing the plant and operating the motor cars, substantiates the statement that the company has left nothing undone to work accumulators for all there is in them. Forty cars were built especially for this work, and fifteen of them were fully equipped for service. The highest number of cars ever out on the road at any one time was ten. At the commencement of the experiments, motors and dynamos, especially designed by Engineer Mailloux, were built for the company, but a little later those made by the Thomson-Houston Company were tried and found more satisfactory. Two fifteen horse-power motors, weighing 1,690 pounds each, were used on each car. The Baltimore Car Wheel Company's improved storage battery truck added 2,000 pounds, and the total weight of the car thus equipped was six and one-half tons. The horse cars on the Metropolitan line weigh about two tons each.

At first much difficulty was experienced with the regulators, but improvements devised by Messrs. Mailloux and Chamberlain soon remedied this. The arrangements of circuits to secure five distinct rates of speed were as follows:

1. Both batteries in multiple, motor fields and armatures in series.
2. Both batteries in multiple, motor fields in series, armature in multiple.
3. Both batteries in series, motor fields in series, armature in multiple.
4. Both batteries in series, motor fields and armature in multiple.
5. Same as 4 with $\frac{1}{10}$ shunt across the fields.

To sum up the elements of the undertaking, the following points are clear: Steam plant perfect; dynamos and accessories, comprising the charging machinery, everything that could be desired; facilities for handling the batteries admirable; cars and their motor equipments of the best; the track newly constructed by the Johnson Company, of 62 pound improved grooved girder steel rail and in excellent order; the best professional skill obtainable; intelligent, skillful and energetic business management—all essential elements to success—and success must have been attained had the performances of the accumulators been equal to the company's expectations and the promoter's promises. As the records stand, failure must be written for every one of them. They started out with high hopes and ambitions, but hopes were doomed to disappointment, while ambitions and amperes disappeared together.

The names of the nine companies whose accumulators were tested will be designated by number.

No. 1.—The car was equipped with 120 cells, weighing 27 pounds each, and the trial lasted about seven months. The longest run made on one charge was 27½ miles. When the cells were new they were given a charge of 100 ampere hours and the discharge was 86 ampere hours, but this creditable performance was not sustained. After being charged and discharged a few times the efficiency fell steadily and rapidly, and after a service of 1,327 miles the cells were entirely exhausted and worthless. This feature of rapid depreciation was experienced with every battery used. In no instance was the electromotive force allowed to fall below 1.5 volts per cell.

No 2 was one of the most promising accumulators experimented with. It was furnished and its use superintended in person by one of the best scientific and practical electricians in the country. Ninety-six cells, 32 pounds each, comprised the outfit for a car. It required 250 ampere hours to charge these cells, and, in return, they gave just 43 ampere hours' service, never making more than six and one-half miles' run on one charge. At the end of their 365th mile they were dumped into the scrap pile.

No. 3 was another serious disappointment. One set of 96 cells, 33 pounds each, was first procured, and its service proved so satisfactory that the company ordered equipments for 10 additional cars. The latter were failures. The first was charged in 100 ampere hours, discharged in 86 ampere hours and ran 21¼ miles on one charge. The record of the others shows 420 ampere hours' charge and 43 ampere hours' discharge, with a run of only nine and one-half miles. The total service of the best car on which this system was used was 660 miles. After this discouraging experience there came, with serene confidence and high hopes, the promoters of

No. 4.—Ninety-six 42 pound cells were used. After carefully and faithfully giving them a charge of 450 ampere hours, the car was put on the road, made a fitful and feeble run of exactly 5,000 feet, and never turned a wheel again. Horses hauled the car home, and the accumulator expert left the city before daybreak.

No. 5.—The staying qualities of this battery were vouched for by business managers and electricians of high character and long experience. There were 112 cells, 32 pounds each, in a set. Their record in ampere hours is 100 charge to 86 discharge for the first few trips, after that they fell away rapidly. Twenty-two miles was their longest single run and 3,243 miles ruined them.

No. 6.—The operation of this battery was superintended by two experts representing its manufacturers. After receiving a charge of 250 ampere hours it rewarded its owners by discharging itself in 26 ampere hours, getting the car three miles away from the power house before breaking down. It was never tried again.

No. 7.—One hundred and ten cells, 32 pounds each, ampere hours 100 charge to 86 discharge, longest run 22 miles, total service before breaking down 2,227 miles.

No. 8.—Ninety-six cells, 44½ pounds each, ampere hours charge 100, discharge 86, longest run 22½ miles, total service 4,123 miles.

No. 9.—One hundred and twelve cells, 32 pounds each, ampere hours charge 100, discharge 43, longest run 10½ miles. These batteries failed after running 70 miles.

The best batteries tested did not stand more than twenty-seven days' actual service, and the cost of running the cars by five of the most serviceable batteries ranged from twelve and a half cents to thirty-seven cents per car mile. The cost of running horse cars on this line is about six cents per car mile.

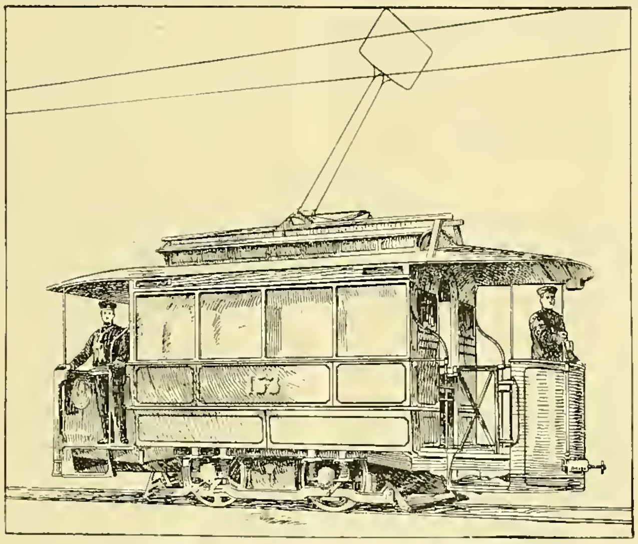
The causes of failure are numerous and not easy to enumerate. Buckling plates, excessive heating, loosening of active material, short circuiting of cells from various causes, general rapid deterioration of positive plates, sudden and sometimes unaccountable loss of current, destruction of connections by acid, are some of the more marked eccentricities of the accumulators.

After more than four years of intelligent and persevering effort the undertaking has been suspended. The motionless machinery, the idle cars and valuelss batteries, the enormous hole in the company's bank account are full of significance. Every available means to attain success was tried, and failed. The experiment has settled many vexed questions, exploded some humbugs and will be of great value to all persons interested in street railroads. It has made it clear that, up to the present time, science and art have not produced a storage battery capable of supplying power to practically operate such roads as the Metropolitan.

New York, N. Y.—The Chamber of Commerce has adopted a resolution authorizing the president to appoint a committee to consider the question of rapid transit and ascertain what action could advantageously be taken by the organization.

ELECTRIC RAILWAY AT HANOVER, GERMANY.

Since last spring three electric lines have been equipped in the city of Hanover, Germany. About seven miles of road are now in operation, and within the next few months eight miles and a half in addition will be electrically equipped. The contract for the electrical equipment was awarded to Siemens & Halske, and several features quite different from American practice are to be noted in the construction. The overhead construction is of the usual type; the contact wires being suspended above the center lines of track, from span wires reaching across the streets or roads, and hanging in their turn from ornamental steel poles. On the streets in the town itself, where the line of buildings comes up to the footway, the span wires are hung from insulators carried on brackets that are attached to the houses. At points where the line is single track only, and therefore lies alongside the footway, the contact wire is suspended from brackets attached to the poles. Outside of town, wooden poles are used.



CAR USED ON HANOVER ELECTRIC RAILWAY.

The trolley wheel contact is dispensed with altogether. Instead of the wheel the company uses a framework of wire rectangular in shape and supported and held against the overhead conductor by two poles. The appearance of the rectangular framework is certainly decidedly clumsy in comparison with a trolley wheel. The installing firm claims for it many advantages, however. By the use of such a device, they state, it is possible to make the overhead construction at curves, points and crossings very much less complex and expensive, inasmuch as the great width of the contact frame (practically as great as that of the car body itself) allows greater angles in the contact wire than would be otherwise permissible.

The overhead conductor is strung at a height of 16¼ feet above the level of the rails. Great precautions are taken to secure good insulation. The lines are divided into sections each one of which is provided with a lightning arrester.

The current is returned through the rails, which are carefully bonded. There has been little leakage and but little trouble has been experienced by the telephone company even when the earth connections are in proximity to the rails.

The power station is on the ground level in the Ihmestrasse, near the river Ihme. The power house, car barn, a building used for offices and also a residence for some of the staff are located at this point. The power house is about 130 ft. long by 115 ft. wide, with a height of some 20 ft. to the rise of roof. It is divided by party walls into rooms, serving for boiler house, engine and dynamo room, and workshop.

Two boilers, of the water tube type, are installed at present, each of a heating surface of about 600 square feet, and working at a pressure of 150 pounds to the square inch. There is sufficient room in the boiler house for two more of similar capacity. Two Worthington steam pumps and two injectors serve to feed the boilers, and the condensers also. In the engine room are two horizontal compound condensing steam engines, each indicating a normal output of about 200 or 300, as a maximum, at 135 revolutions per minute. These are coupled direct to large ring dynamos, of Gramme circular type, having an output of 400 amperes each at a pressure of 500 volts.

The car barns have a capacity of 20 motor cars, and are provided with a series of pits. The building itself is of light ironwork, roofed with corrugated iron; skylights and windows at the side serve to give plenty of light for inspection of cars, etc.

GENERAL VIEW OF HANOVER ELECTRIC RAILWAY.

The area between the power house and car barns is used as a shelter for trail cars, twelve of which can be accommodated under its glazed roof. Transfer tables on cross lines at each end of the car barns serve to carry the motor cars, so that they may be run upon any desired line in the barn itself. A much larger barn, to contain 100 cars, is projected, and will probably soon be erected.

The rolling stock at present comprises 18 motor cars: these each carrying 32 persons, with sitting accommodation for 14. A 15 horse power electric motor is hung between the two car axles, so that the weight may be equally spread. Chain-gearing —with a single reduction of speed—is employed to connect the motor spindle with the car axle; and there is a flexible suspension provided between motor frame and the car, to avoid shocks at starting and while running. Hand brakes are used. For lighting the cars, a lamp is fixed on each platform in the roof, with three inside the car itself.

Proposed Subway in Boston.

The plan which the Boston subway commissioners have drawn up for submission to the legislature asks the latter to grant permission to the Boston city government to borrow $5,000,000 for the building of the subway. The cost of construction alone will be inside of $3,500,000, they estimate, but $1,500,000 additional will be necessary to pay for land and buildings that may have to be taken, and for damages, etc. This estimate of the cost has not been reached without careful investigation by the commissioners. Borings have been made by competent men to determine the composition of the soil under the surface of the street throughout the entire length of the route, so that the engineers know just what they will have to encounter.

The car tracks will be about 18 feet below the surface of the street. But as the platforms will be on a level with the steps of the electric cars they will be only about 16 feet under the ground. A flight of 20 or so steps will lead from the street to the subway. It is possible that large storekeepers, like Houghton & Dutton, may want to arrange for entrances to the subway from their stores. This will be allowed if the commissioners' bill goes through.

There will be no smoke, steam or gas in the tunnel to taint the air, and the ventilation will be of the best. It will be well lighted by electricity, and attractive, being lined with white porcelain faced brick. There will also be tile drains and iron roof. The approaches are to be made as artistic as possible, Mr. Olmstead being in charge of that portion of the work.

There will be other uses for the subway than for electric cars, for sidewalks will be run through it, and it is believed that in stormy weather or on hot days they will be well patronized by pedestrians. The bill will also provide that the commissioners may place a conduit or conduits in the subway for electric wires, water and gas mains. At the northern terminus on Causeway street there will be room enough for six or eight car tracks, which will make ample room for switching cars, etc.

It is said that the cost of the long subway will be more economical than the short one, which was first proposed. The long one will be 10,000 feet long and cost $3,500,000, while the estimated cost of the one authorized by the legislature of last year, and which was accepted by Boston's city government, a subway 3,700 feet long, was to cost $2,000,000. The million and a half which is to be asked for above the simple cost of construction will be used for the purchase of land, largely. This, the commissioners say, is rather in the nature of an investment by the city. For it is likely that the building of the subway will cause an appreciation of values.

The work of construction will take two years, it is estimated, and the tunnel will be built in sections.

The West End railroad will have to pay for the use of the subway. It will probably be compelled to pay an amount equal to the interest on the cost of construction. This will be provided in the bill which will be presented to the legislature.

ELECTROLYTIC EFFECTS IN STREET RAILWAY RETURN CIRCUITS; THEIR CAUSE AND PREVENTION.

BY W. NELSON SMITH.

(Second Article.)

So it comes about that these underground conductors, surrounded with soil, always more or less damp and sometimes containing active chemical compounds, and compelled to carry electric currents of considerable strength, are subjected to electrolytic action. The imperfect connections of bonds with rails, and the inadequate size of the bonds themselves, often bring about electrolytic effects that tend to make the connections still worse and sometimes destroy the bonds altogether. That the resistance of the earth really does amount to something is shown by the fact that two separate sets of pipes, for example water and gas pipes, may have such accidental connections with the rails at points distant from each other that the difference of potential between them, even at points but a few feet apart, may be sufficient to run a small motor. Such things have actually happened in Boston and vicinity. The loss of power that may be occasioned in this way is not pleasant for a street railway company to contemplate, even if no one is shrewd enough to profit by it. The amount of power lost by leakage between two such sets of conductors may be considerable.

It seems to be pretty clearly demonstrated by these widely observed effects, that the current will usually prefer a metallic path to an earthy one. Almost any metallic path seems to have less resistance than the earth, unless the latter be extremely moist, in fact, almost saturated. It should also be borne in mind that besides the actual resistance, in ohms, of circuits that include electrolytes, there is also the counter electromotive force due to chemical affinity, which must be overcome in order to set up and maintain electrolysis. In the case of water, this counter electromotive force is about 1½ volts for every pair of electrodes. Several such electrolytic localities in series, scattered along a return circuit, will of themselves make an appreciable drop in potential, aside from that due to resistance alone. The moist spots chosen for grounds along the line, and at the power house, are thus likely to be actual sources of loss, aside from the destructive effects on the grounds themselves, and on their track connections.

Evidently it is necessary in order to avoid electrolytic effects to make use of the earth as little as possible, and to depend altogether on positive metallic connection, making it of as low resistance as possible.

There are three ways of reducing the resistance by providing an all-metallic circuit: First, by using the double overhead trolley system, or its equivalent in the form of track feeders; second, by so heavily bonding the rails, and inserting adequate metallic connection between the track and power station, that the resistance of the current's legitimate path is reduced to a small fraction of its usual value, and third, by the three wire system of distribution.

There is still another possible way of obviating electrolytic effects—the alternating current. But as the alternating current motor has not yet been so perfected that it can successfully operate under the conditions imposed by street railway practice, that method cannot be considered here, save as a future possibility. The double overhead trolley system was one of the pioneer methods of operating electric railways, but is now generally considered obsolete. Its advantages are that it does away with all ground connections and consequent interference with telephone and similar circuits; and of course it obviates the more serious difficulties now under consideration. There is also less danger from the various electrical troubles with motors, that are incident to the permanent grounding of the armature and field magnet cores which is necessary in the single trolley system. And as connection with the rail is, in this case, of no electrical importance, the presence of snow or mud on the rail is not the impediment to operation that it is with the single trolley. On the other hand, it has the great disadvantage of being mechanically clumsy, with respect to the construction and maintenance of overhead frogs, crossings, etc., and the successful operation of the trolley. It is more difficult to keep the two sides of the circuit properly insulated from each other, and the cost of copper necessary for a line of any size is immensely greater than with the single trolley system. Public opinion is generally opposed to it, on the score of unsightliness.

Conductivity being the question at issue, the conditions governing the amount of copper required should be considered. According to Sprague, "with any given work done, loss on the line, and electromotive force, the weight of copper will vary as the square of the distance and its cross-section directly as the distance." This is for an all-metallic circuit, where the resistances of both sides of the circuit are assumed equal. These are the conditions of a double trolley system. According to the foregoing law, if the distance of transmission of a given amount of power be doubled, the weight of copper is multiplied by four; if trebled, there must be nine times the original weight of copper, and so on. It is very evident that a double trolley system means either a tremendous amount of copper, or else a "drop" in the line that would prevent economical operation. For a large system it would be out of the question altogether.

Coming next to the scheme of depending altogether on track feeders or an overhead copper return for a single trolley system, it is evident that so far as concerns the copper required, this practically amounts to a double overhead trolley, because the earth is left out of consideration altogether, and the resistances of the two sides of the circuit are equal, as before. As far as concerns the cost of copper, this method is open to the same objections as the former, except that it has greater advantages in the matter of insulation.

The second method, in general, involves the use of the track to as great an extent as possible, as the negative side of the circuit. The rails of a road built to operate motor cars must be very heavy; this has been proved by experience. This means a large cross-section of rail, and cross-section means conductivity. A 90-pound girder rail, such as is often used by roads with heavy traffic in large cities, has about 9 square inches of cross-section. The conductivity of 9 square inches of iron is about that of 1½ square inches of copper. Bonding is of course necessary, and in order to be thoroughly efficient, the area of the bonds should aggregate about one-sixth that of the rail. A double track of 90-pound rails is the equivalent in carrying capacity of six square inches of copper, if only it be bonded with that amount of copper for all four rails. It is, of course, necessary to connect the tracks directly with the generators by copper or iron conductors of no less conductivity. There are certainly very few stations which could not safely intrust all their returning current to a few such tracks. Six square inches of copper means a carrying capacity of 6,000 amperes, supposing the track to have been bonded to that extent. In any case, the bonding may be put in with a cross-section sufficient for whatever carrying capacity the size of the plant may demand, with the assurance that the rail area is of ample capacity for taking care of any current likely to be put through it. There is no doubt that the resistance of such a return can be estimated with tolerable accuracy, and this, in turn, will facilitate the computation of the overhead copper, and make it less a matter of guesswork.

There are a number of devices used for bonding rails, that most widely used being the "channel pin." But there is no doubt that the electrical connection afforded by this cheap and easy appliance is extremely uncertain. The fit is very imperfect, and a bad fit means not only increase of resistance but also access of moisture, and moisture means corrosion. The question is, to secure a device that makes so tight a joint in the rail as not only to secure good electrical connection, but also to exclude moisture. There has recently been put on the market, by a well-known supply firm, a bond which is one step in advance of the channel-pin to this extent, that the split bushing, tapered on the outside, which encircles the end of the bond wire, grips the wire all the way around, and so makes a better connection with it, as well as with the rail, when driven into the hole. Still it is open to the objections of making the current traverse four joints, in passing from one rail to the other and also of including an opening (the slit in the bushing) that may admit moisture to the joint unless it is absolutely closed.

Further improvement is shown in the "one-piece" bond, of which there are several varieties. Two are pre-eminently good: The "solid-end" bond, and the "thimble-end" or hollow-rivet bond. The former is a single heavy wire with a flange or collar swaged or upset on it, one inch or more from each end. The bond is inserted into the hole in the rail until the collar sets firmly against the web; the end protruding from the other side of the web is then riveted over so that the bond is locked firmly into the rail without the assistance or intervention of any other piece of metal. Or, the hole can be taper-reamed, and the protruding end of the bond upset into the hole so as to completely fill it—the larger end being on the outside; this also locks it firmly in place.

The "hollow-rivet" bond has each end in the form of a thimble, formed by forging or upsetting the end of the bond to a larger diameter for an inch or more, and drilling a hole in it axially. Placing this enlarged, thimbleshaped head in the rail-hole and driving a little tapered iron pin into it, it is expanded equally on all sides against the circumference of the hole, making a joint as nearly perfect as possible, just as a boiler flue is expanded into the tube-sheet. The end of the thimble has several short slits in it, so that it can be spread or clinched against the web before driving the pin.

Other things being equal, the difference in the efficiencies of these two "one-piece" bonds depends on the relative excellence of their contacts. The one that fills the hole most completely is the better. The question is, whether hammering endwise, or expanding by lateral pressure from within, produces the better flow of metal. When the solid-end bond is riveted over, most of the work of riveting is likely to be expended in forming the head, rather than in expanding the shank that is inside the hole. But the best results can only be obtained when the shank of the rivet is in the closest possible contact with the iron of the rail, because the contact made by the head and flange of the bond against the sides of the web cannot be absolutely good on account of rust and the roughness of the surfaces. Therefore, if the act of riveting does not thoroughly expand or upset the metal into the hole, its value, electrically, is not what it ought to be. In the case of the hollow rivet bond, on the other hand, pressure is brought against the metal of the thimble in such a way that it absolutely fills the hole, and makes the best possible contact at the best possible place.

Another fact worth taking into account concerning the hollow-rivet bond is the comparatively large diameter, and consequently large superficial area of contact, of the head. The resistance of iron being about six times that of copper, there should be six times the sectional area of the copper in actual contact with the surface of the iron, in order to make the area of contact against the iron of the same conductivity as the copper. This condition can be more readily approximated by the hollow-rivet bond than by any other, if contact *in the hole* only be considered. The solid-end bond may have sufficient area when headed up, including both the surface bearing against the interior of the hole, and the inner surfaces of the flange and riveted head; but as pointed out above, good contact with anything except a clean, newly faced surface is very uncertain. This principle of increasing the area of contact with the power conductor inversely as its conductivity, when two conductors of different conductivities are placed in contact, is also followed in designing the field magnets for dynamos, where the magnet cores are often of wrought-iron and the pole pieces of cast-iron whose magnetic conductivity is about half that of wrought-iron.

There are other varieties of bonds made in imitation of the solid-end "one-piece" bond. In one of them the flange or collar is *soldered* to the bond wire, a short distance from its end. In another, this collar is a loose washer, which is held from slipping back on the bond wire by sharply bending the wire—the washer having a groove or hollow cut across it, into which the bend fits. Holding the washer against the inside of the rail by pressure on the bend, the end protruding on the outside is riveted up. Both these last named varieties may have the same efficiency of internal contact as the solid-end bond first mentioned, provided their flanges do not get shaky.

(*To be continued.*)

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Sixth Article.*)

MEASURING THE CURRENT.

Before passing on to another subject it may be well to call attention to something else we have accomplished in the simple instruments we have made. We have talked of amperes and volts and ohms, the three yardsticks by which we measure electrical phenomena, and have solved a number

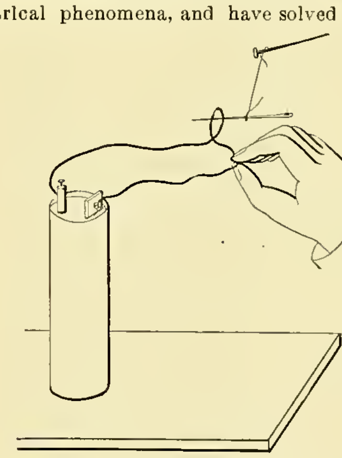


FIG. 7.

of problems involving these terms, but have said nothing, as yet, as to how the volts and amperes of a current or the ohms of a circuit are determined. We are all probably aware that the amperes are measured by an ammeter and the volts by a voltmeter, but we may not know on what principle either of these instruments is constructed. We do know, however, that if we have the volts and amperes we can determine the resistance in ohms by Ohm's law, but, as a matter of fact, we have constructed a device which, by slight modification, is capable of measuring both the volts and ohms.

We have already stated incidentally that the magnetizing power of a solenoid is equal to the number of amperes flowing through it multiplied by the number of convolutions or windings. To state it in another way, the amount of pull which a solenoid will exert upon a soft iron core partly inserted is also equal to the product of the current in amperes multiplied by the number of turns. It may be well to prove this roughly, which we can do by suspending again our short piece of soft iron wire by a thread tied to its center and proceeding as follows: Connect up the battery with a few feet of wire and bend its center into a loop of one turn (Fig. 7) and present this loop to one end of the wire. We have here a solenoid of one turn and it will tend to suck the wire into itself. The attraction will be comparatively feeble to be sure, but much stronger than one would suppose who had not tried it; but note as carefully as possible its strength. Next bend another loop so that we have a solenoid of two turns (Fig. 8). The pull will be perceptibly stronger. A third loop will increase the suction still more, and so on. If it were convenient for us to do it we could show that if we could double the current in the single

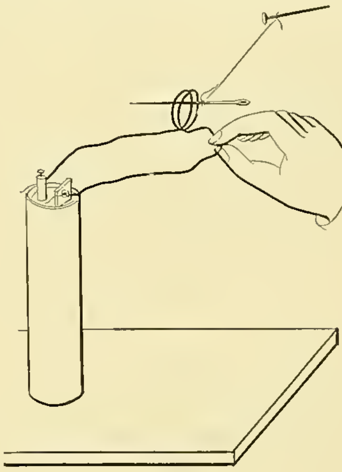


FIG. 8.

loop the increase of pull would be exactly the same as that obtained by adding a second loop. Now if we have a solenoid of any number of turns, it does not make any difference how many, and pass a known current through it and measure the pull on the dial of a spring balance, or in any other convenient way, marking the point where the dial hand rests when the current is on full, and then measure the pull when twice this current and three times and four times this current are passing, marking each time the point where the dial hand rests, we will have a meter which will measure the current passing in terms of the unit used. If the first current used was one of one ampere and the second one of two amperes, etc., we will have an ampere meter or ammeter. Many of the ammeters used in street railway power stations are constructed after this plan, only the solenoid is made to lift a weight instead of pulling against a spring. Since the ammeter is intended to measure the full current, it is always placed in the circuit so that all of the current passes through its coils just as we have placed it in our experiments thus far.

A voltmeter may be regarded as a more delicate instrument of the same kind, intended, however, to measure only a very small portion of the current. For this reason it is made of very high resistance, for as we know from Ohm's law that of two circuits having the same electromotive force or voltage that will have the least current which has the highest resistance. Resistance alone would not be sufficient, however, for with the exceedingly small current used there would not be sufficient pull to operate the dial hand if the coil were made up of but few turns of a high resistance wire such as German silver. The coil is therefore made up of the best conducting copper wire and the resistance is obtained by making this wire very long and bending it into a large number of loops or turns.

In operating an electric motor, the latter does not consume amperes any more than a water-wheel consumes or eats up gallons of water, but it does consume volts just as the water-wheel consumes pounds of pressure. In the water-wheel, the water arrives at the wheel under a certain number of pounds pressure, and after it has gone through the wheel and done its work, it flows away under a lessened pressure. The amount of pressure consumed by the wheel, in doing its work, will evidently be the difference of pressure, at which the water arrives at the wheel and that under which it flows away. So with the electric motor if we wish to know the amount of electromotive force (volts) consumed in its operation, we measure the difference of potential at which the current arrives at and leaves the motor. The voltmeter is used to make this measurement and is placed in a derived or shunt circuit, one end of which is connected with the main circuit, at the positive side of the motor, and the other is connected with the same circuit at the negative side of the circuit, and the amount of current which will flow through the voltmeter and its circuit will be proportional to the difference of the potentials between the positive and negative sides of the motor. In Fig. 9 the method of placing the voltmeter and ammeter in circuit is shown.

From this it will be seen that all of the current which goes out to the car line passes through

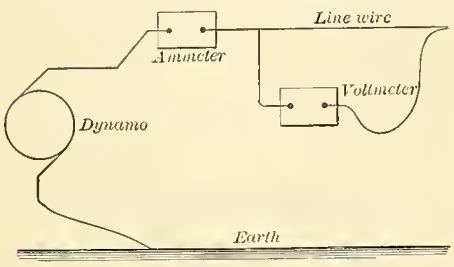


FIG. 9.

a few turns of the coil A, which, with its plunger and weighted lever, index hand and graduated dial, constitutes the ammeter, while a very small portion of the current is diverted from the outgoing wire to the return wire from the earth through the fine wire and coil of many convolutions, B, which, with its plunger, weighted lever, index hand and graduated dial, constitutes the voltmeter.

Of course there are many other kinds of voltmeters and ammeters constructed on nearly as many different principles, but we have not space nor is it worth while to describe them here. There is such an instrument as an ohm-meter which reads directly the resistance of a circuit but it is never used so far as the writer knows in street railway or electric lighting equipments. Resistances are more often measured by means of an instrument known as the Wheatstone bridge by which the unknown resistances, are compared with coils of known resistances enough of the latter being added to just balance the unknown resistance exactly as we weigh an unknown quantity of sugar or butter by placing the latter in one pan of our scales and adding pound and ounce weights to the other until the scales are exactly balanced. But as the motorman is not likely, as such, to ever have the handling of a bridge or be required to determine very accurately the resistances either of his circuits or his apparatus, and as it would only needlessly complicate matters at this time, its description will be omitted. But we already have the means of determining resistances with considerable accuracy in our voltmeter and ammeter as before stated, for if we introduce these two instruments properly into our circuits and take their readings, we learn the number of amperes flowing and the pressure or voltage under which that flow takes place and by substituting these values in Ohm's law $=C=\frac{E}{R}$ the resistances are readily calculated.

MAGNETISM AND ELECTROMAGNETISM.

In discussing the electric current we likened it to a flow or water or other fluid through pipe and showed that this flow is retarded in both cases by obstructions and that in both cases these obstructions produced like results which might be predicted by the simple relation between the flow, pressure and resistance expressed in Ohm's law. We further found that in the case of electric current the influence of the flow within the wire extended to the space surrounding the wire and that the effect of this influence was to produce magnetism in that space or as electricians would say, to produce a magnetic field. Thus every conductor carrying a current of electricity produces in the space surrounding it a magnetic field. That this is true our experiments first showed by the magnetizing effect which the solenoid had upon the needle placed within it, and further by the tendency of the floating magnetic needle to take up a position at right angles to a current passing in a north or south direction either above or below it. That the magnetic field thus generated by the current has a definite north and south pole, which will be later shown is dependent upon the direction in which the current flows in the wire, was proved by the fact that one end of the solenoid repelled one end of the needle while it attracted the other, just as did another magnetized needle—this being the test of magnetic polarity.

It has also been shown that a piece of hard tempered steel, and to a less extent cast iron and even wrought iron which has become somewhat hardened either through drawing or forging or too rapid cooling from a high temperature, retained the magnetism indefinitely which had been imparted to it by the magnetizing current but that the magnetism of the solenoid as well as that of soft annealed iron surrounded by a solenoid lost its magnetism, the moment the flow of current ceased. These two phenomena give rise to two classes of magnets, viz: permanent and electro magnets which differ from each other only in the fact that in one case magnetism when once produced continues practically unchanged after the magnetizing current has been withdrawn, and in the other it is wholly dependent upon the continuance of the current for its existence, and the strength of the magnetism varies with every instantaneous change of the strength of the current.

Since magnetism is produced whenever an electric current flows through a conductor, and in the case of the electro magnet varies instantaneously with the variations in that it flow is readily suggested that the two, electricity and magnetism are closely related and may follow somewhat similar laws, and experiment has demonstrated the correctness of this idea.

While from the fact that a permanent magnet continues to be magnetic even after the magnetizing force is withdrawn we do not associate the same idea of *flow* in a magnet that we do in the case of an electric current, and while there really may be no flow or motion of the thing which we may for the want of a better name call the "magnetic fluid," still, the greatest advance that has ever been made in the science of electricity (of which magnetism is a most important part) was due to this conception that an actual flow of force does take place in the magnet—its direction being from the north pole, through the air to the south pole, and thence through the magnet back again to the north pole. This idea involved the idea of a magnetic circuit similar to that of the electric circuit, which must contain resistances. And, as in the electric circuit, in order to maintain the flow of current, there must be some pressure to force the fluid through these resistances. It would logically follow from these assumptions that if a certain flow could be forced to take place against a given resistance by a given pressure, a greater flow could be maintained through the same resistances by a greater pressure, and we would have for magnetism another Ohm's law expressing the relation between the amount of flow (strength of magnetism), the pressure and the resistance offered to the flow. Experiment has fully verified this hypothesis and we have the law of magnetism that the strength of a magnet is equal to the pressure divided by the resistance of the circuit. While the pressure in the flow of water is usually spoken of as hydrostatic pressure and that in the flow of electricity is called *electro*motive force, the pressure which causes magnetism in a magnetic circuit is called *magneto* motive force.

It has already been stated, and the experiments illustrated in Figs. 7 and 8 have shown that the magnetic field produced by a current flowing through a solenoid consisting of two turns of a wire is twice as strong as that produced by its flowing around a solenoid consisting of but one turn. It has also been stated, and it is equally true, that the magnetizing effect of a coil of wire of any number of turns will be doubled if the current in amperes flowing through the wire is doubled, and it will be three times as strong if the current is increased threefold. The law of the magnetizing effect of a solenoid or hollow coil of wire may therefore be stated as follows—it is proportional to the current flowing and to the number of times it flows through or around the space which constitutes the magnetic field. Or in other words is proportional to the product of the amperes multiplied by the number of turns or convolutions in the solenoid. Since an electric current is always measured in amperes, and a coil of wire may be definitely described by the number of turns of which it is composed, it is a convenient way of expressing the magnetizing effect of the combination of the two by the product of these two, and the magnetic effect produced by a current of one ampere flowing around a coil consisting of a single turn of wire, usually called an "ampere-turn" has been adopted as the unit of magneto-motive force. Thus the magneto-motive force of a solenoid may be said to be that of 100 ampere turns. It matters not how these 100 ampere turns are made up—whether a current of 1 ampere flows through a coil of 100 turns, 2 amperes through 50 turns, 25 amperes through 4 turns or 100 amperes flow through a coil of a single turn—provided only that the product of the amperes and the number of turns in the coil is equal to 100—the magneto-motive force will always be the same.

But we have seen that the quantity of electricity (amperes) that will flow through a circuit is not alone dependent upon the electromotive force but is also dependent upon the resistance of the circuit, being greater where that circuit is short or has little resistance and less where it is long or has greater resistance. Ohm's law says that it is always equal to the electromotive force divided by the resistance. This is equally true of magnetism. When we have expressed the magneto-motive force of a magnet, we have not yet defined its strength because we have not mentioned the resistance of the circuit through which flow is assumed to take place.

Must Fares Be Refunded When Cars Are Stalled?

A short time ago a breakdown occurred on the West Chicago Street Railroad cable system, and passengers were compelled to walk down town. Three persons who refused to accept transfers to a horse car line brought suit to recover the amount of their fares, as the conductors refused to return the money. When they came to trial the company asked that cases be dismissed. The justice before whom the suit was brought refused to entertain a motion to this effect but gave judgment for five cents and costs in each case. "There is no question," he said in giving the decision "that the railroad company entered into a contract to carry these complainants downtown and failed to do it. It also refused to return the money paid or the transportation that it did not give, and is clearly liable. The offer of a transfer slip does not relieve it from that liability. The offer of a transfer slip is not the fulfillment of the contract it entered into. Judgment and costs in each case." The West Chicago Street Railroad Company will appeal from the judgment.

Winnipeg, Man.—On February 5th fares were reduced to 2 cents on the street railway lines.

MR. STETSON AND HIS CONDUIT.

New York, February 1, 1894.

To the Editor of the Street Railway Gazette:—My attention was called to an article in your paper of January 20, 1894. I was pleased to learn that you had also noticed it editorially, for I supposed you would criticise it from a scientific standpoint, and that I should learn something from a man who had given more attention to such subjects than I had, and whose previous training fitted him to impart to all of us workers in that field such information as we needed. I do not find what I looked for. I did not mean to be unjust to any, and some systems I criticised were those of friends of mine. Can you specify the points in which my criticism was unjust, or my conclusions wrong? I established my basis of criticism (viz.: dividend paying), and if you can show financial success in any systems that I stated to be the contrary, I shall be most glad. I am not in charge of the advertisement business of any electrical or engineering paper; I do not have to be careful not to offend an advertiser for fear of losing his subscription, and my only endeavor was to truthfully represent what had been done, and, if any hints that I might give were suggestive, to point out to others the line upon which they might work. That was my motive and my only one.

Allow me to use the "blue pencil" on some of your editorial statements. I am *not* connected commercially with that system, nor any other. I was not at the time the paper was read, and had not been for some months, and then only as consulting engineer. My descriptions and illustrations regarding previous experiments were taken from the recognized authorities on the subject, but I accept the responsibility for the conclusions drawn. Can you mention a dividend promising system among those that I designated as the opposite? If you can persuade the General Electric Company that systems built on the Bentley-Knight lines will succeed, you can name your price for the information.

Perhaps we may differ as to what a paper read before an institute should be, but I consider a review and critique of what has preceded to be an essential. If I erred in my criticism, I am sorry, and would consider it my duty to publicly acknowledge my error. If you will take a concrete instance, will prepare yourself to answer my figures, I shall consider it a favor, but simply striking out wildly, avoiding saying anything that indicates an idea of knowledge of the subject, is, in my opinion, not the best way to handle commercial questions. . . . . . .

Yours truly,

Albert Stetson.

[The latter part of Mr. Stetson's letter not printed here is of a purely personal nature, so that it has no interest to our readers. Some comments upon the above communication will be found upon our editorial page. —Eds.]

FINANCIAL DEPARTMENT.

Financial Notes.

Securities Sold by the General Electric.—Some time ago we published the details of the plan by which the General Electric Company for a consideration of about $4,000,000 turned over to a syndicate known as the Street Railway and Illuminating Properties treasury securities aggregating about $12,300,000 par value. A partial list of these, recently published, shows that among others were the following street railway bonds: Milwaukee Street Railroad Co., $300,000; Tacoma Railroad and Motor Co., $200,000; Queen City Railroad Co., Dallas, Texas, $192,000; Atlanta Consolidated Street Railroad Co., $188,000; Chicago North Shore Railroad Co., $150,000; Cicero and Proviso Street Railroad Co., $115,000.

No Receiver for Atlanta Consolidated.—The Atlanta *Journal* comments as follows on Judge Pardee's refusal to appoint a receiver for the Consolidated Street Railway Company: "The receivership business has been overdone of late, and in escaping the fate of so many other corporations the Consolidated is to be congratulated. Judge Pardee's decision will give President Joel Hurt a chance to perfect his plan of reorganization, in which he will have the sympathy of the public and the coöperation, we, trust, of his stockholders. There can hardly be any doubt that he can manage the affairs of the company better than any receiver could possibly have done."

Boston, Mass.—A petition of J. C. Lane and others has been introduced in the House for the incorporation of the Natick, Newton and Boston Street Railway Company, with a capital of $350,000; the road to operate in Natick, Framingham, Needham, Wayland, Marlboro, Newton, Watertown and Boston, with authority to purchase certain existing franchises.

Elkhart, Ind.—The electric light and street railway plant was sold at receiver's sale to O. N. Lumbert, president of the old company, on February 8. He bid it in for $21,000 and is supposed to be backed by an out-of-town syndicate. The incumbrances are $75,000.

Nashville Road Assigns.—The Nashville Electric Railway made an assignment February 3. The road has been losing money steadily. Its debts are placed at $900,000.

Large Bond Issue.—The Market Street Railway Company, of San Francisco known as the Consolidated, on Wednesday last issued bonds in the sum of $17,500,000.

New Incorporations.

The Mason Electric Company, with a capital stock of $10,000 has been incorporated in Chicago for the purpose of doing a general electric railway supply business. Mr. W. R. Mason, formerly the manager of the Railway Equipment Company, is at the head of the new concern.

Holyoke, Mass.—The People's Electric Railway Company has been organized with a capital stock of $100,000 to build an electric road to connect South Hadley Falls and Willimansett with Holyoke. William S. Whiting is the largest stockholder.

The Columbia Construction Company has been organized in Chicago with a capital stock of $2,000,000 for the purpose of constructing railways and power houses, manufacturing engines, motors, etc.

The American Subway Company, of Camden, N. J., has been incorporated for the purpose of constructing and equipping underground subways. The capital stock is $100,000.

The Union Electric Company, of Portland, Ore., with a capital stock of $5,000, has been organized for the purpose of equipping electric railways, etc.

The Chicago North Division Elevated Railroad Company has been incorporated in Chicago with a capital stock of $10,000,000.

The Underground Sealed Conduit Railway Company has been incorporated at San Francisco, Cal., with a capital stock of $500,000.

The Indianola Fourth Street Railway Company has been organized at Columbus, Ohio, with a capital stock of $10,000.

The Clayton and Creve Coeur Railway Company, of Clayton, Mo., has been organized with a capital stock of $5,000.

NEWS OF THE WEEK.

Atlanta, Ga.—Judge Pardee has decided not to appoint a receiver for the Consolidated Street Railway Company. This will probably end the struggle for a receiver, as over 90 per cent. of the bondholders have agreed to scale the interest on their bonds to 2 per cent. for two years, and to 5 per cent. for the balance of the life of the bonds. They agree to this in consideration of the agreement of the stockholders to pay up the floating indebtedness of the company. This floating debt amounts to nearly half a million, and it is thought it will be cared for by an assessment on the stock. Joel Hurt, president of the company, states that the bondholders who have expressed their unwillingness to enter into the agreement do not represent 2 per cent. of the bonds. He says that the interest due on the bonds held by the parties who want a receiver does not amount to more than $1,100. Mr. Hurt feels sure that his scheme to place the Consolidated on a solid financial basis has been successful. It is probable that the parties who own the bonds on which the appointment of a receiver was asked will sue the company for the interest now due. Mr. W. P. Hill, one of the attorneys for the applicants for a receiver, states that Judge Pardee, while declining to appoint a receiver at this time, said he would do it if the reorganization was not at once effected.

Chicago, Ill.—Passengers on two trains on the Alley Elevated road had a narrow escape on Tuesday night. As the trains were passing each other near Hubbard court, a few blocks south of the down-town terminal, the elevated structure sank. The engineers brought their trains to a sudden stop, and no injury was caused to passengers. The accident was due to the giving way of a brace which had been supporting the structure temporarily while excavations for a building adjoining the structure were in progress. The support was made of twelve-inch timbers and was assumed to be sufficiently strong. The combined weight of the two trains, however, proved too great. A new brace was put in position, and trains were running on the following day.

Buffalo, N. Y.—President Watson and Manager Littell of the Buffalo Railway Company have returned from New York and as a result of their visit to that city it is quite likely that if the power from Niagara Falls is transmitted to Buffalo next summer some of it will be used to supply power for running the Buffalo trolley cars. The opening of new lines is demanding great increase in power, and the company will have to erect another power house on the East Side in a short time if they do not receive relief from some source. When Mr. Watson and Mr. Littell were in New York they saw representatives of the Cataract Construction Company. They agreed to take 2 500 horse power at the earliest opportunity. The officials of the Cataract company said they expected to deliver the power in Buffalo early in the summer.

Cincinnati, O—President John Kilgour of the Cincinnati Street Railway Company has denied the rumor that a belt road was to be built. The electric railway to Madisonville, he said, would undoubtedly be built some day, but as it must come down Montgomery road, it could not be constructed till that thoroughfare had been completed. As to the cross town road and the tracks on McMillan street, Mr. Kilgour says cars will be running there inside of two months, barring unavoidable delays. He thinks there will be no delay. He also says the power house for the incline of Route 23 is rapidly building.

Pittsburg, Pa.—The Braddock electric railway, which has not been in operation for over a year on account of difficulties with the township authorities in regard to its construction, will be extended to Edgewood. There it will connect with the Duquesne road, making a continuous line to Pittsburg by way of the Wilkinsburg branch of the latter. Arrangements were made at a meeting with supervisors of Braddock township to this end by the officials of the road.

Philadelphia, Pa—The Council of Swarthmore borough has passed an ordinance granting the use of Baltimore avenue, about 600 feet of which is within the borough lines, to the Delaware County & Philadelphia Electric Railway Company, under restrictions, which have been accepted by the company. There is a fair prospect that the company will have its cars running to Swarthmore by June 1 next.

New Officers of General Electric.—J. P. Ord has been elected second vice-president of the General Electric Company; Gen. B. F. Peach, treasurer; Henry W. Darling, assistant treasurer, and C. G. Smedberg, second assistant treasurer. Mr. Ord as vice-president will have charge of the treasury, credit and accounting departments. Mr. Peach has been for some time assistant treasurer and the office of treasurer has been vacant.

National Electric Light Convention.—Secretary Porter of the National Electric Light Association has addressed a circular letter to over 500 electric street railway companies, calling their attention to the fact that several of the topics to be taken up at the Washington meeting this month are of interest to them and should lead them to be represented.

Harrisburg, Pa.—John E. Patterson, appointed to take testimony in the matter of the application of the Citizens' Passenger Railway Company to lay tracks in certain streets, recently decided in favor of the company. The decision has been approved by the court and the company has now the right to lay tracks from the northern part of Harrisburg to the west side of Steelton.

Chicago, Ill.—The property owners on Indiana avenue have been holding meetings to consider the question of favoring an electric railway on the street. At the present time horse cars traverse the street. The Siemens & Halske conduit system has been suggested, as the residents are opposed to overhead wires.

Chicago, Ill.—An injunction has been issued restraining the Lake Street Elevated Railroad Company from building an elevated structure on Lake street, between West Forty-eighth and West Fifty-second streets. The order issued on petition of property owners.

PERSONAL.

Jas. F. Kelly has taken the eastern agency for the National Electric Company of Eau Claire, Wis., the new organization that has taken up the business of the National Electric Manufacturing Company. Mr. Kelly's office will be at 906 Temple Court, New York City.

Isaac D. Barton, formerly general superintendent of the New York and New England Railroad, has been appointed general superintendent of the Brooklyn Elevated.

Carl Kammeyer, well known to the electrical fraternity throughout the West, has taken the position of western manager and editor of *The Electrical Engineer*.

John A. Seely, president and general manager of the Complete Electric Construction Company of New York was a Chicago visitor this week.

TRADE NOTES.

Mr. J. L. Barclay has moved into his new quarters on the sixteenth floor, in the south end of the Monadnock Building, the recognized center of electric trade in Chicago. The suite of offices selected is well adapted for Mr. Barclay's electrical interests, and was primarily selected by him for exploiting the Walker Manufacturing Company's electric railway and power transmitting business. The Central and Western departments of that company's business are under Mr. Barclay's immediate supervision and management. Mr. H. McL. Harding, who is also interested in the Walker company, has his headquarters for the Eastern department in New York. While the general electrical interests of the Walker Manufacturing Company will receive the combined attention of Messrs. Barclay and Harding, all business directly connected with the western and middle states will be transacted at the Chicago headquarters. The appointment of district and sales agents is now receiving attention. At this time particularly little trouble in securing competent men is anticipated. Mr. Barclay feels much encouraged at the business outlook, notwithstanding the financial depression. Inquiry for the heavy types of generators and motors, such as the Walker company will manufacture, is numerous.

Are Safes Safe?—The government treasury department has issued a treatise on the various methods employed in burglarizing safes. Although not intending to compile a text book for the juvenile burglar, its authors, employed at the expense of the government, have given the details of numerous safe-cracking operations successfully carried out under expert supervision on the best types of modern safes. A series of photographs and diagrams will show anyone "exactly how nitro-glycerine may be introduced in the crack of a safe door, or dynamite cartridges may be exploded against the side of a safe with the least inconvenience to the operator and the maximum effect upon the safe." The remarkable rapidity with which modern appliances in the hands of an expert can be made to penetrate or tear away the steel and iron plates of the best bank safes and vault doors is a revelation to one who has been accustomed to regard such protection as amply sufficient for all practical purposes. Any street railway official who is interested in the safe storage of money should secure a copy of this really remarkable document.

The Ohio Brass Co., of Mansfield, Ohio, has just commenced the sale direct of its electrical street railway specialties. This company has heretofore manufactured this line of goods for some of the largest street railway supply houses in the west; it will, from now on, however, sell its product direct from the factory in Mansfield. The company will bring out a number of novelties in street railway supplies, overhead material, line devices and car appliances. The officers of the company are E. T. Cooke, president; Frank B. Black, secretary and manager. C. K. King, formerly of the Northwestern Thomson-Houston Electric Company and the Ansonia Company, is the company's electrical expert.

The McLean Armature Works, of this city, owing to the continued growth of their business, have again found it necessary to enlarge their quarters in order to keep up with their business. One can seldom go into their shops without finding them rewinding and repairing from ten to fifteen armatures of as many different types, varying from the smallest motor to the largest generators and coming to them from all parts of the country. This company has just completed a large and handsome model of the Ferris wheel for the California Midwinter Fair. The wheel carries some three hundred incandescent lamps of various colors, these lamps being connected so as to give a kaleidoscopic appearance as the wheel revolves.

One Way to Save Coal.—The Grosvenor-Dale Co. at Grosvenor-Dale, Conn., is building its new coal sheds of iron. The construction is designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn., and is so arranged that the coal can be unloaded direct from the cars into the pockets without handling. The Grosvenor-Dale Company expects to save a large amount of money each year by saving the expense of handling the coal the second time.

RECORD OF STREET RAILWAY PATENTS.

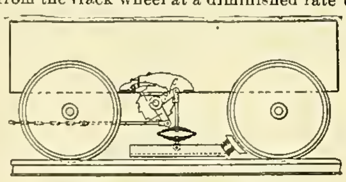
Patents Issued January 23, 1894.

513,076. Trolley Wheel. George C. Bourdereaux, Peoria, Ill. Filed January 31, 1893.

This is a trolley for electric cars comprising two separable portions fitted together to form the wheel and the casing for the trolley bearings. This casing incloses a series of rollers which have enlarged bearing ends and a central bearing shaft, so constructed as to engage the ends of the series of rollers.

513,117. Street of Station Indicator. Hugo R. Kuersten, Chicago, Ill., assignor to himself and Albert J. Paili and Peter Seidl, Menominee, Mich. Filed April 3, 1893.

This consists of the combination with a track wheel and a shaft of an endless belt having slots, this belt being driven from the track wheel at a diminished rate of speed.



NO. 513,207.

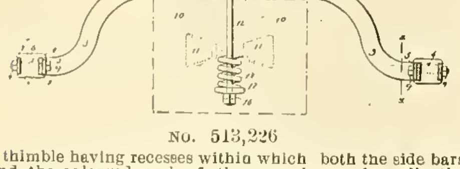
A sprocket wheel is made to engage the slots of the belt and is rotated thereby, operating an indicator to display the name of the street or station.

513,207. Rail Brake. Henry L. Simmons, Wickes, Mont. Filed June 7, 1893.

It will be seen from the illustration that this comprises the combination with a transverse shaft having arms secured to it and track shoes pivotally suspended from the arms, springs interposed between the shoes and arms, wheel brake shoes at the ends of the track shoes and operating devices for depressing the track brake as desired. (See illustration.)

513,226. Motor Support for Motor Trucks. Walter S. Adams, Philadelphia, Pa., assignor to John A. Brill, same place. Original application filed November 12, 1891. Divided and this application filed October 10, 1893.

The first claim of this patent reads as follows: In combination, the side bars, a cross bar or bars, the web of which extends upwardly, having an outward bend or enlargement on the end or ends adjacent to the side bars, and



NO. 513,226

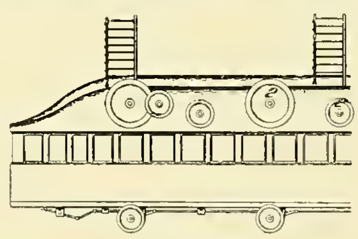
a thimble having recesses within which both the side bars and the enlarged ends of the cross bar or bars lie, the metal of the thimble resisting downward stress of the cross bars independent of any other connection. (See illustration.)

513,229. Car Brake. George M. Brill, Philadelphia, Pa. Filed January 10, 1893.

This invention consists of the combination of brake beam, brakes secured therein, equalizers secured to the beams and directly connected together. An upright lever included in the connecting mechanism and means connected with the car wheels for primarily operating the upright lever and drawing the ends of the equalizers each toward the opposite beam.

513,230. Track Sweeper for Railways. George M. Brill, Philadelphia, Pa. Filed March 25, 1893.

Sweeping brooms are supported at opposite ends of the car truck in such a way that they may be revolved when



NO. 513,268.

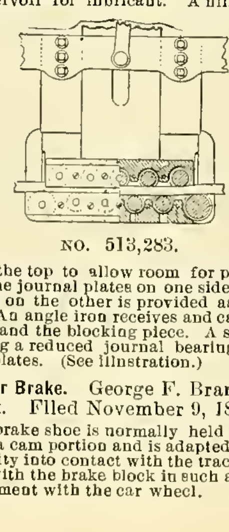
desired. These brooms rest normally in operative contact with the rail. All the brooms are operated from the same source of power in such a way that they may be all simultaneously operated, or by disconnecting one or more the others may be operated independently.

513,268. Car for Elevated Structures. Henry W. Kirchner, Denver, Colo., and George N. Chase, Pasadena, Cal. Filed December 5, 1892.

First claim of this patent reads as follows: In combination with a car or other means of transportation, of aeroplanes in the form of blades arranged one above the other, and means of controlling the inclination of said aeroplanes. (See illustration.)

513,283. Grip for Cable Cars. Wm. H. Russell, Vancouver, Can. Filed September 23, 1893.

This covers the combination of two journal plates having their upper edges recessed, and provided with a cover to form a reservoir for lubricant. A filling or blocking



NO. 513,283.

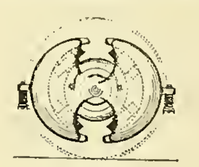
piece open at the top to allow room for pulleys and to receive one of the journal plates on one side and the edge of an angle iron on the other is provided as shown in the illustration. An angle iron receives and carries one of the journal plates and the blocking piece. A series of grooved pulleys having a reduced journal bearing are journaled in one of the plates. (See illustration.)

513,298. Car Brake. George F. Brandau, Cohoes, New York. Filed November 9, 1893.

A swinging brake shoe is normally held away from the track. It has a cam portion and is adapted when released to fall by gravity into contact with the track. The cam portion engages with the brake block in such a way as to force it into engagement with the car wheel.

513,401. Electric Motor for Street Cars. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed March 27, 1893.

In this motor the armature is mounted upon the axle of the car and two field magnets are independently sleeved

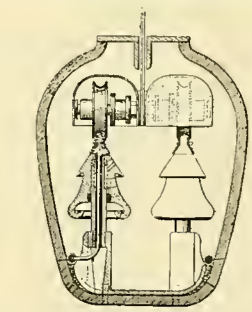


NO. 513,401.

upon the axle and suspended at their rear ends from the car body. Contiguous ends of the field magnets are set away so as to bring the centers of gravity as far as possible from the axle. (See illustration.)

513,426. Span Wire for Overhead Electric Railways. Sidney H. Short, Cleveland, Ohio, assignor to the Short Electric Rrilway Company, same place. Filed April 1, 1890.

This invention covers the use of parallel overhead conductors in connection with span wires divided into two



NO. 513,440.

or more sections, the sections being insulated from each other.

513,440. Supply System for Electric Railways. Henry S. Pruyn, Hoosick Falls, N. Y., assignor to James S. Gibbs, Chicago, Ill. Filed September 16, 1893.

This patent is intended to cover the combination of the main continuous conductor, a working sectional conductor, branch conductors from the main to the sectional conductor, with spring mounted insulating supports containing oil chambers and supporting the sectional conductor. (See illustration.)

513,462. Fare Recorder. Abram Katzky, Moscow, Russia. Filed April 13, 1893.

First claim of this patent reads as follows: A fare recorder for vehicles comprising a dial with suitable mechanism for rotating the same, an arm depending in front of said dial carrying a marking point, an electro-magnet with electric connections to the seat for causing said point to contact with the dial when said seat is taken, and a second magnet with connections whereby said point is removed from the dial.

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CONTENTS.

Electric Roads and Real Estate. Some very sensible ideas upon the consolidation of the interests of the owners of suburban street railways and the proprietors of outlying tracts of real estate are contained in an article by Erastus Wiman on "Electricity in Suburban Development," some extracts from which are given elsewhere in this issue. Mr. Wiman calls attention to the fact that the owners of these two classes of property, although appearing not to possess any interests in common, would be able, if working in harmony, to help each other to success and profit. By this union of interests he thinks it would be much easier to induce capital to back such enterprises than it now is to secure money for the development of either project alone. Mr. Wiman advocates the passage of such laws as will give companies the right to carry on a combined electric light, electric railway and real estate business; and in New York state such a law is now before the legislature. Although the carrying on of a real estate business by an electric railway company may be a new undertaking, the fact that the transactions of real estate deals along the line of a prosperous road might be itself a paying business has often been recognized and advantage taken of it by those directly interested in the railway project. A prominent example of this kind is the close affiliation that has always existed between the West End Street Railway Company of Boston and the West End Land Company, the most extensive holders of the stock of the railway company being also largely interested in the real estate development along the electric lines of the West End Company. More than this, the West End Land Company itself, according to its recent annual report, holds a very large block of the railway company's stock. In Chicago the same thing is true of several of the suburban electric railway lines. Some of these were built either wholly or in part by the real estate firms controlling much of the adjacent property, so that, while the two enterprises have not been conducted by a single organization, they have been carried out under the direction of the same interests and the profits have always reached the same pockets. Evidently the building of these lines for this purpose is a paying investment, for it is understood that the same parties—large real estate dealers of Chicago—are about to carry out another similar undertaking in another section of the suburbs, where they also have large real estate interests. The

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Street Railways and the Blizzard. The storm of the first part of the week which prevailed over so large a section of the country interfered to no small extent with the operation of street cars, and lines were kept open in many places only by extraordinary efforts and at great expense. In the larger cities delays were experienced, but for the most part passengers were subjected to but little inconvenience. In many of the towns it was found impracticable to keep cars in operation. As usual, electric and cable cars proved their eminent superiority to the horse cars. The expenses which the companies incurred in fighting the snow were enormous in the aggregate. The West End of Boston, it is stated, expended $10,000, and the storm cost other companies sums equally as great. Cheap methods for removing snow from street railway tracks remain still undiscovered.

Long Distance Trolley Lines. The latest long distance trolley road projected is that which, it is claimed, will connect New York and Philadelphia. There appears to be a good deal of mystery about this enterprise, but a New York daily which is not of the sensational class, vouches for the statement that the construction of the road may be confidently expected. Many roads of this kind have been planned but few projects have reached the stage of the New York-Philadelphia line, assuming that the positive statements made concerning it are in any wise correct. A railway of this kind must of necessity depend on way traffic, for through traffic cannot be attracted unless it be by extremely low rates of fare. In point of accommodations and in speed the ordinary street car with its constant stops must yield to the steam railroad coach. If the first of these long distance electric lines proves successful as a money-making enterprise, the number of such roads will doubtless multiply within the next few years. Many capitalists are attracted to such enterprises, but as they are too timid to take the initiative they are waiting for an actual demonstration.

Profits of Electric and Horse Roads. During 1893 the number of passengers carried by the street railways of Massachusetts exceeded by nearly one hundred millions the number of travelers on steam railroads in that state. The total number was over 213 millions, an increase of 142 per cent. during the last decade. In the transportation of passengers the street cars covered a distance of over 34 million miles. It requires no more figures than these to prove that the street railway business in the Bay State has reached magnificent proportions. The vast increase in traffic in the last few years may be safely attributed to the introduction of electricity, and this system of car propulsion has now been in service for so long a period that the state railroad commissioners feel justified in drawing conclusions in regard to the financial success of electric railways. That portion of their annual report relating to street railways is presented elsewhere in this issue, and it must be confessed that the findings are not as favorable to electric traction as enthusiasts could wish. After the presentation of a formidable array of figures the commissioners find in them reasons for believing that electric railways are not bonanzas of "rare and inexhaustible wealth," and that they will yield only "moderate and ordinary returns from money legitimately invested" in them. No great amount of fault can be found with this statement. The commissioners have also been unable to find a "demonstration of the superior net earning capacity of the electric as compared with the horse system, but rather the reverse." This finding is certainly not encouraging and it does not agree with the published views of most persons who have investigated the matter. The man who expects to find a rich bonanza in an electric railway is not well posted concerning the business; but certainly the prospect has been held out to owners of horse roads that a higher rate of dividend could be expected if they substituted electric for animal power. For electric roads as money-making enterprises no greater claim should be made than that they offer opportunities for the safe investment of money, and that they are likely to yield such profits as may be expected from investments in first class properties. The statement is of course a general one; there are roads which pay unusual dividends just as there are systems so located that they are not likely to be classed as dividend-paying for many a long year. The contrary idea, which the commission says has gained some currency, that every electric road is a sort of gold mine that is bound to make its owners speedily rich is not warranted in any sense and the circulation of this extravagant notion by industrious promoters is calculated to do vast injury to the business. At the same time the figures of the report on their face seem to justify the inference that the percentage of profit is not as great on the money invested in electric roads as that on the smaller sums expended for the equipment of horse railways, but one hesitates to accept this conclusion in the face of an apparently almost universal belief to the contrary. Before this deduction would be warranted it would be necessary to determine definitely that the capital stock of the companies had been paid in cash to the same extent as was the case with horse roads. To illustrate the point: if the conversion of a road was effected merely by the proceeds of the sale of bonds with an equal amount of stock given away as a bonus, as has been done in some instances, it would scarcely be fair to consider electric power as unprofitable because it failed to bring in a revenue sufficient to meet the interest on the bonds and to pay as great dividends on stock for which nothing had been paid as on the capitalization representing the actual outlay for the horse road. If huge blocks of stocks have been given away for promoters' services or in stock manipulations, electric traction may not increase the traffic sufficiently to pay interest on them. We by no means assert that any of these hypotheses apply to the electric railways of Massachusetts, for no data are at hand, but we should need to know absolutely that the present capital stock represented actual cash outlay to the same extent as did the capitalization of the old horse companies before vouching for the correctness of the commissioners' conclusion. Certain it is that the street railway men of Massachusetts, using the designation in the widest extension, do not share the opinion expressed by the board. They have apparently far greater confidence in electric lines than in horse roads, and they are equipping their railways for motor cars with singular persistence. Of the 874 miles of street railway in the state 700 miles are now operated in whole or in part by electric power, and of this latter total over 200 miles were converted into electric lines in 1893 when the owners had the benefits of years of accumulated experience of electric traction. The change was made for the sake of increased profits, and it is difficult to believe that these men were so regardless of the lessons taught by their own business that they failed to realize that by introducing a new system they were likely to decrease relatively the amount of their profits. Conservative men in the Bay State are not liable to make mistakes of that description. While as we have said the figures on the surface are not encouraging to electric railway investors we are not yet ready to concede that the conclusions drawn from them are in all respects warranted.

PROPOSED REORGANIZATION OF THE NASHVILLE UNITED ELECTRIC.

It is stated that five-sixths of the bondholders of the Nashville United Electric Railway Company, which is now in the hands of the receivers, have agreed to a plan of reorganization. The plan which was suggested by Gen. W. H. Jackson contemplates the issue to each holder of the United Electric bonds 50 cents on the dollar of the par value of bonds in stock at par of the new company.

The new company will have $2,000,000 of 5 per cent. thirty-year bonds, and $1,500,000 of stock. The holders of the $984,000 of the General United Electric bonds thus get about $500,000 of new stock.

Then again Gen. Jackson proposes to set aside sufficient securities of the reorganized company to satisfy the underlying bonds amounting to $1,535,000 and to reserve about $57,000 of the new issuance of bonds to provide for the floating debt secured by the pledge of the income bonds. He further proposes to re-equip the cars and overhead connections and make all improvements needed. The building of a new power-house on the river bank, convenient to coal and water, which, it is estimated, will result in a considerable saving, is also contemplated.

To retire the underlying bonds and make improvements will require all of the bonds, but none of the stock.

The fixed charges under the old management were $161,000, divided as follows: $10,000 interest on loans of floating debt; interest on $1,535,000 bonds, $92,100, and $59,040 interest on the outlying bonds. While the fixed charges under the new management will be $100,000; interest on the bonds, $200,000 bonds reduced from a 6 to a 5 per cent. obligation.

Meetings of the Maine and Texas Street Railway Associations.

The first meeting of the Maine Street Railway Association was held February 7 in the city of Portland. The members discussed informally topics relating to the street railway business, and were pleasantly entertained socially. The old officers were re-elected, and committees were appointed to report on several questions, among which are "mutual insurance" and "taxation." The next meeting will be held in the city of Rockford in August next. The following gentlemen were in attendance: President William Wood, president of the Portland Horse Railway Co ; secretary and treasurer E. A. Newman, general manager of the Portland Horse Railroad Co.; E. H. Banks, president of the Biddeford & Saco Railroad Co ; A. P. Gerald, president of the Waterfield & Fairfield Street Railway Co. and general manager of the Bath Street Railway Co.; E. K. Day, general manager of the Mousam River Railroad Co., Sanford; Chas. P. Prescott, treasurer Biddeford & Saco Railway Co ; E. T. Berry, of the Portland Street Railroad Co. and A. K. Baylor, of the General Electric Co. and Fred. S. Kenfield.

The first annual meeting of the Texas Street Railway Association was held last month in Austin. During the previous month a meeting was held at which a temporary organization was effected, and a call was issued for a convention at Austin. The delegates were hospitably received at Austin. They enjoyed a carriage ride to the Austin dam, an excursion on the lake, and a banquet in the evening. The following officers were elected:

President, William H. Sinclair, of the Galveston City Railway, Galveston.

Vice-president, J. K. Urie, of the Austin Rapid Transit Company, Austin.

Secretary and treasurer, S. A. Hobson of the Waco Electric Railway and Light Company, Waco.

Directors: W. H. Weiss, San Antonio Street Railway Company; A. W. Childress, Queen City Railway Company of Dallas; W. H. Sinclair and J. K. Urie.

Committee on membership, C rl Drake of the Laredo Electric & Railway Company, Laredo; J. K. Urie. A. W. Childress and C. A. McKinney of the Houston City Railway Company, Houston.

NEEDS OF STREET RAILWAYS.

In reply to our questions on this subject we have received the following from Mr. E. G. Cownette, the general manager of the United Electric Railway Company of Nashville, Tenn., in addition to those published in our issues of February 3 and February 10:

First, The direct coupled generators; They allow a large output of power within a small space, thus saving a large expense in land, as well as a saving of power, by dispensing with belts, idlers etc. The perfection attained in the single reduction motors and in controlling apparatus is worthy of mention.

Second, The greatest improvement to be desired is to secure a perfect metallic return for the ground. The rail bonding up to date has been a source of annoyance, expense and trouble.

Third, This is a hard question to answer, as the improvements in the past have been so great that we may expect almost anything in the future. A street railroad equipped with apparatus of the present standard of perfection can be operated to a perfect degree of satisfaction, both as to service and expense. If the conduit system could be made practicable under all circumstances it would remove the annoyance of maintaining as well as the objection to the overhead system.

Mather Electric Company Reorganized.

The Mather Electric Company, of Manchester, Conn., has been reorganized and the business has been taken over by the new company, which includes well-known Hartford capitalists. At a meeting of the stockholders at the Phœnix National Bank at Hartford the following named officers were chosen: Maro S. Chapman, president; T. C. Perkins, vice-president; John L. Bunce, secretary and treasurer. The following named directors were chosen: Charles E. Perkins, T. C. Perkins, M. S. Chapman, Henry A. Redfield, Charles M. Jarvis, John L. Bunce and Norman McD. Crawford. Charles E. Perkins is the well-known patent lawyer expert. T. C. Perkins, his son, is known to the electrical fraternity of the West, through his connection with the Ball & Wood Engine Company as one of its western managers. Henry A. Redfield is the president of the Phœnix National Bank. Charles M. Jarvis is president of the Berlin Iron Bridge Company of East Berlin, Conn. M. S. Chapman is manager of the government envelope works at Hartford, and a largely interested stockholder in a number of paper mills in New England. Mr. Crawford is the consulting engineer for the Pennsylvania Traction Company of Philadelphia and also of the Pennsylvania Railroad Company, being also retained as electrician of the Hartford Street Railway Company. Mr. Bunce has been connected with the Perkins Switch Company of Hartford, the Schuyler Electric Company and with the Pope Manufacturing Company of Hartford. Theodore Gonet, who has been retained as electrical engineer, was connected for some time with the Westinghouse Electric & Manufacturing Company. He will have associated with him W. E. Powell, who for many years has been identified with the Mather Electric Company. It is stated that the company starts out under the reorganization free from all debt and with a capital stock of $250,000. The intention of this company is to make a specialty of large dynamos and generators for electric lighting plants and electric street car systems.

Chicago, Ill.—At a meeting of the trustees of the township of Cicero last week, an ordinance was passed granting to the Lake Street Elevated Railroad Company a franchise to extend its tracks through Cicero territory.

ELECTRICITY IN SUBURBAN DEVELOPMENT.*

BY ERASTUS WIMAN.

There are two classes in very many localities in the United States now seriously affected by the hard times who could, by a union of interests, materially help each other and promote the general prosperity. Either class, operating upon its own account, is likely to have a slow time of it; but united both might make substantial, if not rapid, progress. These two classes are the owners of suburban property and the owners of electrical plants. The owners of suburban properties need of all things something to make their holdings accessible, that the demand for homes may be readily met, and their property easily marketed. This can be best done by the second class referred to, namely, the owners of plants now used chiefly at night for lighting purposes, but which might be employed during the day for producing and transmitting energy that would be available for traction on streets at a minimum of cost for construction and operation.

These two classes of property owners do not seem to have much in common—this suburban burden carrier on the one hand, and this sanguine but somewhat disappointed and subdued electric light promoter on the other. Yet each possesses the element that the other needs to develop his interests and united they can help each other to success and profit.

Hitherto the suburban property owner has taken all the profit of suburban development by electric roads. While capitalists and electrical promoters have put up the money, borne the risk, and done the work, the owners of land along the line have raked in the "shekels." But this is now no longer possible. The electric promoter has about reached the limit of the capital he can for this purpose control. The banker and the investor are becoming timid regarding new enterprises, and without a very large margin of promise new enterprises, in the shape of suburban expansion particularly, are just now unlikely.

But with a union between all the parties concerned, the advantages of a broad basis for capital are afforded. A united effort, under vigorous and combined management, is possible, and such a division of profit probable that the enterprise would attract attention and invite capital. Thus the large gains which are possible to suburban development, by the transposition from land in acreage to land in lots, would be rendered much more rapid of realization if merged into a deal in which the electric interest participated, or if by a union between them capital was attracted which could now be drawn to neither alone.

Union between the land owner and the electric light company therefore seems desirable. As the latter is already an organization capable of expansion and of divisibility, it would seem that its powers might be made available. By enlarging or reconstructing it the company could be made an instrumentality large enough to include (1) the light company; (2) the land; and (3) the electric road. The new combination might with propriety be rechristened,—in order to cover and explain its purpose,—as "The Electric Land, and Railway Company." Into this company could be merged all the interests to be served, and in its bonds, preferred and common stock (as hereafter to be explained) sufficient profit, safety, and attraction might be found for capital, not only locally but from abroad.

It will be asked, What is the prospect for money for these purposes in these hard times? It may be answered that the prospect for money for development of the property and the expansion of electrical enterprises is much more probable by a union of these two interests than by keeping them separate. Both have elements of profit exceedingly potential if united; neither now has any attraction for money, if separated. There is plenty of money,—never was it such a drug as now. For weeks call-money in New York has been at 1 per cent. per annum. There is just as much money in the country as ever there was. It has not been lost in the woods, it is not buried in the earth, nor has it been shipped abroad in ocean greyhounds. This money has got to earn an honest living for the people who own it, just as the electric plant has got to earn a living for its promoter, or the suburban property for its owner. The need of the hour is to bring the three elements together, and that can better be done by a union of the two latter than by any other plan known to those who give most attention to the course of investments, and the projects wherein the greatest elements of profit reside in combination with safety.

It is beyond contradiction that, taking a survey of all classes of investments in the past ten years, no single department of industrial effort has yielded an enhancement of values so great, so universal, and so secure as the profits made by sub-

* Extracts from an article in the *Engineering Magazine*.

urban development, aided by electric roads. Starting at Boston, the most conservative of centers, and long ago thought to be practically a completed city, the increase of values created by the expansion of Mr. Henry M. Whitney's West-End street railway system has been greater than the gain in any other interest. Bank stocks, insurance stocks, railroad bonds, industrial securities, and the thousand other instrumentalities which provide great numbers of Bostonese with bread and butter have barely held their own in the best cases, while in very numerous instances they have declined in values, and some have ceased to yield the harvest even of hope. But the West-End system has not only steadily earned a large return, but steadily enhanced in earning power, while the thrill of life in property along its lines, far out of town, has imparted a new vitality and an enhanced value.

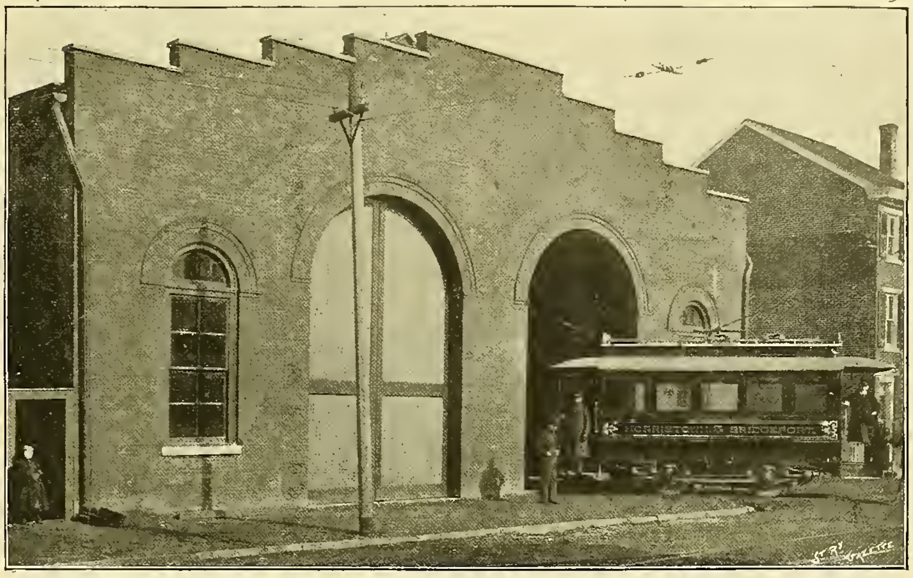
So it is all over the country. In great cities like Rochester, Buffalo, Cleveland, Cincinnati, Chicago, Milwaukee, Atlanta, Omaha, Kansas City, and numerous smaller places the gain in value, the growth in population, the enlargement of area, the stimulation of building, and the general vitality resulting from electric railway extension is more pronounced, is more secure, and is founded on a better basis than has been created by any other form of investment.

There may have been some exceptions to this general conclusion, and undue expansion ahead of the demand may have resulted in a few instances in loss and delay in return. It would not be surprising if this were so, for, as with other good things in this world, the maxim applies, "The greater the good, the nearer the evil." It may be safely claimed that in proportion to the ground covered, the amount of money spent, the number of undertakings pushed forward, and the social, material, and financial results achieved, no class of investment has been so profitable, and so eminently satisfactory, as electrical railway suburban development.

With this general conclusion admitted, there ought to be no serious difficulty in numerous minor localities to perpetuate this impression, and steadily realize a similar result. This can best be done in the way herein suggested for smaller places, namely, by a union of an existing organization in the shape of a local electric light plant and suburban property, the two uniting their advantages to invite the third—local capital—to complete the necessary means of communication, and render readily accessible the property now dormant and dead in realizable value. The property owner must make up his mind to share with others the enhanced value, as something to which their investment, organization, and experience entitle them. He will make twice as much money in five years by this union as could be made in ten years by isolated and restricted opportunity for realization.

The electric company will also be benefited by an enlarged chance for development, the employment of much that is now idle all the hours of day, and by putting into constant use the forces of organization, expert knowledge, experience, and the manifold advantages which exist in a growing concern.

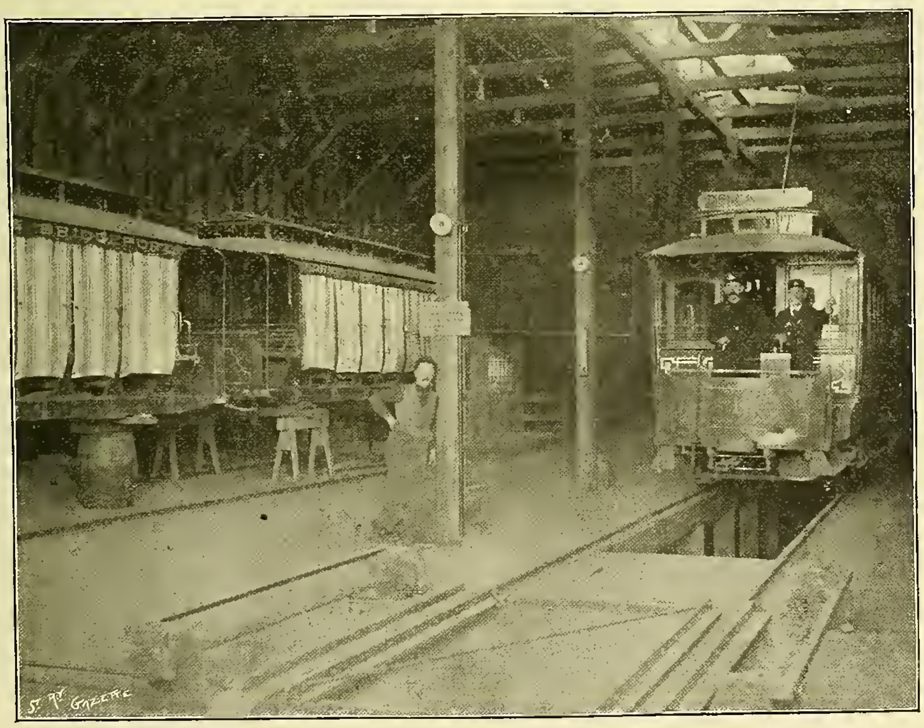
The investor, too, either local or from abroad, will find a ready opportunity for the employment of capital right under the sphere of his own observation. Instead of buying bonds on railroads a thousand miles away, subject to all the chances of competition, crop failures, traffic reduction, and mismanagement, there will be in such local enterprises as are here suggested an opportunity for observation, direction, management, and general interest impossible in far away undertakings.



EXTERIOR VIEW OF NORRISTOWN STATION.

It may be asked what one thing more than others would encourage a movement of this character, and give shape and form to this suggestion of a union between electrical plants and suburban development, the two thus united inviting capital. The reply is that legislation has already set in motion the incipient stage of this movement. By a new general law of the state of New York electric light companies, outside of cities of large class, by a very slight formality may become possessed of all the powers of a railroad company, under which a construction could be carried forward to any point, or in any direction, that public policy permitted. The smallest electric lighting company in the state can thus be possessed of all the powers enjoyed by the New York Central and Hudson River Railroad Company. With these privileges and powers in hand there are hundreds of towns in which electric light plants now lying idle all day long could be made available with slight added expense. Even if their capacity had to be doubled they could be made available at far less expenditure than new undertakings, which nowadays are hardly to be thought of.

The New York law as it exists, while it imparts to electric light and power companies the privilege of railroad construction and operation, does not contemplate the acquirement of land and its improvement, sale, or lease. This amendment it is proposed now to seek, so that three purposes can be accomplished at one and the same time, namely, (1) the creation of light and power; (2) the construction and operation of an electrical railroad; and (3) the acquirement and development of suburban property.



INTERIOR VIEW OF NORRISTOWN CAR HOUSE.

NORRISTOWN PASSENGER RAILWAY COMPANY.

The Norristown (Pa) Passenger Railway Company now operates four miles of single line and five cars are in service. The contract for the entire installation was awarded to the Complete Electric Construction Company of New York, and the work has been well done in all respects. The power house and car barn cover a space of 128 by 65 feet, and are separated from each other by a fire wall. The former building is constructed of brick and the car barn is built of corrugated iron. Both buildings are covered by tin roofs. The steam is generated in a 150 horse power boiler and power is furnished by a 125 horse power engine built by the Buckeye Engine Company of Salem, O. The feed water is heated in a Berryman heater. The electric generator which is of 125 horse power capacity is a Westinghouse machine, and it is connected to the engine by a Schieren belt.

The trolley and feed wires were furnished by the John A. Roeblings Sons' Company and the overhead fixtures are those of the General Electric Company. The poles are wood and are octagonal. The track is laid with Johnson girder rails. The five cars which were built by the Newcastle Car Company are mounted on McGuire trucks, and equipped with Westinghouse motors. The fare registers were furnished by the Security Register Company of St. Louis. The illustrations represent the interior and exterior of the power house, and the interior of the car barn in which a Hathaway transfer table has been installed.

Cleveland, O.—Two motormen employed by the Cleveland Electric Railway Company were fined $10 each last week for operating their cars at a speed greater than that permitted by the ordinance which provides that the speed on bridges and viaducts shall not exceed eight miles an hour. It was stated by the policeman who caused the arrest that the cars were traveling at the rate of fourteen miles an hour when he arrested the men. The men declared that they were unaware of the fact that the speed was too great.

MASSACHUSETTS STREET RAILWAYS.

Annual Report of the State Board of Railroad Commissioners.

The street railway portion of the annual report of the Massachusetts Railroad Commissioners has just been made public, and a summary of the voluminous document is presented herewith. With the exception of the board in New York no commission in the country deals with the subject of street railways so exhaustively as that of Massachussetts, and the figures which it presents are thoroughly reliable.

The commission reports that returns have been received from 60 companies, one less than in 1892, and of this number 43 were engaged in operating railways, 11 had leased their roads, two had been consolidated with other companies, three companies had not completed their lines, and the railway of one company (Beverly and Danvers) was not in operation. The total length of street railways on September 30 1893 (the end of the official year), including double track, but not sidings, was 874 14 miles, an increase of 119.29 miles over the preceding year. Of this total, 711.08 miles were operated in whole or in part by electric power, and 163 06 wholly by horse power. This shows, as compared with the previous year, an increase of 214.78 miles equipped with electric power, and a decrease of 95.49 miles equipped for horse power only.

A table gives the number of street railway companies in the state, the total length of railway, and the length of electric railway, in 1860, in 1870, in 1880 and in each year from 1885 to 1893 as follows:

Years.	Number of companies.	Total length, Miles.	Increase, Miles.	Length of electric, Miles.
1860	20	88.87	88.87	......
1870	23	139.44	50.57	......
1880	29	222.54	83.10	......
1885	34	345.13	125 59	......
1886	43	407.65	59.52	......
1887	44	470.27	62.62	......
1888	46	533.59	63.32	......
1889	46	574.17	40.58	50.52
1890	48	612.38	38.21	160.86
1891	56	672.45	60.07	289.03
1892	61	754.85	82.40	496.30
1893	60	874.14*	119.29	711.08

* The total length of sidings, switches, etc., was 63.154 miles.

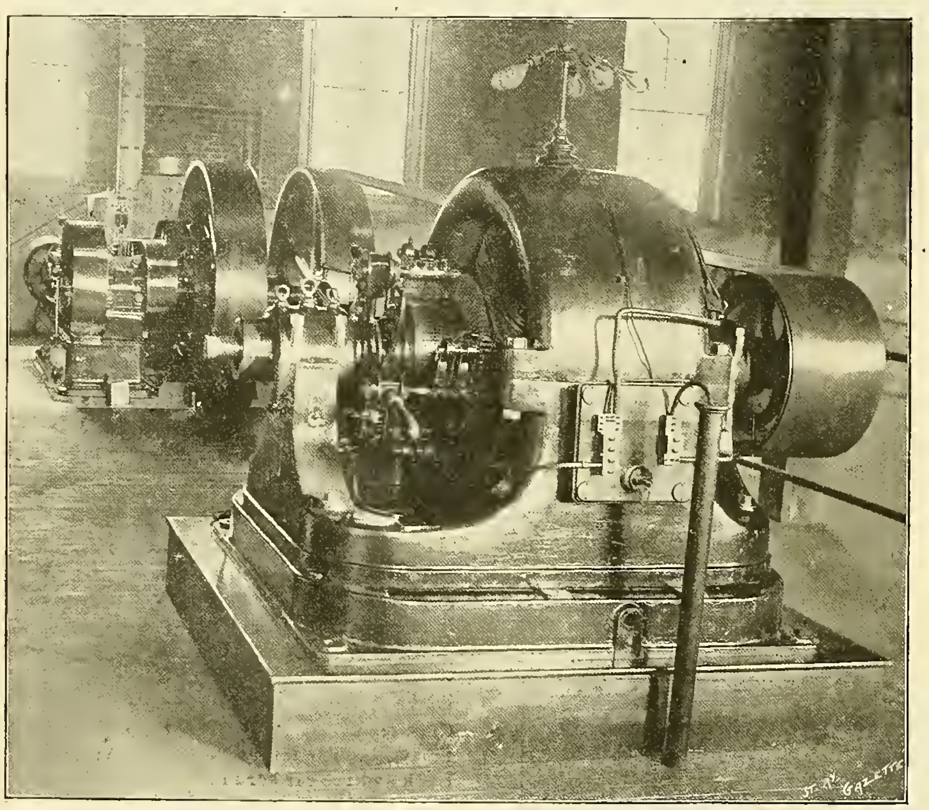
All the companies use the overhead single trolley system except the Milford and Hopedale, which uses the storage battery.

There have been as many miles of electric railway track built, or equipped with electricity, in Massachusetts in the last five years as there have been miles of railroad track built in the last 10 years.

The aggregate capital stock of the 60 companies September 30, 1893, was $25,883,575, an increase of $2,293,039 over the previous year, resulting from new or additional issues of stock.

The whole amount of cash dividends declared and paid the last year was $1,716,637.50, an average of 6.63 per cent. on the total amount of capital stock outstanding at the end of the year, as against 6.71 per cent. in 1892. Computed (as it should be) on the mean amount of capital stock outstanding at the beginning and end of the year, the average dividend the last year was 6.94 per cent., as against 7.34 per cent. in 1892.

One company paid last year 10 per cent.; one (the West End) paid 8 per cent. on preferred stock and 9 per cent. on common stock; four paid 8 per cent.; four paid 7 per cent.; seven paid 6 per cent ; one paid 5 per cent.; one paid 4½ per cent.; one paid 4 per cent.; four paid 3 per cent.; one paid 1½ per cent.; and the remaining 35 companies, including new and old, declared and paid no dividends. The average rate on the capital stock of the 25 companies which paid dividends was 8.22 per cent.



INTERIOR VIEW OF NORRISTOWN RAILWAY POWER STATION.

The following table of capital stock, net income and dividends for the last ten years is given:

Years.	Capital stock.	Net income.	Cash dividends declared.	Percentage to capital stock.
1884	$ 7,732,200	$ 697,469	$ 444,090	5.74
1885	8,077,100	638,436	507,044	6.28
1886	9,125.645	791,335	494 070	5.41
1887	10,096,980	648,382	530,920	5.26
1888	10,894,850	785,008	625,617	5.74
1889	12,290,740	1,025,758	838,649	6.82
1890	14,879,130	1,430,116	963,154	6.47
1891	19,553,952	1,299,158	1,100,015	5.63
1892	23,590,536	1,905,680	1,582.697	6.71
1893	25,883,575	1,993,399	1,716,637	6 63

The gross assets of the companies, September 30, 1893, were $50,130,273.20, which is an increase of $10,498,503 over the assets of 1892. The figures which give the total assets are as follows: Construction, 1892, $14,734,432; 1893, $23,420,066; equipment and other permanent property, 1892, $9,479,539; 1893, $13,509,941; cash and current assets, 1892, $3,932,490; 1893, $2,939,010. The gross liabilities, including capital stock, at the same date, were $49,589,687.91, an increase of $10,794,873 over the preceding year; as there was a gain of only $10,498,503 in gross assets, there is a balance of $296,370 against the companies, diminishing by that amount their aggregate surplus.

During the last ten years it is noted that there has been a steady and rapid decrease in the surplus of the companies. In 1884 the surplus was $1,039,360, or 13.44 per cent. of the capital stock; in 1889 the amount was $726,740, or 5.91 per cent. of the capital stock, and in 1893 the surplus was $540,585, or 2.09 per cent. of the capital stock.

The funded debt of the companies September 30, 1893, amounted to $14,109,000—an increase of $4,138,850 over the previous year, resulting from additional issues of bonds, or from the assumption of additional bonded liabilities.

The total number of passengers carried during the last year on the railways of all the companies making returns to the board was 213,552,009, an increase of 19,380,067 passengers over the previous year. The number of passengers carried on the street railways exceeded the annual number carried on all the railroads of the state by 93,772,062.

The total number of miles run by street cars was 34,507,282—an increase of 4,829,246 miles over the previous year. The total number of round trips run was 4,481,171—an increase of 312,713 in the number of trips. The average number of passengers carried per round trip was 48—one more than in 1892.

Comparing the figures for 1893 with those for 1883, there has been an increase in the last decade of 142 per cent. in the number of passengers carried, of 125 per cent. in the number of miles run, and of 96 per cent. in the number of round trips annually.

The total income of the companies from all sources for the year ending September 30, 1893, was $10,894,704.11, and the total expenditures were $10,617,941.99—leaving a net balance of income for the year of only $276,762.12 to carry to surplus account.

The balance of total income from all sources above operating expenses was $3,392,859—an increase of $584,813 over the previous year. The fixed and other charges on this income balance on account of interest, taxes and rentals amounted to $1,399,460—an increase of $497,094; leaving as the net income available for dividends the sum of $1,993,399—which was larger by $87,719 than the corresponding sum of 1892.

The percentages of operating expenses to gross income from operation, for the last decade are as follows: '84, 78 37; 85, 80 02; '86, 80.04; '87, 82.81; '88, 81.07; '89, 78.80; 90, 74.80; '91, 76.13; '92, 71.74; '93, 69 26.

The ratio of operating expenses to gross income from operation has fallen in the last five years from 81.07 to 69.26 per cent.—a marked decrease. The percentage for the last year was in fact a little lower than that for the railroad corporations of the state, which was 69.79 per cent. The net earnings from operation have increased on the average from $2,420 to $3,810 per mile of railway owned, and from 5 56 to 9.65 cents per car mile run during the last five years.

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There has been in the last five years an increase from 40 to 74 cents in the average net earnings per round trip run, and from 0.96 to 1.56 cents per passenger carried.

The average cost of the street railways of the state per track mile (including the cost, but not including the length of sidings), as it stood on the books of the companies September 30, 1893, was $26,792 for construction; $15,455.06 for equipment; and $11,738.63 for land, buildings and other permanent property—making a total average cost of $53,985.69 for each mile of main railway track, including double track.

These figures are of value as showing just how heavily the street railways, as a whole, are capitalized, or, in other words, the average amount per mile on which dividends and interest are, if possible, to be earned. The cost, as returned by the several companies, ranges from $13,745 to $98,907 per mile.

The report says: "It is too early as yet to draw exact and final conclusions with regard to the financial economy of electric power, as compared with horse power, in street railway operations. It is desirable, however, both for the investor and the public, that current opinion on this point should conform as nearly as may be to the truth, and that false or exaggerated ideas, if such have gained a footing, should be set right.

"The question here is not whether electricity is a success as a motive power, or whether, taking into account the convenience, comfort and dispatch of street car travel on the one hand and the obstruction and danger to ordinary travel on the other, the electric system is, on the whole, preferable to the horse system. The present question is whether the electric system promises a larger return on the capital invested, and thereby a possible future reduction of the charges for transportation; so that the new system may be fairly expected in the long run to prove not only more remunerative to the stockholder, but cheaper for the public."

A comparison of the railway year just closed with that ending in 1888, the last in which the railways were operated wholly by horse power, will evidently afford the fairest and most satisfactory test of the financial results of the two systems thus far:

Earnings and cost.	In 1888, cents.	In 1893, cents.	Per cent of increase.
Net earnings per passenger carried	0.96	1.56	62.50
Net earnings per car mile run	5.56	9.65	73.56
Net earnings per round trip	40.00	74.00	85.00
Net earnings per mile of railway	$ 2,420.00	$ 3,810.00	57.44
Cost of railway per mile	33,685.00	53,886.00	60.22
Capitalization per mile	32,304.00	53,307.00	65.20

"The most direct and conclusive test of the net earning capacity of the two systems is a comparison of the increase in the net earnings per mile of railway with the increase in the cost of railway per mile. Applying this test, it will be seen that, while the net earnings per mile are 57 per cent. greater, the cost and capitalization per mile are respectively 60 and 65 per cent. greater in 1893 than in 1888—the odds being clearly in favor of the horse system.

"As in the case of the newly built and furnished house, the necessary repairs and renewals for the first few years are comparatively slight. For this reason the cost of the maintenance of the new system, which is chargeable to operating expense, has thus far been abnormally small, and the consequent showing of net earnings from operation has been abnormally large. The extraordinary reduction of the last two or three years in the ratio of operating expense to gross income from operation is largely, if not wholly, to be explained in this way.

"The net earning capacity of the electric system will not have been fully tested until time and experience have demonstrated the normal and full average cost of its maintenance; and the net results, as they now appear, must be qualified accordingly.

"The returns show that the railway companies as a whole have been running closer and closer to the wind during the electric period, and have substracted from the old surplus much faster than they have added to the new divisible income. We must conclude, then, taking everything into the account, that there has been thus far no demonstration of the superior net earning capacity of the electric as compared with the horse system, but rather the reverse.

"It can and should be said without hesitation or qualification, that the electric system has not shown or indicated any such margin of profit as to justify the expectation of more than ordinary returns on money legitimately invested in it. The idea, which seems to have obtained some currency, that the electric railway system is a bonanza of rare and inexhaustible wealth is clearly a delusion, and has doubtless proved to some a snare.

"Instead of inflating the liabilities and straining the earnings and surplus for the division of ostensible profit, the manifestly safe and imperative policy for the electric companies—and that without special regard to the present unusual stringency of the times—is to keep the capitalization and charges upon income within the narrowest possible limits, and to set apart year by year some substantial portion of the earnings as a fund for future contingencies, and for the increasing burdens of expense which are sure to come and whose weight is now only partially felt or known. The recent action of the directors of the West End Company—much the largest and one of the most ably and successfully managed of the street railway companies—in voluntarily reducing the rate of dividend on its common stock, was eminently wise and commendable in every point of view. Such action ought to enhance, and doubtless has enhanced, the value of the stock in the estimation of every well informed stockholder and sagacious investor."

The total number of persons injured in connection with street railway operation, as reported by the companies for the year ending September 30, 1893, was 585, of whom 45 received fatal injuries.

The number of passengers injured was 311, of whom only two were injured fatally. Most of the accidents to passengers occurred as they were getting on or off cars.

The injuries to employes were 48 in all, of which five were fatal. The number of injuries to travelers and others on the street was 226, of which 38 were fatal.

Of the whole 585 injured, at least 44 were children. The reports do not in some cases indicate whether the person injured was a child or an adult, and it has been assumed in such cases that the person was an adult. Of the 44 children injured, 22, or just one-half, were killed.

One in 686,662 of the passengers carried was injured, and only one in 106,776,004 was killed street cars were run on the average 152,686 miles without injuring, and 908,085 miles without killing any traveler or other person on the street, and on the average 7,659 round trips were run without injuring, and 99,579 round trips without killing any passenger, employe or traveler, or any other person.

Five-eighths of all the passengers on the street railways of the State were carried the last year by the West End company; and considerably more than one-half of all the car miles and round trips run were run on its lines. In view of its metropolitan location, and the comparatively thronged and congested condition of the streets through which the bulk of its traffic passes, it will be interesting to compare the casualties on this railway with those occurring on all the other railways taken as a group.

Reducing the ratios to percentages, it appears that the casualties to passengers carried were 39 per cent. less on the West End than on the other railways, while the casualties to persons on the street were 26 per cent. less per car mile run, and the casualties to passengers and all other persons were 22 per cent. less per round trip on the other railways than on the West End.

It also appears that on the West End the casualties to passengers and all other persons were 44 per cent. greater in the electric than in the horse car service per car mile run.

The whole number of grade crossings of railroads by street railways, on the 30th of September last, as reported in reply to a circular issued to the railroad companies, was 133—the total number of such crossings has grown in the last two years from 116 to 133. The most noticeable change, however, is the increase from 26 to 100 in the number of electric railway crossings; while the horse railway crossings have dropped from 90 to 33, and bid fair to give way altogether to the new system of motive power.

If the construction of 100 grade crossings of railroads by electric railways were to be brought forward as a direct and original proposition, it would be received with the serious apprehension which it deserves, and would be permitted, if at all, only under careful restrictions and regulations, similar to those which 60 years' experience has proved to be necessary in regard to the crossings of railroads on the same level. It is not to be believed that the allowance of 100 such crossings outside of the public highways would for a moment be thought of. Of all the perils which attend travel on railroads and railways in this commonwealth, there is no one which, in the apprehension of the board, is so serious, both in its character and extent, as that here pointed out.

The report repeats last year's suggestion of the expediency of limiting the issue of bonds of street railway companies to the amount of the paid-up capital stock.

During the last year, taking the street railway companies as a whole, they issued $4,138,850 of additional bonds, while the addition to paid capital stock was only $2,293,039, or about half as much. Seven companies had, September 30, 1893, bonds outstanding in excess of paid capital stock. The capital stock was $2,575,000 and the bonds $5,115,500, the excess of bonds being $2,540,509.

It should be stated in justice to the other companies that their paid capital stock at the same date amounted to $23,308 575, while their aggregate bonded indebtedness was only $8,993,500; so that the other companies, as a whole, were far within the limit above recommended. Railroad corporations have been for many years subject to such limitation by the general law of the state.

In 10 years the number of street railway employes has grown from 3,846 to 8,070, cars from 1,926 to 4,040; horses have diminished from 8,996 to 3,531.

On the question of consolidations and the attendant increase of capital stock, the report says:

"Without going into details, it may be stated that five purchases and consolidations have taken place during the last year. The seven companies concerned—the two purchasing and the five purchased companies—had on September 30, 1892, before consolidation, according to their annual reports to the board, a total capitalization (capital stock and net debt) of $3,857,140. The two purchasing companies, after absorbing the other five, had on September 30, 1893, according to their annual reports to the board, a total capitalization of $8,580,077—an increase of $4,722,937, or about 125 per cent. These figures do not include the $4,000,000 of bonds issued by the Lynn & Boston, nor the excess of those bonds over the unfunded debt.

"The seven companies reported in 1892 a total of 142 80 miles of railway track owned, and the two consolidated companies reported in 1893 a total of 159.93 miles—an increase of 17.13 miles, or about 12 per cent. It is gathered from a comparison of the two sets of reports that, in the intervening year, some 46.61 miles of original horse railway line were also equipped for electric motive power. Making a liberal allowance for the cost of this new construction and re-equipment, there still seems to be left a very large fraction of the $4,722,937 of increased capitalization unaccounted for; at least the board is unable to account for it."

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Seventh Article.)

LINES OF FORCE.

We have the greatest possible variety of conductors of electricity from silver and copper, which conduct it with the greatest facility and offer the least resistance down through all of the other metals and carbon to substances which are non-metallic in character which offer very great resistances and are usually termed "non-conductors." But of conductors of magnetism—that is magnetic substances—we have but three, iron, nickel and cobalt, of which iron possesses the

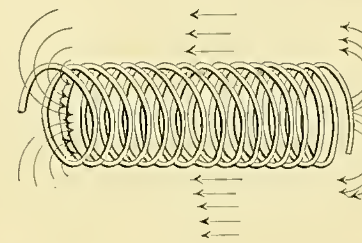


FIG. 10.

property in a preeminent degree. All other substances, including the air, stand about upon a par with each other, hence it is that a magnet acts quite as well through the top of a table, through a teacup or saucer full of water as it does through the same space of air.

If therefore we increase the air gap between the north and south poles of a magnet we increase the resistance to the flow of magnetism for the latter has to traverse this length of non conducting or poorly conducting substance, and with an increased air space, it will, as in the case of an increase in the resistance of an electric circuit, require a corrresponding increase of magneto motive force, or what is equivalent, an increase in the number of ampere turns of wire to produce through this increased resistance an equal flow of magnetic fluid.

With the conception of a flow of magnetism or "flux" as it is technically called, it became necessary to have some unit corresponding to the

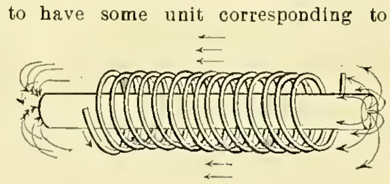


FIG. 11.

ampere as used in the flow of electricity. For the magnetic flow or flux the unit adopted is "the line of force" which is an imaginary line passing out of the magnet at the north pole and into it at the south pole.

Thus in Fig. 10, which represents a solenoid, the lines of force emerge at the north pole and pass around through the air and re-enter at the south pole. In the case of the solenoid, the whole of the magnetic circuit is through the air. The resistance to the flux is therefore very great, and the number of lines of force, or in other words the strength of the magnet, will therefore be very small.

In an electric circuit, if we substitute a good conductor for a poor one, we will get, with the same electromotive force, more amperes, so if in the solenoid (Fig. 10) we substitute a bar of iron, a good conductor, for the air inside of the coil, we will have greatly reduced the total resistance of the circuit and the number of lines of force that will flow around the magnetic circuit will be enormously increased, which means that we have a magnet of enormously greater strength from the same number of ampere turns.

We have here (Fig. 11) a bar electromagnet But strong as this is, it is evident that in any bar magnet at least one-half the magnetic circuit must be in air, and the longer the bar the longer will be the portion of the circuit which must traverse the high- resisting air. If we bend the bar around in the shape of a horseshoe, bringing the two ends near together, we may greatly reduce the distance which the lines of force must traverse the air, and this means a still greater number of lines that will be caused to flow by the same number of ampere turns; thus in Fig. 12

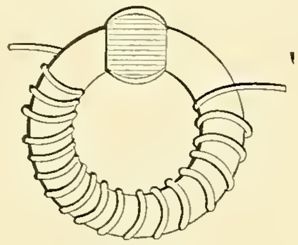


FIG. 12.

the N. and S. poles are brought close together, so that the air space between them is very short. The number of lines emanating from the face of the N pole and entering the face of the S pole will therefore be very dense—much denser than was the case in Fig. 11, where the iron bar was the same length and was excited by the same number of ampere turns.

In making these sketches to any given scale there is, of course, a limit to the number of lines of force that we can draw. We can draw a certain number, but there is no room for more. The same conditions exactly exist, as regards the number of actual lines of force that can be made to thread through any given bar of iron. Up to a certain point the number of lines remains very closely proportional to the magnetizing force (ampere turns) divided by the magnetic resistance, but a limit is finally reached beyond which the increase of ampere turns has very little additional effect upon the strength of magnetism produced—new lines of force are not added, simply for the same reason that we cannot draw any more in our sketch, viz.: that there is no room for them. When this condition is reached the iron is said to be "saturated."

We have heretofore spoken of these lines of force as purely imaginary lines. They have, however, a more real existence than this, for they can be traced or made visible in various ways. If a plate of grass be sprinkled with fine iron filings, and then held close to a magnet and be gently tapped so as to allow the particles of iron to take up any position they desire, they will arrange themselves in curved lines emanating from the north pole and re-entering the south pole, which correspond in length and direction with, and, in fact, are the visible representatives of what we have been speaking of. They may also be traced with a small compass needle, which in whatever position it may be held, with reference to the magnet, will have exactly the same direction as the line of force which passes through it has at that place. Thus a compass needle points in a north and south direction, simply because all lines of force passing between the two poles of the earth have a north and south direction. If, however, we bring another magnet near the needle the lines of force emanating from it will overpower those of the earth's magnetic poles, and the needle will take up a position in accordance with the stronger, or rather in a position which is a compromise between the two.

THE CLOSED MAGNETIC CIRCUIT.

By reference to the lines of force shown by the iron filings it will be seen that they emerge from and re-enter the magnet only at the poles. We may therefore define the magnetic poles as those portions of the magnet where the lines of force emerge from and re-enter the magnet. We have also seen that as we decrease the air distance through which these lines have to pass, by bending the magnet around so that the poles come closer together, the magnet increases in strength. It would be logical, therefore, to assume that if we brought the two poles into actual contact or in fact made a closed ring of the magnet, we would have a magnet of maximum strength, because the air resistance would be reduced to nothing, and such is really the case and the smaller the diameter of the ring, the stronger will be the magnet because the lines of force will have a less distance of iron to traverse and hence meet with less resistance due to that cause.

But according to our last definition, a magnetic pole is that surface whence the lines of force either emerge or enter the magnet. Since iron is such an enormously better conductor of magnetism than the air, the lines of force will continue in the iron even though they may have to go considerably out of the shortest path to do so. There will in this case be no surfaces from which the lines will emerge or into which they will enter and therefore there will be no poles. If there are no lines of force external to the magnet, there will be none to direct a compass needle and the latter will not be deflected as by an ordinary magnet, nor will this ring magnet attract other particles of iron or steel. This is entirely contrary to the popular conception of a magnet and it is only in the more modern works that a magnet is not defined by the unqualified statement that it posesses both north and south poles which have the property of attracting to themselves other magnetic substances. We have however learned that we obtain the strongest magnet with the least expenditure of energy in an absolutely closed magnetic circuit and by making that circuit as short as possible, and yet this strongest magnet has neither north pole nor south pole nor will it attract or repel other pieces of iron or steel.

MAGNETIC LEAKAGE.

It is seldom however that we can realize fully these ideal conditions. Although our iron ring may be of the softest iron and there may be plenty of it to carry all the lines of force that are generated by the ampere turns used, some of these lines are apt to wander outside the iron and to take a short cut across the air space. These may be readily detected and their direction indicated by the deviation of the compass needle. To such straying lines the term "leakage lines" or "magnetic leakage" has been given.

While the unbroken ring or closed magnetic circuit gives us by far the strongest magnet for the material and energy employed, there are many uses of the magnet which require that it should have polarity—that its lines of force should pass for a portion of the distance at least, through an interval into which may be introduced substances to be acted upon by these lines, but it is a cardinal law of magnets that that magnet which most nearly approaches the closed magnetic circuit will be the most efficient. For this reason magnets, whether permanent or electro-magnets, are usually bent around so that their poles approach each other and the object to be magnetized is introduced into the gap between the two poles. In order to concentrate the lines and make them as dense as possible in this gap, it is usual to wind the substance to be acted upon on a core of iron, or imbed it in its mass, and this is introduced into the gap reducing by that much the air resistance. Of course all leakage lines, or those which do not pass through the path intercepted are wasted, and whatever of current was required to generate the leakage lines was uselessly expended. Exactly parallel would be the case were we pumping water through a long pipe to operate at its other end a small waterwheel. If the pipe were full of small holes along its length just as much more water would have to be pumped into the pipe to do the same amount of work as leaked out through these holes. That is to say, the water that leaks out will cost us just as much to pump, per gallon, as that which issues from the nozzle, and yet it does no useful work. The economical man will therefore not use a sieve for a water pipe and the builder of magnets will avoid shapes which tend to magnetic leakage. In designing magnets it is always desirable to keep the two sides—the north half and the south half as far away from each other as possible except at the poles so that the air-gap between the latter where we want to utilize the lines of force will be the path of least resistance and the great distance between all other portions of the magnet of different polarity will offer too great a resistance for lines of force to jump across.

Sharp angles or points should also be generally avoided because magnetism leaks more readily from a point or angle than from a smooth surface. A magnet of a circular ring shape best meets the required conditions, although a strict adherence to that form is not always practicable or even desirable.

ELECTROLYTIC EFFECTS IN STREET RAILWAY RETURN CIRCUITS; THEIR CAUSE AND PREVENTION.

BY W. NELSON SMITH.

(Third Article.)

Another method somewhat different in principle from the foregoing, but having in view the same object—the avoidance of the earth and rails as the negative side of the circuit—will now be discussed, namely, the three-wire system of distribution, using the rails and earth as the neutral wire.

This method is in every-day use with the low-tension direct-current system of lighting. The electromotive force between the positive and negative mains is double, and the current half of

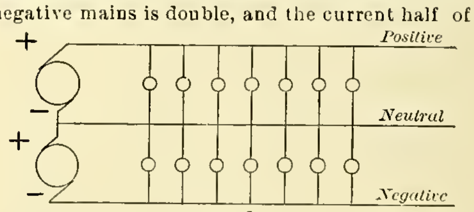


FIG. I.

that required in simple multiple distribution, because the lamps are placed two in series across them. Two generators are required, also placed in series, the positive terminal of one being connected to the negative of the other. From this point of junction of the generators is run a third wire called the neutral. It runs parallel with the other two mains and is between them at every part of the circuit. One-half the lamps are connected between the positive and the neutral, and the other half between the neutral and the negative. When all the lamps are burning, the resistances of both sets of lamps are equal, and no current flows through the neutral back to the generators. The same is true whenever the lamps burning on one side equal those on the other, even if only a fraction of the whole. But if the two sets of lamps become unequal in resistance, on account of fewer burning in one set than in the other, current will flow through the neutral in an amount equal to the excess of current of the larger branch over the smaller. As it is not usual for all the lamps on one side of the circuit to be burning, while those on the other side are all out, it is obvious that the neutral will not be required to carry the entire current; while such a condition is possible it is very far from probable; so the neutral wire may be considerably smaller than either the positive or the negative main, though it is frequently the same size. The accompanying diagram shows the simplicity of the system. (Fig. I.)

The application of the system to electric railways requires, in the first place, a double-track road. The generators in the power station must be run in pairs, and the trolley wires connected, one to the positive terminal of one generator and the other to the negative of the other generator, as above indicated; the generators are joined as before stated, and their junction is connected to the rail side of the circuit. The two trolley wires are thus each at 500 volts potential difference from the earth, and 1,000 volts from each other. On one track, the current direction will always be from trolley to rail; on the other from rail to trolley: current direction, however, makes no difference with the operation of the series motors used in railway work; the direction of their rotation will be the same.

The advantages of this system are several. In the first place, the cost of overhead copper is one-fourth that required for a two-wire system of the all-copper type, like the double overhead trolley. The bonding of all four rails taken together need be no heavier than the cross-section required for either of the trolley wires with its feeders; i. e., the neutral wire need not be larger than either the positive or negative main. The same is true of the metallic connection between rails and generators. The two tracks must be cross bonded at frequent intervals, so as to bring all four rails to as near the same potential as possible. It is evident that if the number of cars in operation be the same on each track, the neutral side—i. e., the rails, etc., will carry no current back to the generators: it will all go out by one trolley wire and in by the other. If there is more current demanded by the cars under the positive wire than by those under the negative, the neutral will carry the excess back to the generators. On the other hand, if the side under the negative wire be using the more current, the neutral will carry this excess out from the generators. Thus the direction of the current in the earth and rail part of the circuit, will be alternately outward and inward. Should any electrolytes be included in the rail-circuit, the reversals of the current will tend to reverse the electrolytic reactions that may be induced, and as the current will constantly alternate with the fluctuations of load continually prevalent on the line, the corrosion of pipes, etc., will certainly be retarded, if not altogether prevented. There would be but few moments in the day when the entire current would be flowing along the rails; it would be most likely to happen when the cars first ran out in the morning, and when the last of them were turning in at night (for at those times the cars that were running would be on the same track) or in cases of "bunching" which would be exceptional. A series of tests on any line would show whether a car took more current during one-half trip than during the other. On a level road there should be no difference to speak of.

The disadvantages of this system are in the overhead work, rather than under ground. The two trolley wires must be naked, and a potential difference of 1,000 volts maintained between them. This means extra precaution in insulating them from the span wires and from each other. Either new insulators and hangers would have to be devised, or the span wires would have to be cut and one or more circuit breakers or strain-insulators inserted. There would be no more danger than at present, as far as concerns the relations between the wires and the earth; the danger lies in the proximity of two naked wires with a potential difference of 1,000 volts. It would be almost impracticable to construct a complicated combination of overhead crossings and frogs such as would be required at street intersections, branch lines, etc., and at the same time maintain a proper degree of insulation between the intersecting wires. But the difficulty could be obviated by inserting line circuit breakers (several in series, if necessary) in either trolley wire—for instance, the positive—before reaching and after passing the frogs, crossings, etc., and carrying the current around by a "jumper" to a point beyond them: the intersections of the network then being connected together and on the negative trolley wire.

The subjoined sketch (Fig. 2) will give an idea of the method proposed. Three circuit breakers are cut into the positive wire at A, B, and C. The whole network of intersections is on the negative trolley wire. A jumper connects the three sections of the positive wire which lie outside of A, B, and C.

Besides this change, the feeders would have to be equally divided between the two trolley wires, so that each side should have one-half the total cross section of copper. At the power station there would also be a change from the ordinary arrangement. The diagram (Fig. 3) shows a convenient method of connecting machines, switches and bus-bars.

Comparing with the switchboard arrangement now in vogue, there would be required in addition two equalizing bars, one for the generators on the positive side of the neutral, and one for those on the negative. The large equalizer already in use could be converted into the neutral bus-bar and connected directly with the rails. The triple-pole generator switches would be connected up in the order shown, bringing the odd-numbered machines on the positive side, and the even-numbered ones on the negative. One pair of machines is represented in the sketch (Fig. 3), and obviously the connections of any additional pair would be duplicates of these. The lightning arresters would also have to be divided up between the feeders.

The only change necessary in the track circuit would be to thoroughly cross-bond the two tracks (in case it had not been done before) with heavy bonds and at frequent intervals.

It does not appear that any changes would be necessary in the car equipment. The Edison Company followed the practice of making the

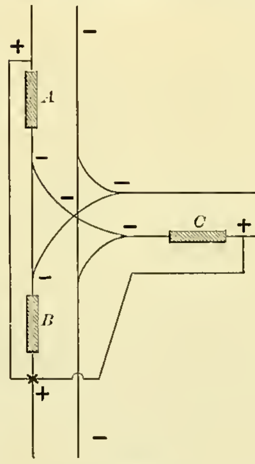


FIG. 2.

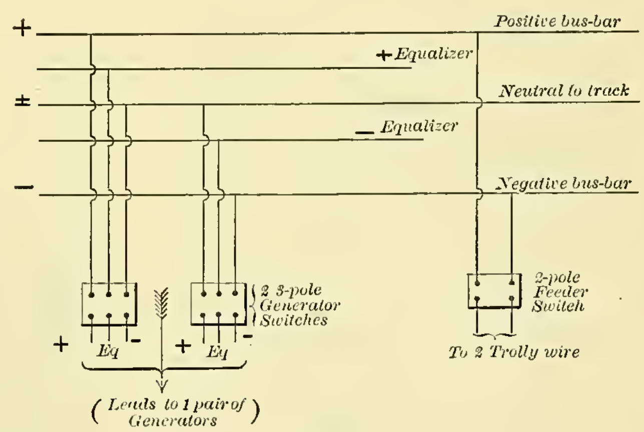


FIG. 3.

trolley negative, without serious embarrassment, and many roads are operating on that plan at present.

The three-wire system was proposed by Sprague about four years ago simply as a desirable means of operating a long-distance, high-speed line without excessive first cost of copper. Since that time no mention of it has ever appeared in print, concerning its applicability to street railways. Whether ever tried or not, it appears at any rate to be worthy of consideration.

The only obstacle to its general adoption is the Edison patent, controlling the three-wire system. It would seem that this restriction would not apply, however, to users of apparatus manufactured by owners of that patent.

No mention has here been made of a plan that has been proposed and actually tried—that of bonding track and water pipes together all along the line, and also connecting directly to the pipes at the power-house. It makes direct and intentional use of the pipes as a part of the circuit, and endeavors to keep the current confined to them as much as possible, by bonding them. But this method involves a great deal of excavation, which is expensive, and the use probably of more copper than it would take to bond the rails thoroughly in the usual manner. Besides this, it subjects the pipes to liability of electrolytic action at the pipe joints, even though it may obviate the corrosion to be expected at other points where the current would otherwise leave the pipes.

It has also been suggested that a way out of the difficulty might be attempted, by insulating, if possible, the rails from the earth, coating them with some compound like asphaltum. But it is not likely that any attempt will be made to accomplish this seemingly impossible task.

To recapitulate: The double overhead trolley system, and the single trolley system with an all-copper return, will require about the same amount of copper, and a very large amount in a road of any length, as the weight varies with the square of the distance.

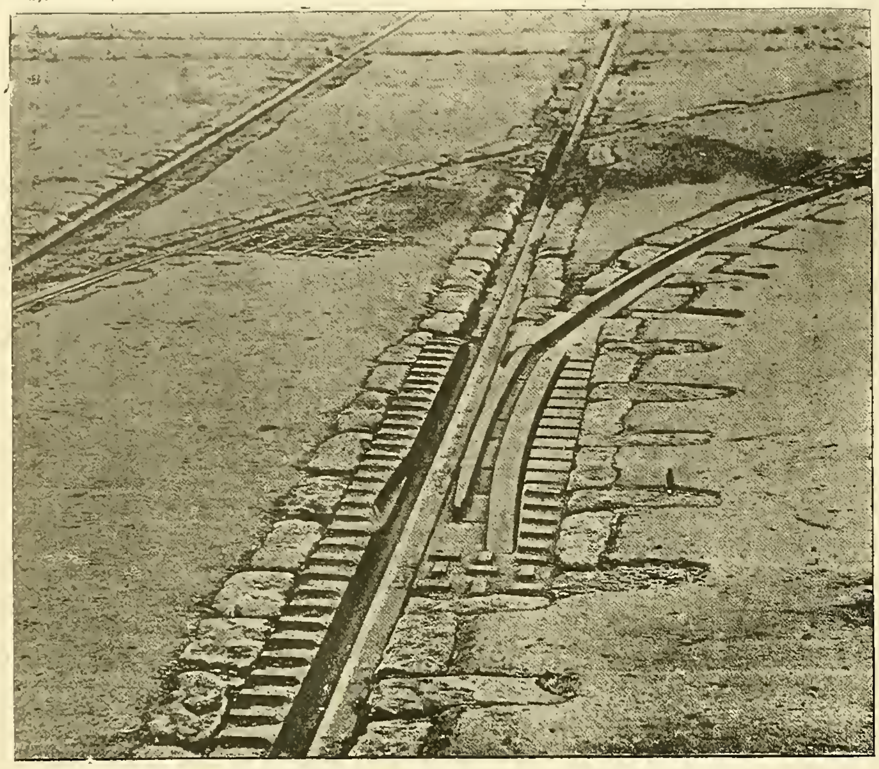
The single overhead trolley system, even with heavy rail bonds, will cost considerably less, the amount of overhead copper required being one-fourth of that needed for the double trolley, plus about 20 per cent. additional (to approximately compensate for track resistance)—say 30 per cent. of the former. In addition, copper bonding is required, costing, say $200 per mile of single track for No. 0000 bonds, and as much more in proportion as heavier bonding is needed. There must also be adequate copper or iron connections between rails and power station.

By the use of the three-wire system, the cost of the overhead copper is one-fourth of that required in the first instance. In addition there is required copper for bonding, but not nearly so much as for the simple multiple system; neither must the connection between rails and power house be as heavy; say $150 per mile for the bonding, and for the neutral return to the power station, a metallic cross section not greater than that of either set of trolley feeders.

With regard to bonding in general, it may be noted that a good deal can be saved by using a shorter bond, a 12-inch instead of a 30-inch. This has been actually done with the solid end bond, and it is perfectly practicable with the other types. The same amount of metal will thus make twice as many bonds as before, and if so distributed will appreciably lessen the track resistance.

Another way of reducing track resistance has been proposed, namely, increasing the length of the rails and thus diminishing the number of joints. This would also have the effect of again lessening the cost of bonding.

There is not an electric railway in the country which could not profit by the knowledge to be gained by a series of tests of the resistance of its tracks. The results would eliminate, from problems and estimates in construction, the uncertainty arising from imperfect knowledge of the properties and conditions of a very important part of the circuit. A standard unit of resistance per mile of track could then be adopted and afterward maintained by occasional measurements, which would locate any faults that might occur. A potential wire would be required, running everywhere parallel with the line, so that measurements could be taken at any point in the system. The cost of erecting and maintaining such a wire, would be more than counterbalanced by the



WHARTON UNBROKEN MAIN LINE SWITCH—MAIN LINE CLEAR.

advantages to be gained by eliminating guesswork. Several methods of making these measurements have been published in the electrical journals. The report of Mr. T. J. McTighe to the New York State Street Railway Association last September contains a great deal of valuable information on the subject in general.*

The general conclusion is, that if the rails be used as the return circuit, or any part of it, their electrical connections must be as perfect, and of as high conductivity, as possible.

(*Concluded.*)

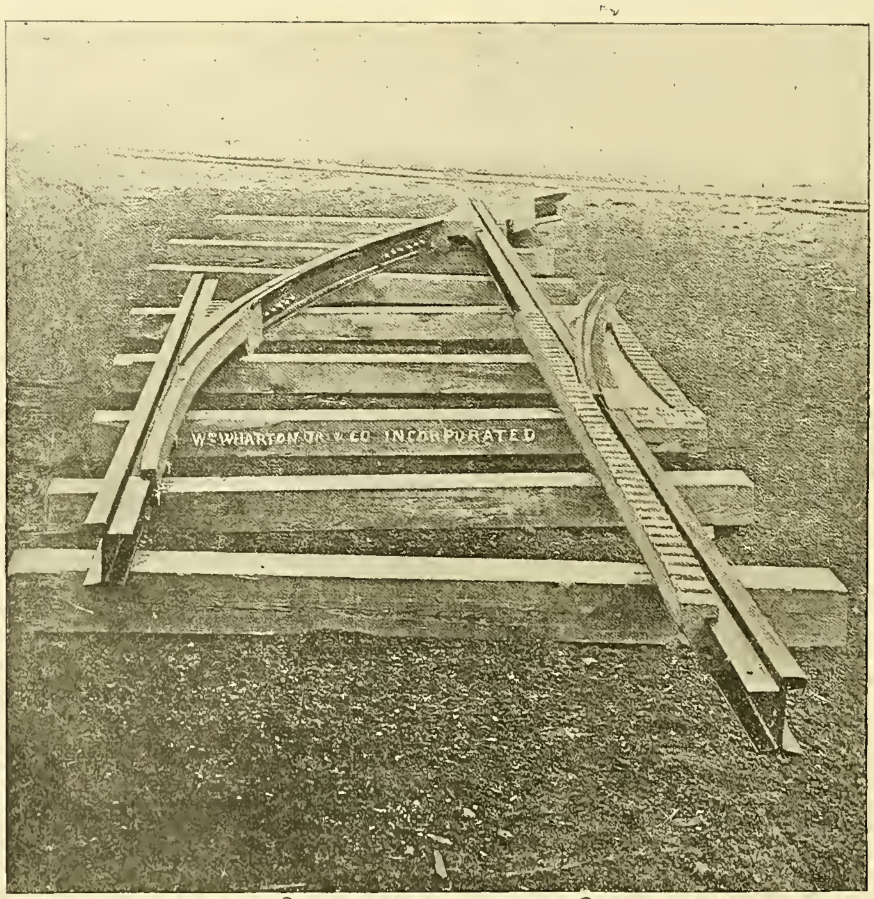
UNBROKEN MAIN LINE SWITCH.

The accompanying illustrations show the construction of the Wharton unbroken main line switch, mate and frog. Fig 1 represents the switch in the street with the main line clear. Fig 2 shows the switch set for the curve with six inch girder rail; ordinarily the track is cut in two places to admit the switch mate and frog, so that six joints are introduced, and there is a constant danger that they may get out of level. In addition to bumping over these joints, every car traveling on the straight track, is shaken in going on to the tongue of the switch and in jumping over the gap in the frog. Rolling stock is thereby caused to deteriorate, power is wasted, while the switch, mate and frog are rapidly worn out.

With the unbroken main line switch shown in the cuts the straight track is not cut for either switch, mate or frog. These pieces are attached to the rail by bolts passing through the stem of the rail, and the only movable part, viz, the tongue rail of the switch, is, when not in use, thrown entirely off the head of the track rail, giving an absolutely unbroken through line.

It is not intended that the unbroken main line switch shall take the place of standard switches at points where as many or nearly as many cars take the curve as continue on the straight track. Under this condition, the usual style of switch, mate and frog, must be used, but where only an occasional car is to use the switch, or where the switch is called into use only at the beginning and end of a day, or when some emergency arises, there is no reason, if it can be prevented, that all the cars that use the main line should bump over a broken track. To obviate this necessity the Wharton switch was designed, and it has given entire satisfaction where it has been in use.

In double track street railways, the unbroken main line switch is particularly advantageous in crossovers put in as safeguards against the block-



WHARTON UNBROKEN MAIN LINE SWITCH—SET FOR THE CURVE.

ing of cars by parades, fires and accidents, and in single track lines, in curves connecting with cross lines, for the same purpose; such crossovers and curves being aptly called "emergency crossovers" and "emergency switches." Such crossovers are also advantageous for the operation of short-trippers to churches and places of amusement. The switch is also most advantageous in branch-off curves leading into car-houses, the switches of which are only used once or twice a day for handling cars from storage tracks. This switch is manufactured by William Wharton Jr. & Co. of Philadelphia.

*This paper was reprinted in full in the STREET RAILWAY GAZETTE of September 23, 1893.

ON TO WASHINGTON.

The meeting of the National Electric Light Association which convenes in Washington February 27 promises to be the largest meeting ever held.

Special excursion rate on the certificate plan has been authorized, and for the accommodation of those attending from Chicago and the Northwest a special sleeping car has been arranged for, to leave Chicago Sunday morning, February 25, to run through to Washington via the popular Big Four and the picturesque Chesapeake and Ohio railways.

This is the only line from the West with *electrically lighted trains* and through dining cars. All trains are also vestibuled and steam heated.

This ought to be made the largest solid delegation the West has ever sent to the national convention. The Chicago party will be joined at Indianapolis by the St. Louis and Peoria contingent and at Cincinnati by the Queen City delegation and parties from the South and Southwest. For space in sleeping car from Chicago delegates should address J. C. Tucker, Gen'l Nor. Pass. Agt. "Big 4," 234 Clark street, Chicago.

Storage Battery Suit.—The Brush Electric Company and the Consolidated Electric Storage Company, as co-complainants, have sued the Electric Storage Battery Company and W. W. Gibbs, president, manufacturers of the Chloride Accumulator, for infringement, in the United States Circuit Court for the district of New Jersey. The suit is brought on the Brush storage battery patents, recently sustained by the United States Circuit Court of Appeals. The motion for preliminary injunction will be heard before Judge Green at Trenton, on the 20th inst.

FINANCIAL DEPARTMENT.

Financial Notes.

The Illinois Steel Company, at its annual meeting in Chicago last Wednesday, elected the following directors: H. H. Porter, Nathaniel Thayer, Francis Bartlett, Morgan Rotch, Marshall Field, A. J. Forbes-Leith, Norman Williams, J. C. Hinton, J. C. Morse, W. R. Stirling, Robert Forsyth, Francis Hinton; executive committee, Norman Williams, J. C. Morse, W. R. Stirling, Robert Forsyth, Francis Hinton; officers, president, J. C. Morse: first vice-president, W. R. Stirling; second vice-president, Robert Forsyth; secretary and treasurer, H. A. Gray. H. S. Smith, who has been manager and superintendent of the Joliet Iron and Steel Company from its organization twenty-two years ago to the consolidation in 1889, retired from the directory. He will be made consulting engineer. Francis Hinton, who succeeds Mr. Smith on the directory and on the executive committee, is the manager of the Bay View Mills at Milwaukee. J. C. Stirling declined re-election as treasurer, and the offices of secretary and treasurer were consolidated. An analysis of the balance sheet shows that at the close of the year the quick assets, consisting of cash, materials, and supplies on hand, and bills and accounts receivable in excess of bills and accounts payable and accrued interest, amounted to $8,698,320. To this amount should be added the salable securities owned by the company (not including railroad stocks and bonds)—viz.: $3,364,434, making a total of $12,062,755 of convertible assets, being equal to 91.38 per cent. of the amount of bonded debt outstanding in addition to its five plants and its railway securities.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn Street, Chicogo, said yesterday: "Our local market has been largely devoted to specialties and the cables, quite a little neglected until the last day or so, now show considerable demand for account stock, which was sold when the general market was influenced by a fall in Diamond Match of 20 points. The bears do not find as much stock as they expected and we consequently have higher prices as the result. There is evidently a good short interest in West Chicago, and we look for higher prices in the near future. In Philadephia the dullness of the general market has of course extended through all the traction stocks. On the decline to 14 most of the Baltimore traction that was in weak hands was shaken out and that stock is very steady to-day at 15¼ sales and bid. Metropolitan sold at 101 and Philadelphia 92½ bid, offered 93½ without sales; Electric sold at 49 and People's at about 38½; People's 4s sold at 84½ and Newark Passenger 5s, 92⅝. There seems to be an entire absence on both sides."

Boston, Mass.—The West End Street Railway Co. has sold $2,000,000 20-year 4½ per cent. gold bonds to a syndicate of Boston bankers. Receipts for these bonds are selling at 94 and interest. The bonds will be dated March 1.

Tonawanda, N. Y.—Creditors have seized the cars of the Tonawanda street railroad, operating in the village of North Tonawanda, for debt and are now offering them for sale. The road has never proved a paying investment.

Nashua, N. H.—A controlling interest in the Nashua Street Railway Company has been purchased by Boston capitalists. G. H. Knowles, president and general manager has resigned and has been succeeded by John A. Fisher.

Kansas City Cable Earnings.—During January the gross earnings of the Kansas City Cable Railway Company were $32,655, and operating expenses $23,787; net $8,868.

NEWS OF THE WEEK.

Medina, N. Y.—The business men's association has been considering the project of building an electric railway from Batavia to the lake. It is estimated that the road complete with equipment would cost $600,000, and the company wants Medina residents to take $100,000 worth of stock.

Detroit, Mich.—Some of the arbitrators have been chosen to settle the differences between the Detroit Citizens' Street Railway Company and its employes concerning the reduction of 10 per cent. in the latter's wages. One of the arbitrators selected declined to act.

Harrisburg, Pa.—As soon as the weather will permit the East Harrisburg Passenger Railway Company will begin the rebuilding of the Third street line north of Reily; the Cameron street line, between Hanover and Market, and the Reily street line.

Cleveland, O.—The last pole for the Cleveland and Berea electric railway is in place, and it is expected the road will be in operation by April 1. The power house will be located near the village of Berea. Cars will run every half hour, and a large traffic is expected.

Rochester, N. Y.—It is reported that the Rochester Railway Company has secured a lease of the Rochester Electric Railway Company's property for a period of twenty-five years at an annual rental of 10 per cent. on the capital stock of the latter corporation, which would be equal to $20,000.

Washington, D. C.—The commissioners have returned to the House Committee on the district bill No. 2,373, authorizing the Washington, Alexander and Mount Vernon Electric Railway Company to construct a railroad in the District of Columbia.

Indianapolis, Ind.—Another attempt has been made to wreck a car on the Irvington line. A tie was placed on the track, and the car struck it. The car was badly damaged, but the employes in charge were not injured.

Chicago, Ill.—The South Side Rapid Transit Company has reduced the wages of all its ticket sellers, ticket takers and trainmen as the decrease in traffic on the line necessitated substantial reduction in operating expenses.

Worcester, Mass.—The Worcester Traction Company has elected the following officers: President, Charles B. Pratt; treasurer, A. H. Stone; secretary, T. C. Barr; assistant secretary, A. H. Stone.

Chicago, Ill.—A rumor has been in circulation that the Lake street line of the West Chicago Street Railroad Company was to be equipped with an electric system but the report has been denied.

Bridgeport, Conn.—The strike is a thing of the past. Cars have been running without interference, but because of public sympathy with the strikers the patronage has not been large.

Omaha, Neb.—The East Omaha Motor Railway Company has commenced work on a double track road to be constructed from Sixteenth street, Omaha, to the bridge.

PERSONAL.

Allen R. Foote of the National Statistical Association of Washington, D. C., writes us to say that he will be glad to be of service to any delegates to the National Electric Light Convention who may care to write to him to secure hotel accommodations or to arrange for printing or other service in advance of their arrival.

Prof. E. J. Houston has resigned his position in the Boys' Central High School of Philadelphia and will form a partnership with A. E. Kennelly, chief electrician of the Edison laboratory, to be known as Houston & Kennelly. The headquarters of the firm will be in Philadelphia, and it will engage in expert work.

G. E. Pratt, formerly contracting agent for the Lamokin Car Works, will hereafter represent the Jackson & Sharp Company, the proprietors of the Delaware Car Works. This company has recently added to its extensive business of steam railroad car building that of street car construction.

Prof. F. B. Badt has severed his connection with the Chicago office of the General Electric Company.

H. R. Woodward of Peoria, formerly President of the Central Railway Company died on February 9.

S. Dana Greene of the General Electric Company was a Chicago visitor this week.

TRADE NOTES.

The Walker Manufacturing Company is well pleased with the outlook for spring business. The fact that an immense amount of capital is locked up awaiting investment, that a number of new roads are to be constructed, and that renewals on a large proportion of electric roads throughout the country will be necessary, lead the company to expect plenty of business. The amount of business already brought to the office of the Walker Manufacturing Company, before a single machine has been offered for sale, is a gratifying evidence of the confidence displayed by railroad men in the ability of the company to furnish first class dynamos and motors in every detail of construction. Within the last two weeks, the working force in the electrical department has been considerably augmented in view of the large amount of business now under consideration. In two instances arrangements for heavy installations are nearly complete, and preliminary work on these will doubtless be commenced within a very short time. It is the intention to hurry all work forward with the utmost dispatch consistent with thorough attention to mechanical detail, and to this end the company is now preparing to materially increase its present forces. Some of the improvements suggested are carried out, while in nowise a radical departure from existing types, have been found to effectually increase the output of the machines, and give additional economy in construction. The armature winding of the motor, possesses certain valuable innovations and improvements, tests upon it having recently shown the most gratifying results.

The Charles Munson Belting Co. has received an order for 141 feet of 60-inch three-ply Eagle Belt from the American Wire Company of Cleveland, O. It is very gratifying to the company to receive the order, as it is said to have come on merit. The company put in two 44-inch three-ply belts four years ago and they have given splendid satisfaction. They have never given the least trouble and have transmitted full horse power ever since they were first placed on pulleys. These belts travel 7,000 feet a minute and are subject to very severe strains. They are still in excellent condition and will last the American Wire Company for a long while to come.

Messrs. P. H. Carey and E. J. Shrader have been appointed western selling agents for the Phœnix Iron Works, of Meadville, Pa. This company manufactures the Dick & Church high speed engines, a number of which are in use in Chicago and vicinity. Mr. Shrader is a mechanical engineer of wide experience and excellent ability. He was formerly assistant superintendent of the Union Iron Works of San Francisco, and more recently chief of the mining department in the Cincinnati offices of the General Electric Company. Mr. Carey is well known to street railway and electrical men as a member of the firm of Harrison & Carey. The office of the Phœnix Iron Works will be located as heretofore at 519 the Rookery, Chicago.

The Berlin Iron Bridge Company of East Berlin, Conn., believes in attractive advertising and its announcements each week in the Street Railway Gazette are interesting and instructive. Comparatively few advertisers appreciate the importance and necessity of looking after their advertisements closely, and the example set by the Berlin Iron Bridge Company is a good one to follow.

The Standard Paint Company reports that the demand for P. & B. motor cloth and P. & B. insulating tape and compound is steadily increasing. Street railway companies find these goods most desirable, especially at the present time, and the success which the Standard Paint Company has attained in this department is well deserved.

The Weston Electrical Instrument Company of Newark, N. J., is meeting with great success in the street railway field with its standard measuring instruments. There is nothing superior in the market, and there certainly is no one who appreciates the wants of the trade and understands the manufacture of such instruments better than Mr. Edward Weston.

The Chicago Electric Truck Company, of this city, reports the outlook as very encouraging. Their salesmen report that the street railway men interviewed by them are all favorably impressed with the principles and construction of the new trucks manufactured by this company. Inquiries already received indicate a good business this season.

The Western Telephone Construction Company, of Chicago has lately made a trial of its new magneto telephone between Chicago and New York, and reports that the instruments worked quite as well as the regular long distance instruments of the Bell Telephone Co.

The Okonite Company is doing a large business notwithstanding the dull times, and the merits of Okonite insulation are deservedly appreciated. Capt. Candee, who recently returned from abroad, reports that the use of Okonite in England and on the Continent is growing rapidly.

The J. G. Brill Company of Philadelphia is doing a large business at the present time notwithstanding the strained condition of business throughout the country. Every department of the extensive car works is exceedingly busy with orders obtained at good prices.

The Consolidated Electric Storage Company of 926 Drexel Building, Philadelphia, have just issued a new pamphlet containing information of value regarding storage batteries as an auxiliary in power stations.

Recent Truck Sales.—Among recent orders received by P. S. Bemis Jr. for the Peckham truck are 50 for Cincinnati and 5 for Dayton, O. These trucks have been adopted as the standard by the Cincinnati Street Railway Company.

J. W. Fowler Car Company's new works at Elizabethport, N. J., are in excellent shape for business and a number of good orders are in hand. The company reports the outlook as very promising.

RECORD OF STREET RAILWAY PATENTS.

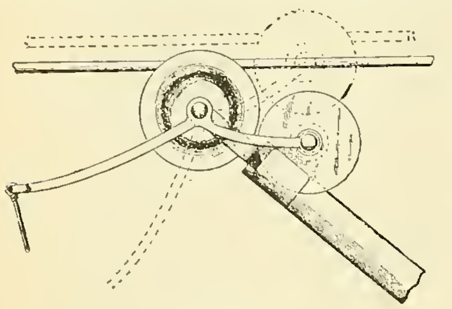
Patents Issued January 30, 1894.

513,546. Car Wheel. Nathan Washburn, Boston, Mass. Filed January 28, 1893.

This car wheel has a composite structure and cousists of a cast iron center with a chilled rim or tread, which is converted into steel.

513,566. Trolley Wire Finder. Edward Gale, Peoria, Ill. Filed November 21, 1892.

The construction of this trolley will be readily understood from the illustration. The second claim of the patent reads as follows: The combination of the trolley pole and wheel, with a guard or finder, mounted on the



NO. 513,566.

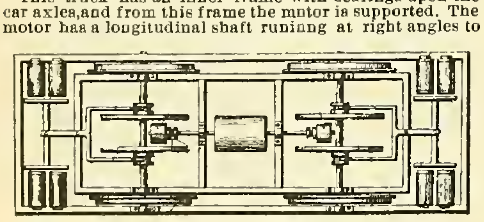
pole near the wheel, said guard having mounted thereon a revoluble sleeve extending laterally beyond the vertical planes of the sides of the wheels, and being movable vertically with relation to the wheel. (See illustration.)

513,598. Starter and Propeller for Electric Cars Ernest Schmitz and James Mendenhall, Chicago, Ill. Filed April 4, 1893.

This is a starting and propelling mechanism for railroad vehicles, comprising a number of thrust bars actuated from a driving axle through the medium of a rock shaft, and having alternate rising and falling and advancing and receding movements. These bars operate by contact at their lower ends with the two track rails, upon which the vehicle rides.

513,599. Gearing for Electric Locomotives. Geo. W. Swartz, Florence, Ala. Filed October 6, 1892.

This truck has an inner frame with bearings upon the car axles,and from this frame the motor is supported. The motor has a longitudinal shaft running at right angles to



NO. 513,599.

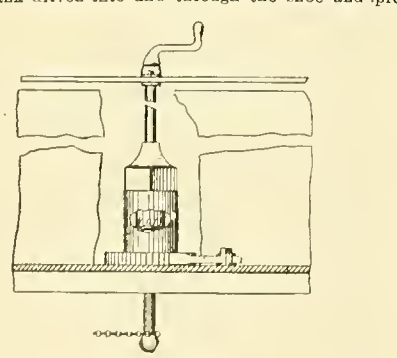
the car axles and extended at both ends. Friction wheels are provided on the ends of this shaft, which are brought into contact with friction upon the car axle by means of the electro magnets, shown in the cut. (See illustration.)

513.611. Dynamo Brush. Wilfred H. Fleming, Bayonne, N. J. Filed November 13, 1893.

This brush consists of successive layers of wire gauze put together under high pressure. The wires are disposed diagonally to the length of the brush.

513,656. Brake Shoe. Charles T. Schoen, Allegheny, Pa. Filed October 28, 1893.

This invention consists of the combination of a clip having a shank driven into and through the shoe and .pro-



NO. 513,670.

vided with notches into which the metal of the shoe is forced, thus effecting the union of the shoe and clip.

513,670. Car Brake. Herbert E. Collett, Chelsea, Mass., assignor of three-fourths to Herbert E. Collett, Jr., Lynn, Mass., and Charles W. Armstrong and James Howard Bing, Philadelphia, Pa. Filed July 24, 1893.

This has a sectional rotary brake staff in combination with a rachet fixed to the lower section of the staff, and so arranged as to form a clutch. A companion clutch member is rigidly fixed to the upper section of the staff, while a cap incloses the clutch mechanism and is attached to the ratchet. (See illustration).

513,672. Car Brake. Willard Curtiss, Grand Rapids, Mich., assignor of one-half to William T. Powers and William H. Powers, same place. Filed September 19, 1893.

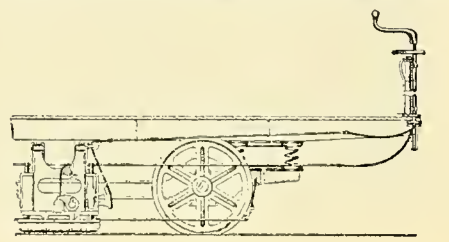
The first claim of this patent reads as follows: In combination with a car, and slot rails, a laterally and vertically movable bar having a brake shoe adapted to engage said slot rails, spring to maintain said bar in mid-position laterally, and means for vertically moving said bar. (See illustration.)

513,701. Wheel Fender or Guard for Cars. Geo. Blakistone, Baltimore, Md. Filed June 29, 1893.

This comprises a safety net or flexible sheet, located under and behind the front of the car body and attached at its rear end to a suitable part of the car. A propelling device is attached at one end to the front part of the car and at the other end to the safety net. The safety device is therefore pulled along instead of being pushed, as is common with ordinary fenders.

513,702. Wheel Fender for Cars. Geo. Blakistone, Baltimore, Md. Filed July 18, 1893.

This is a wheel fender or guard. First claim of this patent reads as follows: For a car which consists essentially of an apron of flexible material attached at its inner end to the car body or truck, and at the outer end provided



NO. 513,672.

with a bar, combined with supporting rods attached to the front end of the platform and springs to yieldingly keep the said bar in its lowest position or in contact with the track rails.

513,703. Safety Fender or Trap. George Blakistone, Baltimore, Md. Filed October 20, 1893.

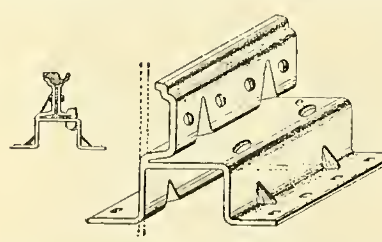
The first claim of this patent reads as follows: A safety trap for a car constructed of flexible material attached at its rear edge to a suitable part of the car and at its front edge to the rear end of the drawing rods, whose outer ends project forward and are suitably fastened to the front of the car, means for holding the trap suspended and an automatic tripping device to release the trap, actuated by an obstruction on the track

513,711. Railroad Rail Joint. Arthur J. Moxham, Johnstown, Pa. Filed February 20, 1890

This rail joint consists of the following named elements in combination: A base plate supported by two vertical sides, provided with two angular feet, a brace on one side attached to the ends of abutting rails and a separate splice bar acting as a washer for said bolts. (See illustration.)

513,712. Combined Chair and Cross Tie for Railroad Rails in Track. Arthur J. Moxham, Johnstown, Pa. Filed December 5, 1890.

This is a metallic cross tie for securing railroad rails, having a rail chair struck up therefrom, forming a rail



NO. 513,711.

seat, the metal of the tie being forced out laterally in the operation of striking up the chair. (See illustration.)

513,777. Electric Connection for Railway Rails. Alfred Green, Rochester, N. Y., assignor of one-half to William Rosbrough, same place. Filed September 30, 1893.

This consists of the combination with track rails of the main conductor and wire connections for joining it to the rails. These connections being provided with stem and slots and the wire being removably fixed in the slots. The wire also extends and is supported beyond the ends of one or more rails in each direction, so that a rail may be disconnected and removed from the track without interrupting the circuit.

513 835. Car Truck. John B. Smithman, Oil City, Pa. Filed May 29, 1893.

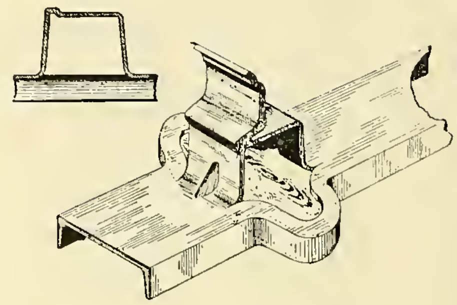
This consists of the combination of a pair of swiveled trucks, bell crank levers, and connecting rods extending between the levers and trucks, and a transversely movable axle to which the bell crank levers are pivoted. (See illustration.)

513,846. Trolley-Pole Stand. Gustaf Valley, Cleveland, Ohio, assignor to the Steel Motor Company, same place. Filed May 6, 1893.

This comprises a base plate for attaching to the car top a trolley pole plate with a socket for the pole, links engaging the four corners of the trolley pole plate for suspending the same. Two of these links engaging fixed members of the base plate, the other two engaging a cross head which is controlled by a half elliptic spring. (See illustration).

513,847. Trolley-Pole Stand. Gustaf Valley, Cleveland, Ohio, assignor to the Steel Motor Company, same place. Filed May 11, 1893.

This is substantially the same as the preceding device, except that the cross head is controlled by a coiled spring



NO. 513,712.

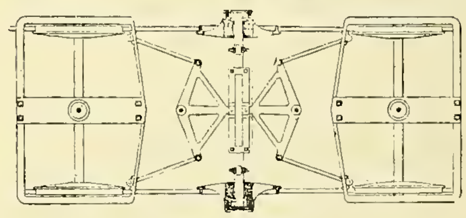
placed upon the inside of the cross head instead of being located as the semi-elliptic spring.

513,883. Switch-Operating Device. Handley P. Cogswell, Brooklyn, N. Y. Filed May 2, 1893.

Tilting levers are attached to the car arranged parallel with each other, and these carry at their extremities fixed shoes, which are brought into contact with a projection in the track for operating the switch. Shifting levers are provided so that the motor man or car driver may operate the switch at will.

513,888. Street Railway Brush. Philip A. Coonradt and Arthur R. Coonradt, Rockford, Ill. Filed September 8, 1893.

A brush is provided for each rail and a spring bar for each brush, and an adjustable connection with a part of



NO. 513,835.

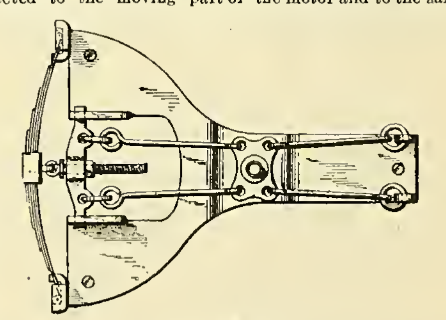
the truck. These brushes are so connected with suitable mechanism that they may be operated by the car driver.

513,894. Sectional Electric Railway. Geo. W. Demmick, Lynn, Mass., assignor of one-half to Henry Robinson, Geo. Fuller, John S. Earl and Knott P. Martin, same place. Filed July 20, 1893.

Bars are laid longitudinally and supporting posts are held normally raised by springs, while levers are connected with these posts and suitable mechanism is placed between these levers and the feeder wire, wherebyan electrical circuit is established when desired.

513,895. Power Transmitting Mechanism for Electric Locomotives. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed April 17, 1891.

The first claim of this patent reads as follows: The combination with an electric motor and a shaft or wheel to be driven, of an electric speed reducing mechanism connected to the moving part of the motor and to the said



NO. 513,846.

shaft or wheel, and consisting of two parts in close proximity to and adapted to electrically attract or repel each other, and a friction clutch also connected to the moving part of the motor, and to the said shaft or wheel.

513,950. Insulated Rail Chair. Louis McCarthy, Boston, Mass. Filed September 27, 1892.

A layer of insulating material is placed over the bed piece and upon this a top plate is placed and to this latter cheekpieces are attached for holding rail. Wherever bolts pass through both metallic plates insulating bushings are used.

STREET RAILWAY GAZETTE

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VOL. X. CHICAGO, FEBRUARY 24, 1894. No. 8.

CONTENTS.

Electric Light Convention. The annual convention of the National Electric Light Association will be held Tuesday, Wednesday and Thursday of next week in Washington, D. C. A large attendance is expected and a meeting of more than ordinary interest is anticipated. We present the programme elsewhere in this issue, and it is noticeable that several subjects of importance to electric street railway men will be discussed. A report of the proceedings in so far as they relate to street railway work, will be published in the next issue of the STREET RAILWAY GAZETTE.

Rails and Rail Bonds. The practice which the Lynn & Boston Railroad Company follows in bonding rails is explained somewhat at length in a letter from Mr. Maurice Hoopes published elsewhere in this issue. The communication is designed to correct certain errors in a report of a recent meeting of the Massachusetts Street Railway Association, and we trust that all our readers who perused the statements attributed to Mr. Hoopes in a former issue will note his letter of correction. Among other things it is to be observed that Mr. Hoopes did not incline to the belief that the use of copper for bonds was questionable, which struck us as singular at that time.

Car Wiring System. We present elsewhere in this issue a diagram of the connections between the controllers and the motors of an electric car equipped with the G. E. 800 motors and type K controllers of the General Electric Company. We have also supplemented this with a diagram showing the 10 combinations that are made by the 10 positions of the handle of the controller. By a careful study of these diagrams in connection with an actual car equipment of this kind, it will be possible to trace out the various combinations upon which depends the speed of the car. This method of control has been highly spoken of by street railway managers who have adopted it, and for this reason the diagram will be of especial interest.

The Trolley in Philadelphia. It is astonishing to note the popularity of the trolley system in Philadelphia. In his annual report Chief Walker of the Electrical Bureau makes the remarkable statement that he does not know of a single line that has failed to apply for and to obtain the privilege of discarding horse power and of substituting electricity. He also meets the objections which have been made by local fault finders to the character of the construction of the roads now in operation by saying that these lines "are without doubt the best equipped overhead street railway systems in the country." It is possible that two or three cities may feel disposed to dispute this claim with Philadnlphia, for several municipalities jealously maintain the superiority of their electric railway systems.

Vestibule Law in Ohio. There is every reason to believe that the vestibule law in Ohio will be thoroughly tested. Officers of Toledo street railway companies have been indicted for their alleged failure to equip cars with proper vestibules. The companies provided storm fronts of canvas and glass, but the grand jury did not consider them suitable vestibules as contemplated by the law. The matter has been agitated in Toledo for months and that indictments were returned has occasioned no surprise. It is assumed that the constitutionality of the law will be attacked, and a decision that will serve as a precedent is to be expected in Ohio rather than in Minnesota, as street railway companies in the latter state are now conforming strictly to the letter and spirit of the vestibule law. Municipal courts in Minneapolis aod St. Paul have sustained the law but their judgments are not significant, and in view of the general conformity to the law it is questionable if the higher courts will be asked to to pass upon it.

English and American Street Railways. We present elsewhere in this issue a table of statistics for 1893, relating to the tramways of the United Kingdom which are for the most part operated by horses, although the question of equipping many of them for electric cars has been very seriously discussed during the last few months. It is interesting to compare these figures with those contained in the recent report of the Massachusetts railroad commissioners, although the conditions are so entirely different that deductions from the comparisons are scarcely warranted. The return from the capital invested in the tramways of the United Kingdom in 1893 was but 5½ per cent, without any allowance for track, plant and stock depreciation. During the same period in Massachusetts the percentage of cash dividends, to the aggregate capitalization of the street railway companies, was 6.63, although, as we understand it, some allowance was made for depreciation. This, by way of contrast, is a fine showing for the Bay State companies, although the railroad commissioners do not find the figures encouraging. The patronage which street railways receive in Great Britian is small in comparison with that which roads in the United States enjoy. Although the combined population of New York and Massachusetts is not over one-third that of the United Kingdom, still the surface street railways of the two streets named carried in 1893 150 millions of passengers more than all the tramways of Great Britain. According to the figures each resident of the two states rides between sixty and seventy times on a street car every year, while in Great Britain each inhabitant is to be credited with about sixteen rides annually. The greater patronage of the American roads is partially due to the better service that they give, but other causes are operative, among which perhaps is the fact that there is, or was, last year, at least, more money available for gratifying the universal desire to escape walking.

Street Railway Engineers. We take pleasure in presenting this week as the most prominent feature of the STREET RAILWAY GAZETTE the portraits of twenty-eight prominent street railway engineers, accompanied by sketches of their professional work. Although our record is by no means as complete as we would like to have made it, we think it shows in a remarkable degree some of the characteristics of the men who are now devoting their best energies to the construction of street railways and to the general engineering problems involved in the construction, operation and maintenance of street railway plants. It will be noticed that most of the men engaged in the business are, comparatively speaking, very young, the majority of them being between 25 and 35 years of age; that many of them before taking up the street railway business had obtained valuable experience in the electric lighting field; that not a few are engineers in the commercial sense as well as technically; and that the ranks of the profession contain both those who have been thoroughly educated in the engineering schools and those who have succeeded by other methods in fitting themselves for the work they have undertaken. We do not wish to boast about the high grade of engineering talent now obtainable by those who set out to construct a street railway plant of the most modern type, but we think that it is safe to hazard the statement that no other profession of the same age can show a greater proportion of well trained, well educated and trustworthy engineers who have made for themselves such admirable records in the few years they have been engaged in such a rapidly expanding business. It must be remembered too, that the ranks of electrical and street railway engineers have had comparatively few accessions from the apparently overcrowded ranks of the civil, mechanical and mining engineers. Engineers in these lines for many years looked with scorn upon their fellow engineers who thought they could see in electrical engineering a field sufficiently broad to call for the exercise of anything more than the most ordinary ability. Even now there are those who think that nine-tenths of electric street railway engineering is nothing more than the work of the average civil and mechanical engineer. We grant that a knowledge of the principles of mechanical and civil engineering is of the utmost value to and is indeed a large part of the equipment of the successful electrical engineer; but this knowledge must be so interwoven with a thorough knowledge of the principles of electrical engineering, that the expert trained in this field has a tremendous advantage over his competitor who is not so equipped, however thoroughly he may be prepared to meet the difficulties that arise in the conduct of either a mechanical or a civil engineering business. We bespeak for the record we have presented, the careful consideration of those who contemplate the construction of street railways or the further extension of existing lines. It will always be found to be a "penny wise and pound foolish" policy that dispenses with the advice of a trained engineer in the consideration of problems involving either the construction, operation or maintenance of a street railway plant.

RAILS AND RAILBONDS.

The following letter from Maurice Hoopes of the Lynn & Boston Railroad Company of Lynn corrects several errors which appeared in a recent report of the February meeting of the Massachusetts Street Railway Association. The stenographer who reported the remarks of Mr. Hoopes evidently was obliged to guess at his notes, for he attributed to the latter several statements that were very wide of the mark.

To the Editor of the Street Railway Gazette:

I have just read your report of the proceedings of the February meeting of the Massachusetts Street Railway Association, including, among other things, my remarks on the subject of track wiring. Although I appreciate the fact that it is no easy task to report such an informal talk as was this, word for word, I cannot be satisfied to go on record as saying the things you credit me with.

The parts of your article that I take exception to are rather numerous, and to correct all of them would take too much space, but I shall note what I consider the most important errors. You speak of "channel rails," in a number of places, probably meaning "channel pins." You also represent me as stating that we use hard drawn copper wire for bonds, whereas I said *soft* drawn copper wire. In this connection, I would say that engineers of the General Electric Company have told me that their experience had been that hard copper wire stood the vibrations of armatures better than soft, and crystallized less easily. In view of this, it might show the same result in rail bonds, but it would be next to impossible to put it in place without giving it the scratches that result in breaks, always, with such wire, especially if it were very hard. Again, it would not be soft enough for channel pins.

You make me say that "it was a question whether copper should be discarded for something else." I did say that it is a question whether the *tinning* of copper avails much. Copper is certainly the one conductor to use for track wiring, unless the particular conditions forbid its use.

I cannot account for the sentence, "It was customary to drive a drift pin into the holes so that the wire would slip in easily." I certainly said nothing of this kind. Our holes are simply drilled, and have the corners removed with a reamer, to avoid cutting the pin.

Regarding bonding of special work I said that our practice was to bridge this over with heavy insulated wire of sufficient quantity to carry the whole current, with a liberal reserve, so that the parting of one wire would not throw enough current into the others to warm them. In addition to this we run a No. 0 working supplementary through, tapping each piece of special work to it. We make no attempt to bond the joints of the special work. I put emphasis on the word *dry*, as modifying sand, when I said that wires were safer in sand than in earth.

You rather exaggerate my supposed case when you speak of 150, on one side, and 450 volts on the other side of a turnout, but report me correctly in stating that we have found cases where we were losing 40 or 50 volts across a turnout. I would state, however, that these cases were always on unimportant outlying lines of tram rail. The trouble, of course, was a completely open track circuit.

In answering Mr. Weeks' question, I did say that I did not think it necessary to tap from tracks to track feeders at every pole, but I certainly did not say that I considered overhead track feeders unnecessary. I quite agreed with him that they are necessary in almost all cases.

In your editorial you write that "one speaker inclined to the belief that the use of copper for bonds was questionable, for the reason that the metal was so soft that it was likely to be injured." I shall assume that I am correct in the belief that I am the speaker referred to. One might be misled by your comment, thinking that the reference was to the whole bond. I have stated that I consider copper the best metal for track wires, and this applies to the wire part of bonds. I only spoke of copper as being too soft for use as a rivet, as is necessary in one-piece bonds, and stated that in properly made channel pins the stress is one of compression only, and that there is not the opportunity to loosen that existed with the former. In this respect, Mr. Brown's sleeve pin has the decided advantage, as it is sweated on the wire and brings no stress on the copper. In conclusion I wish to state that I do not write in the spirit of criticism but merely in the desire to set the company I represent, as well as myself, straight in the opinions of your readers.

MAURICE HOOPES.

Lynn, February 15, 1894.

THE THREE-WIRE SYSTEM FOR SINGLE TRACK ELECTRIC RAILWAYS.

To the editors of the STREET RAILWAY GAZETTE:—

In Mr. W. Nelson Smith's third article on "Electrolytic effects in street railway return circuits; their cause and prevention," your volume 10, No. 7, page 79, February 17, 1894, appears the following statement with regard to the application of the three-wire system to electric street railway work:

"The application of the system to electric railways requires, in the first place, a double-track road."

The three-wire system is also equally applicable to a single-track road with turnouts provided two trolley wires be strung. The cars will then run in one direction on the positive and return on the negative trolley wire, the rails being neutral. As cars will pass only at turnouts there is no interference and the switching arrangements are comparatively simple.

J. STANFORD BROWN.

New York, February 19, 1894

MR. PREECE'S OPINION OF AMERICAN ELECTRIC RAILWAYS.

W. H. Preece recently read before the Institution of Electrical Engineers of London a paper on "Notes of a trip to the United States and to Chicago, 1893." The paper gives the result of the writer's rapid survey of the American electrical field, and institutes comparisons with existing English practice. He refers somewhat at length to electric railways and notes the marvelous progress that had been made since his previous visit in 1884. After mentioning the number of cars in operation and the miles of lines of electric roads, he makes the curious statement that "the capital embarked is $13,000,000." Just how much money is invested in electric railway enterprises cannot be accurately stated, but Mr. Preece's amount must be multiplied by a factor of considerable size. Of Chicago electric roads he says: "There are two very fine specimens of electric railways in Chicago. One, the Intramural railway, conveying visitors to and from different parts of the grounds of the World's Fair, working very well, carrying an immense number of people, and financially very successful. It is not a trolley line, but it has a third rail acting as the main conductor. The other is the Chicago North Shore Street Railway, running to Evanston." The company which operates the Intramural road would probably not be as confident regarding its financial success. Mr. Preece finds fault with overhead wires in this way:

The trolley wire alone is not unsightly, but when it is protected with three guard wires, as at Boston, and the same poles carry the feeders, it becomes hideous, and it is astonishing that the American community submit to it. Such a system is impossible in England. This trolley wire must be elastic, otherwise the trolley itself frequently jumps off and stops the car. Attempts have been made to improve the appearance of the road by using handsome central iron poles, with solid brackets on each side to carry the two trolley wires, but the want of elasticity has introduced evils. The trolley frequently comes off, and great sparking is evident.

In regard to the future Mr. Preece has this to say:

The feeling is pretty prevalent in the States that the conductors must eventually go underground. Experiments in this direction are being made in several directions, notably in Washington and Chicago. The trolley with its guard wires is really an abomination, and the disturbances created by insufficient return accommodation are annoying the telegraph and telephone interests, and alarming the gas and water companies. The future working must be metallic circuits and underground conduits. It is done in Buda-Pesth, and it has been partially done in Blackpool and in Rome. Other experiments are contemplated in England. No one can doubt that the future of electric railways is very bright. The South London Railway and the Mersey Dock Elevated Railways are examples of great successes in England, but it is in the States, where this form of locomotion has become a necessity, that we are sure to see a speedy and practical solution of the problem.

National Electric Light Convention.

The annual convention of the National Electric Light Association will be held in Washington, D. C. next Tuesday, Wednesday and Thursday. The headquarters of the association will be at the Ebbitt House. The programme is as follows:

TUESDAY, FEBRUARY 27.

Meeting of the executive committee at 9 A. M., Parlor 36, Ebbitt House.

Morning session, 10:30 o'clock—Grand Army Hall. Address: President E. A. Armstrong. Reports of committee; Legislation, C. H. Wilmerding; World's Fair, B. E. Sunny; Relation between Manufacturing and Central Station Companies, F. Nichols.

Afternoon session, 2 o'clock—Reports of committees, Data, H. M. Swetland; Finance, John A. Seeley; Underground Conduit and Conductors, M. J. Francisco; Rules for Safe Wiring, William J. Hammer; Paper by E. A. Leslie: "Impressions of a Central Station Man Abroad."

WEDNESDAY, FEBRUARY 28.

Morning session, 10 o'clock—Paper by J. H. Vail: "The Importance of Complete Metallic Circuits for Electric Railways." General discussion of the topics, Electrolytical Effects of Return Currents and Storage Batteries.

Afternoon session 2:30 o'clock—Paper by A. B. Herrick, "Development of Switchboards for Modern Central Stations." General discussion of the topics. "What is the most Economical Size for Arc Dynamos?" Charles R. Huntley, George A. Redman, E. F. Peck, G. H. Blaxter, H. H. Fairbanks; "Underground Circuits."—George W. Plympton, H. J. Smith, C. H. Wilmerding, M. J. Francisco, John A. Seeley; "How to Rate Arc Lamps."—James I. Ayer, C. F. Hesser, A. J. De Camp, E. W. Rollins, George R. Stetson M. A. Beal.

Evening session, 8 o'clock—Paper by T. C. Martin and L. Stieringer: "Electric Lighting at the World's Fair and Some of its Lessons." Illustrated with Stereopticon.

THURSDAY, MARCH 1.

Morning session, 10 o'clock—Paper by Charles F. Scott: "Polyphase Transmission." General discussion of the topics, "Arc Lights on Incandescent Circuits;" C.L. Edgar, L. B. Marks, J. T. Ridgway, W. S. Barstow, Thomas Spencer, Jno. C. Knight, Frederic Nicholls; "Meters vs. Flat Rates;" Charles E. Scott, J. D. Barth, W. J. Greene, J. J. Burleigh, J. Gynne, J. J. Moore; "The Alternating Motor;" Nikola Tesla and others.

Afternoon session, 2:30 o'clock—Executive session. Reports of secretary and treasurer and executive committee. Election of officers.

Motive Power of the Metropolitan L Road Chicago.

John Worthy, president of the Metropolitan West side Elevated Railroad Company of Chicago, recently made the following statement regarding the motive power to be used on the road:

"The company would like very much to use electricity, if it is demonstrated to be entirely practicable. Of course the people behind the road do not intend to make any mistake in the equipment of the line. It is intended to furnish rapid transit that will be rapid in fact as well as name. Two of the four tracks are to be devoted to express trains that will make no stops for the first two miles of the road, while the other two tracks will take in those first two miles with stations scattered all along the way. The trains from branch lines will run express on the main line in and out.

"That kind of service will require a very complete and reliable equipment. If the electricians can convince our engineers that their way of running trains is as reliable as steam, and within a reasonable cost for service, electricity will doubtless be put into operation on the entire road. If there is any question at all as to the feasibility of electricity, steam locomotives will be used. The first and imperative object is to furnish a high grade service for the patrons of the road, and that will be done.

"If electricity proves the right thing it will be a very interesting advance over the present method of operation for elevated roads. There will be no dirt, no smoke, comparatively little noise, and no cinders or ashes to distress passengers. We hope it will come up to the mark when the tests are made that will decide whether it is to be adopted or not. We will soon have to place orders for power apparatus of some sort.

Minneapolis, Minn.—A local paper states that a project is under consideration to connect Minneapolis and St. Paul by an elevated railway. It is said that it is proposed to use the Cook elevated electric railway system of which a model was shown in operation on a circular track in the Transportation Building at the World's Fair. The cost would be so great that no immediate step is expected

Tramway Statistics in the United Kingdom.

The following figures relating to tramways in England, Scotland, Ireland and Wales have recently been published:

Total number of tramways	153
Tramways belong to municipalities	35
Total length of lines (miles)	961
Total capital expenditure	£14,194,152
Total capital expenditure per mile	£14,700
Total capital expenditure on roads owned by municipal corporations	£11,335
Total capital expenditure on roads owned by companies	£16,032
Number of horses	30,225
Number of cars	4,098
Number of locomotives	563
Passengers carried during the year ending June 30, 1893	598,289,509
Gross receipts 1893	£3,606,095
Working expenses 1893	£2,837,446
Net receipts 1893	£768,649
Percentage without allowance for depreciation	5½

Standard Brake Shoe.

It has been suggested that street railway companies would make quite a material saving in the course of a year if they would adopt a standard brake shoe. The Sargent Company of Chicago recently sent us a blue print of a standard brake shoe for street railway service which is almost identical in measurement with the standard adopted by the M. C. B. Association for all railroads of the United States. The company writes as follows:

"The standard measurements for the head are determined for the face which fits the shoe alone, as the back must be made to fit any particular type of beam used. This pattern of shoe was adopted by the M. C. B. Association after much consideration of the question, and is undoubtedly as economical a method of using a detachable brake shoe as there is in service at the present time. The street railway companies could reduce the cost of their brake shoes very largely if they would insist upon having this pattern of shoe on all new trucks. Where but one pattern of shoe is used the storekeeper's task is considerably simplified, also that of the repair man. This pattern of shoe is coming very largely into use, and in order that all the railway companies interested may have the dimensions of the shoe, as generally used, at their disposal, we shall be pleased to mail the blue prints with full dimensions to all who send their address to us."

The Wallace Electric Company, of Chicago, has increased its capital stock from $2,000 to $25,000.

WIRING DIAGRAM OF THE G. E. 800 RAILWAY MOTOR.

The accompanying diagrams show the present methods of wiring a street car equipped with G. E. 800 motors and type K. controllers. As is the case with most diagrams of this kind the apparent complication is much greater then the actual. As a matter of fact a few hours' careful study of the diagrams will enable any intelligent man to understand quite fully the arrangement of this apparently interminable tangle of conductors. In the large diagram, Fig. I, a double motor equipment is shown connected to the binding posts

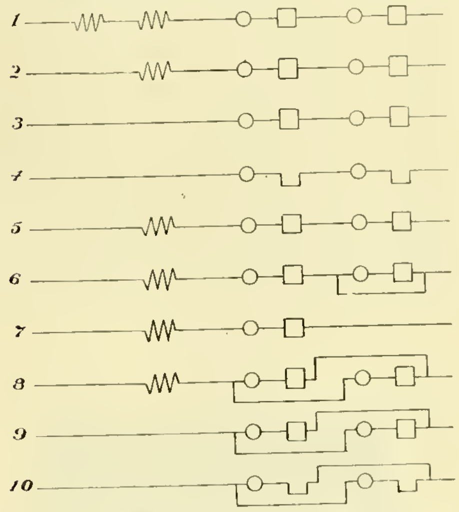


FIG. 2. CONNECTIONS OF THE G. E. 800 MOTORS.

at the bottom of the two controllers. Only one set of connections to the reversing switch, however, are shown and the same is true of the set of contact points along the side of the switch cylinder. The connections made through the contact plates of the cylinder itself may be traced in the developed plan shown in the middle of the diagram at the top. Here are shown the various combinations that will be made as the fixed contact points at the side of the cylinder move successively over the cylinder plates from the first to the tenth point. These ten positions are indicated by the numbers from 1 to 10 at the top of the cylinder.

If now we assume that the controller has been shifted to the first point of contact we can follow the path of the current through its circuitous path from the trolley wire through all of the resistances, the armature and full field of one motor and the armature and full field of the second motor, all in series, back to the contact that leads to the frame of the motor and so to the ground. This arrangement of motors and resistances is shown diagramatically at 1 in Fig. 2. Upon moving the controller cylinder to the second point as shown at 2 in Fig. 1 we can again trace the path of the current, which will be found the same as when upon the first point except that one section of the resistance has been cut out. This is diagramatically shown at 2 in Fig. 2. Each of the ten combinations as represented by the ten points on the controller may be taken up and traced out in a similar manner. These ten combinations will be found to be as shown in Fig. 2 and these may be summarized as follows:

1. Both motors in series; all resistance in.
2. Both motors in series; part resistance in.
3. Both motors in series; all resistance out.
4. Both motors in series using light field circuit.
5. Same as (2).
6. Same as (2) except that one motor is short-circuited.
7. One motor in series with part of resistance; second motor cut out.
8. Two motors in parallel; with part resistance in series.
9. Two motors in parallel; all resistance out.
10. Same as (9) except that the light field circuit is used.

These diagrams should be studied with a type K controller upon which to follow the connections.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Eighth Article.)

For the purpose of showing the lines of force, I bought for ten cents a small horseshoe magnet 2½ inches long. Laying this on its side on a table, I placed over it a piece of glass which had been varnished on one side and allowed to become perfectly dry. Upon this I sifted as evenly as possible some fine iron filings and then tapped the plate gently on the edges in order to permit the filings to arrange themselves. The beautiful curves

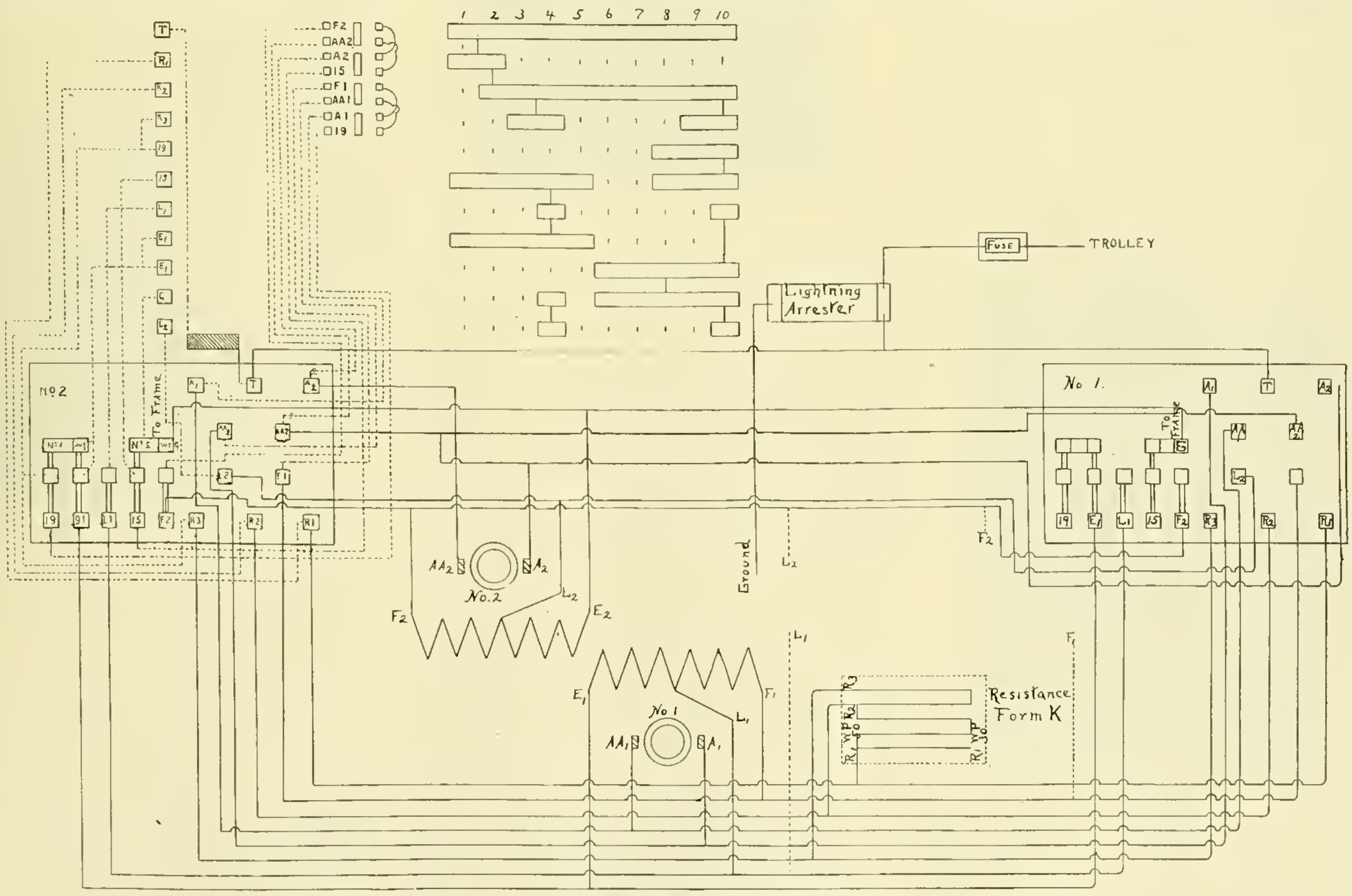


FIG. 1. WIRING DIAGRAM OF CAR EQUIPPED WITH G. E. 800 MOTORS AND TYPE K CONTROLLERS.

shown in Fig. 13 were the result. The glass was then carefully lifted from the magnet and heated over a gas flame. This softened the varnish so that the filings were stuck to the plate and when the varnish had hardened again were preserved for the making of this cut. Fig. 13 shows the lines of force emanating from this magnet when the armature or keeper is entirely removed. Fig. 14 shows the lines as they were when the armature was removed about ½ inch from the

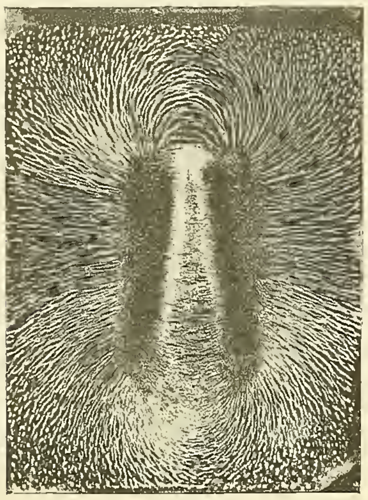


FIG. 13.

poles and Fig, 15 shows the lines as they appeared when the polar ends of the magnet alone were presented to the under side of the glass plate.

We may look upon these lines of force as so many elastic bands or strings by which the magnet attaches itself to other pieces of iron. When the iron is in actual contact with the poles of the magnet, it is bound to the latter by a great number of these strings. When we endeavor to pull the iron away, we have to pull against the combined elasticity of all these strings. The moment we succeed in pulling it the slightest distance from the magnet, a great many of these strings snap, or pull out of the iron and disappear in the magnet just as india-rubber strings would if they came out of a hollow tube and were attached to the piece of iron we were trying to pull away. As we remove the iron still farther, more and more of these elastic strings or bands snap until the iron is removed beyond the attraction of the magnet

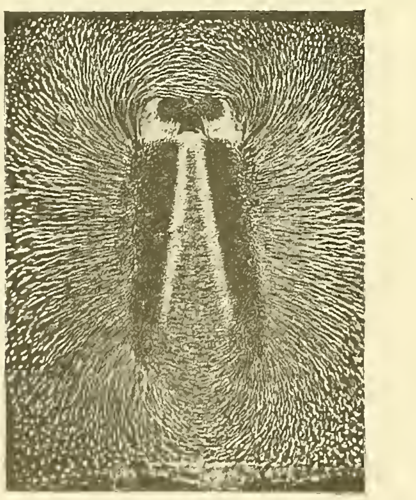


FIG. 14.

when it may be said that all of the bands have been snapped.

Reversing the operation by gradually approaching a piece of iron to the poles, we will have to draw upon our imagination somewhat for an equally good illustration. As it comes within the attraction of the magnet, first one or two elastic bands jump out of the north pole, thread their way through the iron and attach themselves to the south pole. With a nearer approach a great many more do the same thing and pull the iron to the poles with all the force of their elasticity, and finally as the iron comes nearer they come out with a rush and with their combined pull hold the iron to the poles with the greatest force of which that particular magnet is capable.

Now a clear conception of the behavior of these lines of force is indispensable to an intelligen understanding of the theory of the dynamo and the motor, and it is for this reason that so much space has been devoted to the subject. Do not be deceived with the idea that these lines of force are solely of theoretical interest. We discussed them at first as though their existence was purely imaginary, Then we showed by means of the iron filings and the photographs that they really do exist. Next we discussed their behavior in a somewhat theoretical manner and shortly we will show how upon this behavior depends entirely the action of both the dynamo electric machine and the electric motor. But before taking up this latter task, which, to make easily intelligible, so much has been said by way of preparation, a few words must be added as to the effect which the direction of flow of the current in the solenoid has upon the polarity of the resulting magnet.

POLARITY.

It may be stated at once that the way in which the wire of a solenoid is wound has absolutely nothing to do with which end of the enclosed iron

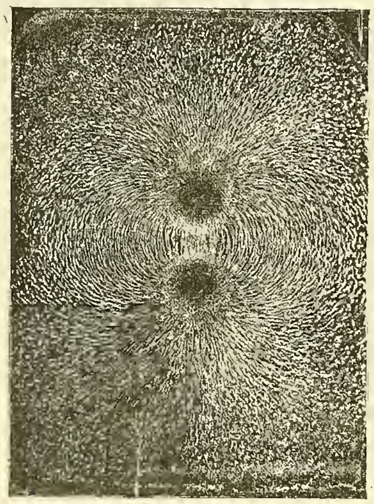


FIG. 15.

bar will be the north pole and which the south, but all depends upon the direction in which the current flows around it.

If in looking at the end of a coil the current flows around it in the direction of the hands of a clock, that end will be a south pole (Fig. 16). If the current is flowing in the opposite direction to that pursued by the hands of a clock, or from right, over the magnet to left, that end will be a north pole (Fig. 17). It is therefore merely a matter of convenience whether we wind a magnet right handed or left handed, we can make either end a north pole and the other a south pole by simply connecting the ends of the coil with our circuit so that the current will flow around the magnet in the proper direction, and if at any time we wish to reverse the poles of the magnet we simply have to reverse our connections. It is well to bear this in mind for there is a popular fallacy that the direction of winding the magnet, right handed or left handed determines which end will be north and which south, but as a matter of fact it has nothing to do with it.

MAGNETISM AND CURRENT.

For the purpose of illustrating the part which the lines of force (magnetism) play in the generation of current, I went to a blacksmith's shop and cut off a piece of ⅜-inch round iron 5½ inches long. This I heated and bent into the shape of a hairpin (A Fig. 18) bringing the ends to within 1¼ inches of each other. I then cut off another piece from the same rod and bent its two ends upward at right angles (B Fig. 18) so that the distance between these two ends was the same as between the ends of A. The ends of both A and B were then filed smooth so that when placed together the surfaces rested flatly against each other. Any blacksmith would probably have done this job for me for 25 cents.

I next made two paper spools, each an inch long, by wrapping several thicknesses of manilla paper around a stick, whittled to about the same

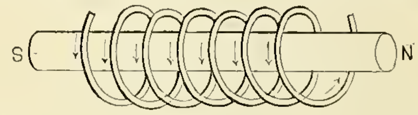


FIG. 16.

diameter as my iron, and forcing on to this paper cylinder two washers made of heavy cardboard and pasting the upturned ends of the paper cylinder to the outside surfaces of these washers, so as to hold them in place. Then, while the spools were still on the stick, I wound on them tightly and as evenly as possible, layer after layer of insulated wire until the spool was full. I counted the number of turns on the first spool and it happened to be 382 turns. I wished both coils to be as nearly alike as possible, so in winding the second spool, I put on just the same number of turns. Then slipping the spools off of the stick I slipped one out on each leg of my bent iron rod A until about a quarter of an inch or less of the ends protruded, one end of each of the coils, having been cleaned of its insulation, were twisted together and the other ends were connected to the battery. The connections of the coils with each other were such that in whichever way the current passed, when we

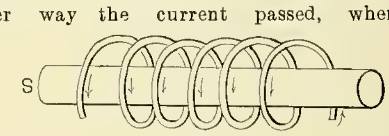


FIG 17.

looked at the two poles it would be clockwise around one and counter clockwise around the other. Immediately the current began to flow in the coils the hairpin, or bent iron A, became a most powerful magnet and upon bringing the ends of B in contact with its poles, it attracted it with great force. Although the iron A weighed less than quarter of a pound it sustained a weight of about 10 pounds attached to the armature B. That such a small amount of iron could support such a weight would seem almost incredible to one who had not witnessed it, and in fact would have been utterly impossible with a permanent magnet of the same weight. On breaking the current the magnetism disappeared at once, as has already been explained. It was found, however, that it would still hold up a steel penpoint or two, showing that its magnetism was not entirely lost. This *residual* magnetism, as it is called, was probably due to the fact that the iron had become some-

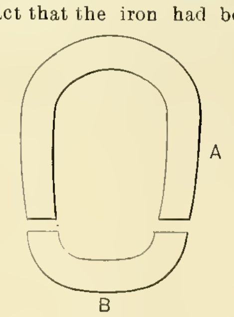


FIG. 18.

what hardened either by the hammering it was subjected to on the anvil, or by too rapid cooling after it came from the forge. After it had been left for 24 hours without current, however, the residual magnetism had become so small that it would no longer support even the smallest piece of iron accessible, although slight traces of polarity were detectible on presenting the two ends successively to one end of the floating needle. These tests, therefore, showed that it fairly answered all the requirements of a good electro-magnet.

STREET RAILWAY ENGINEERS AND THEIR WORK.

PROF. W. A. ANTHO Y,
Vineland, N. J.

William A. Anthony was professor of physics at Cornell University from 1872 to 1887. In that capacity he planned and equipped the new physical laboratory building, organized the physical laboratory courses, and organized and had charge of the department of electrical engineering. Being offered a favorable opportunity to engage in the practical development of the applications of electricity to power transmission and lighting he resigned his position in Cornell in 1887 to accept a position as consulting electrician to the Mather Electric Company, manufacturers of apparatus and machinery for electric lighting and power transmission. During his connection with that company several new motors and power generators were designed and built under his direction. Prof. Anthony is a member of the American Institute of Electrical Engineers and of the American Association for the Advancement of Science, to which societies he has presented occasional papers. He is at present in business for himself as a consulting electrical engineer and electrical expert, having severed his connection with the Mather company in August, 1893.

JULIUS MEYER,
New York City.

Julius Meyer, consulting engineer, began his professional career as architect in 1874; studied civil and mechanical engineering at the Polytechnicum of Hanover, Germany, until 1879; had charge of river and harbor work and of railroad construction; took both government degrees for civil engineering, and was appointed Prussian Government civil engineer. Mr. Meyer came to the United States in 1886 and was employed on bridge work with the Keystone Bridge Company; the Toledo, St. Louis and Kansas City railroad; the Lake Shore and Michigan Southern railroad; and as resident engineer on branch line construction with the Missouri Pacific railroad in Nebraska. He subsequently went to the Pacific Coast and engaged in the building material business at Seattle, Wash., after the big fire. While at Seattle he was engaged in the fall of 1889 by Mr. Henry Villard to be his investigating engineer in street railway matters. Propositions from Butte City, Mont., St. Paul, Minn., Lincoln, Neb., Milwaukee, Wis., and elsewhere were investigated by him for Mr. Villard. He also made a study of the utilization of the water power of the Mississippi River between Minneapolis and St. Paul —the so-called Meeker Island scheme—and many other projects. Upon the organization of the Edison General Electric Company he was appointed its special engineer. He built that company's shops at Peterborough, Ont. He did preliminary work for a change of motive power on the street railways of Milwaukee, Wis., and in the spring of 1891 took charge of construction for the Milwaukee Street Railway Company as its chief engineer. Mr. Meyer originated the deep girder rail construction for street railways. In January, 1892, he was appointed on the engineers' committee of the North American Company to formulate specifications for a trunk line electric locomotive. He was afterward sent to Europe by the same parties to investigate and report on the progress made there in electrical matters, especially as regards the development of three phase apparatus, long distance transmission and the use of storage batteries. Mr. Meyer established himself as consulting engineer in January, 1893, and makes a business of investigating for capitalists, street railway and kindred enterprises and properties, and engages in promoting, designing and superintending engineering work in general in connection with such enterprises.

R. H. PIERCE,
Chicago, Ill.

R. H. Pierce is perhaps best known as the electrical engineer of the World's Columbian Exposition although he has for many years been connected with the carrying out of important projects in various parts of the country. Mr. Pierce was born in Woonsocket, R. I., November 20, 1860. He obtained a liberal education at Yale, where he graduated in 1882 taking the degree of A. B. He then took an engineering course of study at the Massachusetts Institute of Technology where he graduated in 1885 with the first class graduated in the electrical engineering course from that institution. From March, 1886 until the spring of 1891 he was connected with the Edison interests, as inspector, expert, etc., laying out and inspecting construction for the Western Edison Co., Humbird & Gorton, and Leonard & Izard; and as sales agent under Leonard & Izard, the United Edison Manufacturing Company and the Edison General Electric Co., operating for the last named company in Wisconsin and the upper peninsula of Michigan. Mr. Pierce was then in the construction business for himself, with others, as a member of the Electrical Engineering Co. until November 23, 1891, when he became assistant electrical engineer of the World's Columbian Exposition. About the first of April, 1893, one month before the opening of the Fair, at the most difficult and trying period of the construction, he was promoted to the position of electrical engineer-in-chief. The work that thus came under his charge was successfully completed and the entire equipment kept in successful operation until the close of the Fair—a fact that reflects great credit not only upon Mr. Pierce's ability as a constructive engineer but upon his capability as a managing director of a plant of the most complex character. Mr. Pierce resigned his position on February 20, 1894, to become associated with R. E. Richardson of Chicago, under the firm name of Pierce & Richardson, to do a general electrical engineering business, with headquarters in Chicago. Mr. Pierce is a member of the American Institute of Electrical Engineers, of the United States, and of the Institution of Electrical Engineers, of England.

PROF. E. P. ROBERTS,
Cleveland, O.

Prof. E. P. Roberts graduated at the Stevens Institute of Technology in 1877 and during 1879 and 1880 was superintendent of a machine shop in Newark, N. J. In 1881, at the time electric lighting interests were exciting such widespread attention, he was engaged with the United States Electric Co., first as assistant to Hiram S. Maxim, and afterward as assistant to Edward Weston. He was then engaged for two years in the installation of electric light plants, designing and constructing the Cheyenne (Wyo.) plant; and finally becoming general manager of the company and superintendent of the Cheyenne Gas Company. He was afterward elected professor of electrical engineering at Cornell University, but gave up that work to engage again in a more active commercial life. He then took the position of superintendent and general manager of the Swan Lamp Manufacturing Company, of Cleveland, O. For the last year he has acted as an independent consulting electrical and mechanical engineer, carrying on a general practice, as well as conducting the Correspondence School of Technology, with headquarters at Cleveland, O. In this enterprise Prof. Roberts has associated with him a mechanical, an electrical, a civil and a bridge engineer and an architect, the entire staff working together on professional work when so desired, thus putting Prof. Roberts at the head of a very strong organization for taking care of street railway engineering matters.

J. H. BICKFORD,
Salem, Mass.

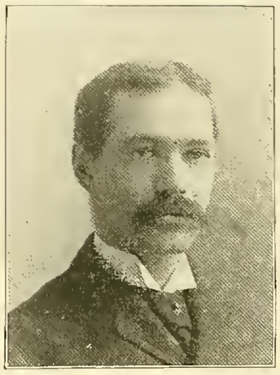
J. H. Bickford, consulting and constructing electrical engineer, at Salem, Mass., first entered the street railway business at that place for the Sprague Electric Railway and Motor Company, which was at that time, in 1888, installing a six-car equipment for the Naumkeag system. After this road was in operation he was sent to Richmond, Va., and had several months' experience there on the now famous Sprague road, together with other pioneers in the business. He afterward had charge of construction for the Sprague company, in St. Joe, Mo., Omaha, Neb., Council Bluffs, Iowa, and Nashville, Tenn., having previously had a hand in the operation of the Sprague system on the West End road in Boston. About the time Mr. Bickford finished his work at Nashville, the Sprague company became a part of the Edison General Electric Co., and seeing an opportunity to better himself and be located at his own home, he resigned his position with the Sprague company, and accepted the position of chief engineer for the Naumkeag Street Railway Company, at Salem, where he remained over two years in charge of the construction and operation of the elec'rical department. At the end of that time he saw another opportunity of advancing his own interest by entering the engineering business, and in July, 1892, he opened an engineering office at Salem. Some of Mr. Bickford's work since that time has been as follows: A complete power station, buildings and machinery, ultimate capacity 3,000 H. P., with car house for 50 cars, for the Scranton (Pa.) Traction Co.; car house, capacity 55 cars, for Reading (Pa.) Traction Co.; car house, capacity 25 cars, for Reading (Pa.) Traction Co.; twenty-three miles of overhead trolley lines, complete, for Reading (Pa.) Traction Co.; compleet power station buildings and machinery, ultimate capacity 3,000 H. P., for Steinway Railway Co., Long Island City, N. Y.; complete power station buildings and machinery, ultimate capacity 2,500 H. P., for North Shore Traction Co., Salem, Mass.; car house, capacity 100 cars, for the Lynn & Boston R. R. Co., Lynn, Mass.: 700 H. P. additional equipment to the Chelsea station of the Lynn & Boston R. R. Co.; 700 H. P. additional equipment to Lynn station of the Lynn & Boston R. R. Co.; power station buildings and general outline of machinery of 300 H. P. capacity for Northampton (Mass.) Street Railway Co.; power station buildings alone for Alton Street Railway Co., Alton, Ill.; power house of 1,000 H. P. capacity for the Reading (Pa.) Traction Co.; car house, 100 cars capacity, for the Steinway Railway Co., Long Island City, N. Y. Mr. Bickford is at present consulting engineer for the Steinway Railway Co., Long Island City, N. Y.; Reading Traction Co., Reading, Pa.; Metropolitan Electric Co., Reading, Pa.; Lynn & Boston R. R. Co., Lynn, Mass., and the North Shore Traction Co., Salem, Mass. The last named road comprises the old Naumkeag system and other roads in the immediate vicinity.

W. P. CRAIG,
Palatka, Fla.

W. P. Craig, who is now among other things the president of the Palatka and Heights Street Railway Company of Palatka, Fla., has perhaps had a longer experience in street railway building than any engineer whose professional career is here given. Although not a civil engineer by profession Mr. Craig has been engaged for 35 years in the construction of street railways. He is now nearly 60 years old. His introduction to the railroad business was on the Erie road in 1864, and his next experience was in grading for the second track of the Hudson River road between Fishkill and Poughkeepsie at the age of 15. From this he went to the Eighth avenue road in New York, then to the Harlem road as section master, then in the same capacity on the New Haven and New London road, then to the City Line of the Harlem road as roadmaster and then for 13 years he was road master of the Eighth avenue road in New York. After holding this position Mr. Craig began construction work for himself and built among others the Staten Island horse road, the Fall River street railway, the New Bedford street railway, the City Island horse railway and the City Railway of Trenton, N. J., in addittion to work on the Ninth, Sixth and Third avenue elevated roads in New York City, several roads in Brooklyn for the late Wm. Richardson, the Central Crosstown road, New York City, the Grand street road, New York, an extension of the Ninth avenue road to One Hundred and Twenty-fifth street, and several roads in Hoboken and Newark, N. J. Especial mention should be made of the Orange Crosstown road which was equipped electrically by Mr. Craig at a time when he had very little faith in the success of electric roads. Now he thinks differently and believes that street railway building, especially for suburban and interurban work, is still "in its infancy" and he expects to see a decided advance in the next few years. Mr. Craig has just been reëlected president of the Palatka and Heights street railway, which he built five years ago.

CHAS. F. UEBELACKER,
Jersey City, N. J.

Chas. F. Uebelacker graduated from Princeton College in the first class whose members received the degree of electrical engineer from that institution. His first electrical work was with the Brush Electrical Manufacturing Company at Cleveland, whose shops he entered as a student or "beginner." After a few months' work at the bench and lathe he was advanced to the position of foreman of millwrights and a little later to that of mechanical engineer. His principal work while with the Brush company, however, was the rearrangement of its shops, which he completed in the fall of 1891. Upon finishing this work he resigned his position with the Brush company to accept that of engineer with the Short Electric Railway Company. In his new position he had charge of the designing and technical correspondence, acting as Prof. Short's assistant. Mr. Uebelacker's most important work while connected with the Short company was in connection with the design and development of the six-pole generator exhibited at the Cleveland street railway convention in the fall of 1892. Upon the breaking up of the Short company's office Mr. Uebelacker returned to the Brush company to take charge of the manufacture of special apparatus of which there was a great deal in process of construction at that time. Early in 1893 he resigned his position to enter the field of consulting engineering as junior partner in the firm of E. P. Roberts & Co., and in the fall of the same year he severed his connection with this firm to accept an engagement with the Consolidated Traction Company of New Jersey, and is at the present time engaged in carrying out the projects of that company.



PROF. GEO. FORBES,
New York City.

Prof. George Forbes has become so prominently identified with American electrical industries that he is almost as well known as if this instead of England were his permanent home. He has become so closely associated with American enterprises that he has found it advantageous to open an office in Wall street, New York City, from which he has carried on his work as consulting engineer for the Cataract Construction Company and the other enterprises in the development of which he has taken an active part. Prof. Forbes is an Englishman by birth and was educated at St. Andrew's and Cambridge universities. After leaving Cambridge he spent a year in the laboratory of Prof. Tait at Edinburgh. At the age of 23 he was elected professor of Natural Philosophy at Andersons' College, Glasgow, where he remained eight years, from 1872 to 1880. In 1874 he was sent out by the government to the Sandwich Islands in command of an astronomical expedition. In 1877 he acted as special correspondent to the London *Times* in the Russo-Turkish war, and was the only Englishman who gained access to the Russian camps in Asia. In 1881 he became manager of the British Electric Light Company and exploited the Gramme dynamo and the Lane-Fox incandescent lamp, starting the first central station for electric light in London. He began to practice as consulting engineer in 1882. Prior to the opening of an office here Prof. Forbes had visited the United States several times in addition to extended travels on the Continent and elsewhere. Prof. Forbes is a fellow of the Royal Society of London, of the Royal Society of Edinburgh, of the Royal Astronomical Society and of the Algemeine Astronomische Gesellschaft, and is also a member of the Institution of Civil Engineers and of the Institution of Electrical Engineers. His most important inventions include a fire-damp indicator, a dynamo for large currents and an electric current meter. He has found time in the course of an extremely busy professional career to publish a number of books and to contribute many articles on engineering and scientific subjects to a number of technical journals and society proceedings. At the present time Prof. Forbes is 45 years of age.

FRANK B. RAE,
Detroit, Mich.

Frank B. Rae was born July 25, 1854, at Elmira, N. Y. He attended the common schools until he was about 12 years old, when his parents removed to Syracuse, N. Y. When fifteen years old he succeeded in securing also about three months in mathematics at the business college, but beyond this he did not enjoy the advantages of regular tuition. At the age of sixteen he obtained a position as messenger boy with the Atlantic and Pacific Telegraph Company, at Syracuse. After carrying messages for only a month or two, he was made batteryman and repairer for the division. In 1872, after a short service as operator on the New York Central road, Mr. Rae returned to the Atlantic and Pacific Company, at Albany, and later was installed at Syracuse as manager. In 1874 he became associated with the Western Union Telegraph Company in New York. In 1876, in connection with Mr. C. H. Davis, he published a book of "Diagrams and Connections." This literary effort attracted attention and helped him to obtain a position in San Francisco as quadman. The work that he did there in making the then new system successful, came to the notice of President Orton while that gentleman was visiting the Pacific Coast, and Mr. Rae was appointed electrician for the Western Union Company in that division. He served in this capacity until 1879 or 1880, when he went into the employ of the Brush Electric Light Company, of San Francisco, and in 1882 he took charge of the Brush plant at San Jose, where he erected one of the first high towers used for city lighting. In February of 1883, Mr. Rae came east to obtain some patents on devices that he had invented, and had the good fortune to meet Mr. Stephen D. Field, with whom he had already been acquainted in San Francisco. It had been his intention to return to the Coast, but he was induced by Mr. Field to remain in

New York. In 1883 he was sent by Mr. Field to Chicago to build the electric railway for the Chicago Exposition of Railway Appliances, and there, with Messrs. Mailloux and Healy, he put in operation the road equipped with the motor "The Judge." Returning to New York Mr. Rae was for a time associated with Mr. Field in perfecting the Field system of stock printing telegraphs and then into the electrical engineering business with Mr. C. O. Mailloux, and then became electrician in 1886 for J. H. Bunnell & Co., New York city. Mr. Rae soon afterward made a business trip to China, and upon his return he was employed as an expert to report upon the electric railway system of the Detroit Electrical Works. He was subsequently requested by the Detroit concern to undertake for them the production of a new system. He consented, and in November, 1888, settled in Detroit, assuming charge of the inventing and electrical engineering of the railway department of the works. Since that time the Rae system has become very widely known and it is now in use on a number of roads. Mr. Rae is now established in a consulting electrical engineering business in Detroit, Mich.

PROF. A. L. MCRAE,
Rolla, Mo.

Dr. A. L. McRae, consulting electrical engineer, of Rolla, Mo., was born in McRae, Ga., October 25, 1861. He graduated from the University of Georgia in 1881; entered Harvard University in 1882 and spent the next four years there studying physics with especial reference to electricity and magnetism and received the degree of doctor of science in 1886. From 1886 to 1889 he was employed by the U. S. Signal service in making investigations on the electric potential of the atmosphere. In 1889 he was elected assistant professor of physics in the Missouri State University and remained there until 1891, when he was elected professor of physics in the Missouri School of Mines, which position he now holds. Dr. McRae has made a special study of the transmission of energy by electricity and of electricity applied to mining operations. In his professional work as a consulting electrical engineer he gives special attention to the installations, tests and improvements of electric power, railway, lighting and mining plants.

PROF. D C. JACKSON,
Madison, Wis.

Prof. Dugald C. Jackson graduated in civil engineering from the Pennsylvania State College and then spent two years of study under Professor Anthony at Cornell University, where he was elected successively to the position of fellow and instructor in electrical engineering. During this time he entered, with Professor Anthony, into experiments with alternating current motors which were continued during later years and developed some interesting results. Leaving Cornell University, he entered the Western Engineering Company, of Lincoln, Neb., as its vice-president and engineer. This company was organized to do business as mechanical and electrical engineer and contractor, and it carried out the installations of quite a number of important electric light and railway plants. One of the earliest electric plants supplying power to large motors was installed by them during this time. The company finally sold its interests to the Edison Electric Company and Professor Jackson became assistant chief engineer of the Sprague Electric Railway and Motor Company which was then related to the Edison interests. He remained in the employ of the Edison interests as engineer until his appointment in 1891 to the chair of Electrical Engineering which he now occupies in the University of Wisconsin. He is a member of various engineering societies, and is the author of a generally used text book on the construction of dynamos, in addition to numerous articles published in technical journals and society proceedings. He practices as a consulting electrical engineer and designer, and acts in matters relating to arbitrations, investigations and general expert work.

DANIEL ASHWORTH,
Pittsburg, Pa.

Daniel Ashworth is a well-known steam expert and mechanical engineer of Pittsburg, Pa. He is a thorough embodiment of the self-made man, and the prominent position he occupies in the profession is the result of close application and studious devotion to work. Commencing work of a practical character at an early period, he passed through all the grades of shop practice. For a number of years he was master mechanic and designer for a number of prominent glass works in the United States. During this time he became enthusiastically interested in the investigation of steam engines and motive power. With his practical experience, he entered the field of steam and transmission of power, where he soon obtained an advanced position, his clients numbering some of the most prominent manufacturers in the country—the Carnegie Steel Company, Ltd., and others. At the outbreak of the Civil War he was found at the front, participating in some of the heaviest engagements of the Army of the Potomac. From there he was transferred and appointed in the engineering corps of the United States navy, serving there until the close of the war. Mr. Ashworth is an eloquent speaker, and when occasion requires, commands undivided attention. In the literary field his services are constantly in demand, his contributions to the various technical journals being valued highly. As he is a comprehensive reader he is enabled to cover a wide field in this direction. He is also an active member of various scientific bodies, among them the American Society of Mechanical Engineers and the Engineers' Society of Western Pennsylvania. He is also an honorary member of the Society of Stationary Engineers.

A. J. BURNS,
Kansas City, Mo.

A. J. Burns, electrical engineer and expert, of Kansas City, has had a wide and varied practical experience in electric railway work. He is a native of Cleveland O.; and previous to 1882 he was engaged as a mechanical engineer in doing work in both eastern and western states. In that year he became connected with the Edison Electric Light Company at its Broad street office in New York City, under Mr. J. H. Vail, who was then superintendent. He continued with the Edison company in different departments until 1886, when he became associated with Mr. Van Depoele and worked with him on both the Van Depoele roads at Port Huron, Mich., and Windsor, Ont., on which the overhanging trolley or carriage was used. He then joined the forces of the Sprague Electric Railway and Motor Company and did construction work on the St. Joseph (Mo.) road. He also did some work for the Thomson-Houston Electric Company at South St. Louis, on the Broadway line. He then went west and became connected with the Northwestern Electrical Supply and Construction Company at Seattle, Wash. While with this company he did work on two roads in Portland, Ore., and one each in Tacoma, Port Townsend and Whatcom, Wash. He was next connected with the Northern Pacific railroad as its electrician and in 1889 went east to New York. He soon returned, however, to Chicago and became connected with the Leonard & Izard Company and remained with this company and its successors through all the changes and consolidations that resulted in the formation of the Edison General Electric Company and the absorption of the Sprague company. Mr. Burns' last work in Chicago was upon the Cicero & Proviso electric road, as he severed his connection with the Edison interests in April, 1891, and located in Kansas City, where he conducts his practice as an electrical engineer and expert.

FRANCIS B. BADT, R. E,
Chicago, Il.

Lieut. F. B. Badt was born October 4, 1849. In 1869 he joined the Prussian artillery. During the Franco-Prussian war of 1870-71 he was second lieutenant in the eleventh regiment of field artillery attached to the army of Crown Prince Frederick William, the late Emperor Frederick III. He took part in twenty-two battles and assaults, among them the battle of Sedan and the siege of Paris. He was decorated for bravery with the iron cross and a campaign medal. He left the service in 1881 and came to the United States. In January of the following year he entered the service of the United States Electric Lighting Company, and in the spring went to Chicago as representative of that company. In 1888 he was transferred to the New York office of the company, and during the summer was sent as its representative to Europe, on a confidential mission. After traveling in Europe for six months, he returned and joined the Western Electric Company. He remained with this corporation until he received the appointment of superintendent of the engineering department of the Edison Company. On November 1, 1890, Lieutenant Badt resigned his position with the Edison Company, and accepted the position of manager of the western power and mining department of the Thomson-Houston Electric Company. During the last four years Lieutenant Badt has written several popular handbooks on electrical subjects, including "Dynamo Tenders' Handbook," "Bell-Hangers' Handbook," "Incandescent Wiring Handbook," "Derivation of Practical Electrical Units," and "Electric Transmission Handbook." He has also given long distance transmission of power, electro-metallurgy and electric street railway service special attention, has taken out numerous patents bearing on these subjects and has contributed a number of valuable papers and articles to the electrical journals. He is well known by the electrical fraternity on both sides of the Atlantic.

C. H. MACLOSKIE,
Chicago, Ill.

C. H. Macloskie, now established in the electrical engineering business for himself in Chicago, was born near Belfast, Ireland, in 1867. He came to the United States in 1876 and eleven years later, in 1887, graduated from Princeton college, New Jersey, when only 20 years of age. He was then engaged, for a short time, in pottery manufacture in Trenton, N. J., but gave this up to enter the electric lighting business at Pittsburg. Mr. Macloskie afterward became associated with the Bentley-Knight Electric Railway Company in connection with the conduit road, equipped by that company in Allegheny City, Pa. Upon the absorption of the Bentley-Knight Company by the Thomson-Houston Electric Company, Mr. Macloskie entered the employ of the latter company and was engaged for nearly two years upon the West End street railway of Boston in carrying out the contract of the Thomson-Houston Company with the West End company. Here Mr. Macloskie had charge of the maintenance of all overhead lines, as well as of the car motors, a task of no mean proportions when the extent of the lines and the number of car equipments are taken into account. He continued with the Thomson-Houston Company and its successor, the General Electric Company, until the fall of 1892, when he accepted the position of electrical engineer of the Intramural railway at the World's Fair. He remained in that capacity until February 1 of the present year. The third rail system of distribution in use on the Intramural road was Mr. Macloskie's invention and the patent upon it was issued to him. It is also worth mentioning, as showing his inventive ability in this line, that the present standard overhead apparatus as used by the General Electric Company is manufactured in accordance with the patents and designs of Mr. Macloskie.

I. H. SILVERMAN,
Philadelphia, Pa.

I. H. Silverman, who was born in April, 1863, was for a number of years engaged in mercantile pursuits. In the spring of 1883 he formed a co-partnership with William A. Stern under firm name of Stern & Silverman, with headquarters at Pittsburgh. The firm secured the exclusive selling agency of all Edison lighting and railway manufactures. Mr. Silverman devoted the greater portion of his time to the selling of central station plants. In 1886 the Edison company, after purchasing the Sprague patents, placed the firm in charge of additional territory. Mr. Silverman took charge of the Pittsburgh office and with a corps of men conducted this branch covering Eastern Ohio, Western Pennsylvania, West Virginia and Maryland, and was noted for the success he atttained in the sale and construction of numerous large power stations and street railway plants in the territory mentioned, embracing those of Pittsburgh, Allegheny, DuBois, McKeesport, Erie, Uniontown and Connellsville, Pa.; Cumberland, Md.; Martinsburg, W. Va., Hornellsville, N. Y., and others. In the spring of 1892 he again associated himself with his former partner, William A. Stern, at Philadelphia, as a designer and builder of electric railway, light and power plants. The firm of Stern & Silverman, since its removal to Philadelphia has done a large business in the construction of railway and power plants, having built several lines for the Philadelphia Traction Company during the past year. They have also built lines for the Baltimore electric railway, the West Jersey Traction Company, the Trumbull & Warren electric railway, etc. The firm also has the exclusive selling agency of Ball-Wood engines for Pennsylvania, Maryland and Delaware.

FRANK M. ASHLEY,
New York City.

Frank M. Ashley was born June 10, 1867, in Catskill, N. Y. When 11 years old he removed to Brooklyn where he was educated in the public schools. After leaving school he learned the machinist's trade with the E. W. Bliss Company of Brooklyn and later undertook engineering work in that city. In July, 1891, he organized the Ashley Engineering Company for the manufacture of a number of patented mechanical and electrical specialties of which Mr. Ashley was the designer and inventor. Mr. Ashley is the manager of the company and also conducts a private business as a consulting engineer and contractor. He is the inventor of an electric railway system for the exploitation of which a new company has just been formed.

WILLIAM A. STERN,
Philadelphia, Pa.

William A. Stern was associated with Thos. A. Edison in the early days in laboratory work at Menlo Park, devoting considerable time to experimental work upon storage batteries, car lighting, street railway motors, incandescent and arc work. Later he was in charge of the construction of plants. He owns patents with Mr. Edison on car lighting. In the spring of 1883, he associated himself with I. H. Silverman and opened an exclusive constructing agency at Pittsburgh, Pa., for all Edison patented apparatus. This firm was successful in covering the field of Western Pennsylvania, Eastern Ohio and West Virginia, and in 1886 Mr. Stern was made manager of the Philadelphia office of the Edison General Electric Company, which office he retained until the consolidation of the Thomson-Houston and Edison companies. After the consolidation, he was appointed manager of the railway department of the Philadelphia General Electric Company, leaving the position to again associate himself with the present firm of Stern & Silverman, now located in Philadelphia. Mr. Stern was born in Philadelphia 33 years ago. He has a large acquaintance with financial institutions, and socially is held in high esteem. He is thoroughly practical in every detail of street railway construction.

H. WARD LEONARD,
New York City.

H. Ward Leonard may easily be ranked as one of the best known men engaged in the electrical and street railway construction business. He has for many years been prominently identified with the most advanced methods of constructive engineering as applied to electrical projects, and has succeeded in keeping his name constantly among those of the leading electrical engineers. Mr. Leonard was born in Cincinnati February 8, 1861. After leaving the High School he worked for two years as machinist in the railway shops at Cincinnati, and then went to the Massachusetts Institute of Technology, where he took a course in mining engineering. He practiced his profession during each vacation while at the Institute, working during different summers in coal and iron mines and as a railway engineer. Graduating, in 1883, he secured a position with Mr. Edison, became one of four selected by him as a staff of engineers to erect stations in this country. Two years later Mr. Leonard accepted a position as electrical engineer to install Edison's stations in Ohio. In 1887 he went to Chicago as general superintendent of the Western Edison Light Company. Two years later, as senior partner, he started the firm of Leonard & Izard, which constructed some of the most important electrical work in Chicago and its vicinity. In 1889 Mr. Leonard accepted the position of general manager of the United Edison Manufacturing Company, on the purchase by it of Leonard & Izard's business. The following year, he became manager of the light and power department of the General Electric Company, which position he occupied until September 1, 1891, when he resigned to create the firm of H. Ward Leonard & Co., doing important electrical work in various eastern cities. Mr. Leonard is a member of the American Institute of Electrical Engineers, before which as well as other societies, he has read many papers on important engineering problems. Possessed of the highest theoretical and practical ability, Mr. Leonard has held positions from the lowest to the highest in the business, and has made important inventions, used under royalty to him, by leading manufacturers. He comes of distinguished Revolutionary ancestry, and has the decision of active life with the training of the student.

JAMES I. AYER,
St. Louis, Mo.

James I. Ayer needs no introduction to electrical engineers or indeed to any of those who have been in any way associated with the recent progress of the electrical industry. Although he has only recently established himself as an independent engineer, the head of the firm of James I. Ayer &Co., of St. Louis, Mo., Mr. Ayer has done a vast amount of the very best class of construction both in street railway and electric lighting power plants. He is best known through his work in St. Louis where he planned, constructed and afterwards managed for many years the plant of the Municipal Electric Lighting

Company—one of the largest lighting stations in the world. While he was managing this immense plant he also superintended the construction work on the Benton & Bellefontaine Railway in St. Louis. Although originally planned by others, the design of this plant was modified by Mr. Ayer according to his own advanced ideas. Early in 1892 it was turned over in a completed state to the railway company. Mr. Ayer was made president of the National Electric Light Association in recognition of his services in advancing the interests of electrical engineering along the lines of improved and economical practice. He is now engaged in the consulting electrical and mechanical engineering business, and makes financial and physical reports and insurance appraisements on electrical properties, and superintends electrical construction of railroads and central stations.

B. J. ARNOLD,
Chicago, Ill.

B. J. Arnold, a consulting and constructing engineer of Chicago, has designed and constructed some of the most important electric railway plants in the west, but is best known, perhaps, through his connection as designer and builder of the Intramural railway power plant at the World's Fair. Mr. Arnold was born at Cazenovia, near Grand Rapids, Mich., August 14, 1861. In 1866 he went to Nebraska. He was educated in the public schools of that state and in 1879 entered the civil engineering course of the University of Nebraska. After remaining here one year he entered the scientific course at Hillsdale College, Michigan, from which institution he received the degree of B. S. in 1884, and three years later the degree of M. S. In 1889 the same institution conferred upon him the honorary degree of M. Ph. for engineering work done subsequent to his graduation. It was just at this time, in June, 1889, that Mr. Arnold finished a post-graduate course in electrical engineering at Cornell University. Regarding Mr. Arnold's natural engineering abilities it may be said that he has always been trying, even in his schoolboy days, to "build something," and his work in this line extended to the construction of small steam engines, motors and other mechanical appliances. At twelve years of age he had made a bicycle, and at eighteen a small railroad locomotive complete in every respect. When about fifteen years of age he began to spend his summers running traction engines, doing threshing work on western farms. Having thus acquired a certain amount of skill in the handling of machinery he spent his summer vacations when in college, traveling as an engine expert for different engine companies. One summer, however, he spent in the field with a civil engineering party running an instrument. On graduation in 1884 he engaged as general agent for an engine company which position he held for two years. He then became connected with the Edward P. Allis Company, of Milwaukee, as a draughtsman, leaving his position with that company to become chief designer for the Iowa Iron Works, of Dubuque, Iowa. In this position he designed a large number of steam engines, some of which are among the largest now operating in the United States. Here he also had some experience in the design of cable railway machinery. Leaving this position he engaged with the Chicago, St. Paul & Kansas City Railway Company as a civil engineer and when the road was turned over to the operating department, Mr. Arnold was made mechanical engineer, a position which he resigned in 1888 to take the post-graduate course at Cornell University. On leaving Cornell Mr. Arnold engaged with the Thomson-Houston Electric Company as engineer and manager of the St. Louis office. Two years later he was appointed consulting engineer for the Chicago office of the same company, a position he continued to hold after the consolidation of the Thomson-Houston and Edison General Electric companies into the General Electric Company. During this period some of Mr. Arnold's most important work was carried out. The principal plants which he has designed and built are the Columbian Intramural railway; the City Electric street railway, Little Rock, Ark.; St. Joseph & Benton Harbor street railway, St. Joseph, Mich.; Marquette City & Presque Isle railway, Marquette, Mich., the Chicago-North Shore street railway, and others. Mr. Arnold has had an extended experience in reporting upon the financial and physical condition of electric properties for investors, and makes this a leading feature of his business. Among the properties upon which he has reported are the street railway plants in Los Angeles, Cal., St. Louis, Mo., Peoria, Ill., Kansas City, Mo., Ft. Smith, Ark., Springfield, Mo., Quincy, Ill., Chicago, Ill., Denver, Colo., and Negaunee, Mich. Mr. Arnold has a finely equipped private laboratory where he spends most of his leisure time in experimental engineering work, with the result that he has taken out a number of patents on electric railway construction which he still controls. He is a member of the American Institute of Electrical Engineers, the Engineers Club of St. Louis, and the Western Railway Club, of Chicago.

C. J. FIELD,
New York City.

Cornelius J. Field was born in Chicago, Ill., in 1862. His early life, up to his thirtieth year, was spent in Chicago and vicinity. At the age of thirteen he went east and spent a few years in Montreal, Canada, moving to Brooklyn in 1881. Between his thirteenth and twentieth years, Mr. Field was engaged in mercantile pursuits entirely except during the time occupied with such schooling as he had given himself. At the age of twenty, after a few months study and preparation, he entered Stevens Institute of Technology to take the mechanical engineering course, from which he graduated in the spring of 1886, when he was twenty-four years of age. Mr. Field has the honor of having worked his own way through college, thus paying all his own expenses. In the fall of 1886, after graduating, he entered the employ of the Edison Electric Light Company in the engineering department, with Mr. J. H. Vail, under whose able direction he received his early training in the electrical business. In 1887 Mr. Field was appointed chief engineer of the Edison United Manufacturing Company. In this position he had entire charge of the engineering business of the Edison company for this department throughout the country, including the installation of all isolated and marine plants and smaller central stations. Here he gained extensive and varied experience, designing and installing large plants, including the first direct connected plants for the new navy. In 1889 Mr. Field resigned this position, at the time of the consolidation of the Edison interests, to take the position of chief engineer and general manager of the Edison Electric Illuminating Company of Brooklyn, and in this position he took charge of the designing and building of the new power plant of that company, which had just been organized. In the management of this work Mr. Field made a record in the construction of a large central station, putting up one of the largest, most complete and most economically operated stations in a shorter time than had ever before been accomplished. After completing the Brooklyn station and getting it in operation, Mr. Field resigned to establish his present company in the engineering and contracting business. In 1890, with the assistance of one of his old classmates, Mr. Edward F. White, he organized the Field Engineering Company to undertake the designing and engineering construction of the larger electric railway and central station plants. To this class of work they have strictly adhered for four years, and in that time they have established for themselves an enviable reputation, as they have done more or less work for all of the large railway syndicates. Their work has covered the design and construction of some of the largest and most complete electric railway plants in the country, including those at Buffalo, Newark, Philadelphia, Brooklyn, Paterson, Trenton and a large number of other places. They have also designed and installed at Buffalo and Philadelphia the most complete system of underground feeder lines for the trolley system that has as yet been used in commercial work in that line. Mr. Field was one of the first and most earnest advocates of direct connection between engine and generator. In addition to his connection with the Field Engineering Company, Mr. Field has established during the last year an independent consulting business, for reporting on properties and advising with bankers, manufacturers, etc., on electric traction and power problems; and is also acting as consulting engineer for a large number of interests. In the organization and equipment of the Field Engineering Company, Mr. Field has surrounded himself with a corps of the most able and efficient young engineers in the country: and it is to this fact of thus having a staff of engineers who could handle any problem which they undertook under Mr. Field's general direction and supervision, that he attributes much of his success. Mr. Field is a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Naval Engineers, the Society of Naval Architects and Marine Engineers, and the American Street Railway Association.

A. W. GILBERT,
Philadelphia, Pa.

A. W. Gilbert, constructing engineer of the Wakefield Electrical Engineering Company, was born in Hartford, Conn., and received his technical education at the Worcester Polytechnic Institute, Worcester, Mass. He then entered the railway engineering department of the Thomson-Houston Electric Company, Lynn, Mass., and during his stay there constructed several electric roads in New England. Later he was transferred to Philadelphia as railway engineer for the Pennsylvania General Electric Company, designing and constructing for this company, during the last few years, electric roads in Reading, Shamokin, Carbondale and Shenandoah, Pa., Camden, N. J., Baltimore, Md., and Warren, O. He also designed and constructed the electrical work for the first elevated electric trolley road in the United States at Hoboken, N. J. He is now engaged in the construction of a seven-mile extension of the Lehigh Traction Company's lines at Hazelton, Pa.

JOHN A. SEELY,
New York City.

John A. Seely has for many years been one of the most prominent advocates of high grade work

in connection with the construction of electrical plants and street railway systems. His work has been of the most varied character, and his experience is as extended as that of any man now doing construction business. He has always been a regular attendant at the meetings of the American Street Railway Association and the National Electric Light Association. Of the latter organization Mr. Seely has for many years been a member of the executive committee and at the present time holds this office. He is the president and general manager of the Complete Electric Construction Company of New York City. This company has, since its organization, carried out the installation of many important street railway plants, one of the latest being that at Norristown, Pa., a description of which appeared in the last issue of the STREET RAILWAY GAZETTE. Mr. Seely stands high in the estimation of his brother engineers as a man of unusual ability and of firm business integrity.

CLIFT WISE,
Chicago, Ill.

Clift Wise, the western manager of the Complete Electric Construction Company, has had an

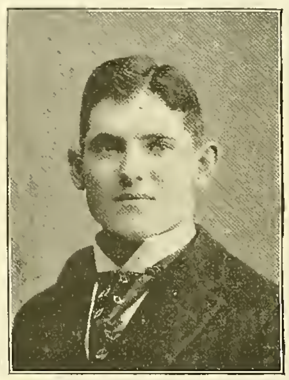
extended experience in street railway construction and engineering. Before the days of the electric railway he had a valuable experience in the construction of cable railways. In this line of work he commenced operations in 1883 as division engineer on the Kansas City cable railway. Two years later he was appointed chief engineer of the same road and built three of the cable lines in Kansas City. In 1888 he went to St. Paul and superintended the engineering and construction of the cable lines of that city. He afterward engineered and constructed the electric lines in Minneapolis and St. Paul, a total of some 200 miles of road. Mr. Wise recently drew up plans and specifications for reconstructing the cable system of the Philadelphia Traction Company. His present headquarters are in Chicago, where he manages, as already stated, the western business of the Complete Electric Construction Company.

OWEN FORD,
St. Louis, Mo.

Owen Ford, electrical engineer and contractor, of St. Louis, Mo., was born in Ohio 28 years ago. At the age of 16 he graduated from the Middletown high schools, and immediately entered the employ of the Bell Telephone Company as inspector in Butler, Warren and Greene counties, Ohio. After a service of one and a half years in this capacity he became connected with the Edison Illuminating Company, of Middletown, Ohio, as its electrician and manager. This was one of the original Edison companies to be established for central station work. After remaining with this company about a year Mr. Ford took up construction work for the Ohio Edison Company in Ohio and Kentucky, and a few months later accepted the position of superintendent of construction for the Western Edison Company in Chicago. He remained in Chicago several months and then took charge of the building of Edison central stations in Illinois, Missouri, Iowa, Nebraska and Dakota. He afterward took the Edison agency in partnership with Geo. W. Coster in Nebraska and Dakota, and later moved to Cincinnati for the Edison Company, operating in Ohio, Indiana, Kentucky and Tennessee. In 1889 he was appointed general superintendent of the United Edison Manufacturing Company for the Rocky Mountain district with headquarters at Denver, covering the territory from New Mexico to Montana inclusive. Here Mr. Ford developed a very large business and upon the organization of the Edison General Electric Company he was appointed district engineer for the Rocky Mountain district. Upon the further consolidation of the Edison and Thomson-Houston companies he was made manager of the railway, lighting and power departments at Denver. Mr. Ford removed from Denver "after the panic" of 1893 and opened his present office in St. Louis as engineer and contractor.

H. P. BROUGHTON,
St. Louis, Mo.

H. P. Broughton who is now associated with James I. Ayer of St. Louis in the consulting elec-



trical and mechanical engineering business, is a graduate of Cornell University from which he received his degree in the mechanical and electrical course in 1890. Since that time he has been engaged in practical work in the installation and operation of electrical apparatus of all kinds as used for lighting and and power purposes. During nearly the whole of this time he has been closely associated with Mr. Ayer while manager of the Municipal Electric Lighting and Power Company, where he had under his special care the management, direction and operation of the separate stations maintained for the distribution of power for 500 volt service.

MASON D. PRATT,
Steelton, Pa.

Mason D. Pratt, C. E., street railway engineer for the Pennsylvania Steel Company of Steelton,

Pa., graduated as civil engineer from Lehigh University, South Bethlehem, Pa., in 1887. For seven months thereafter he was employed by the Phœnix Bridge Works as draftsman of the Kings County elevated railway structure. His first active interest in street railway work was aroused during 1888, when employed by the Johnson Company of Johnstown, Pa., in the erection of its new plant at Moxham. During that year he built for them the first electrical railway in Washington, D. C.—the Eckington and Soldiers' Home railroad. Leaving the employ of that company for a part of 1889, he entered partnership with M. Tschirgi, Jr., C. E., of Dubuque, Iowa. During that summer they occupied the city engineer's office and carried out extensive municipal improvements, and took an active part in the street railway construction begun that year. He returned to Johnstown that fall as assistant chief engineer and in the course of extended travels since, has acquired a wide acquaintance among street railway men. Early in 1891, the Pennsylvania Steel Company, then beginning the manufacture of street railway rails and special work, employed Mr. Pratt as engineer in charge of this branch of its business, and he is largely responsible for the many excellent features of its work, which has already brought this company abreast of its competitors.

FREDERICK SARGENT,
Chicago, Ill.

Frederick Sargent, the senior member of the firm of Sargent & Lundy, of Chicago, is doubtless

best known through his connection with the World's Columbian Exposition as the designer of the entire steam and electrical power plant, which attracted so much attention from visitors to the Fair. Mr. Sargent was put at the head of the mechanical and engineering construction, a position which he resigned about one month before the opening of the Fair. Prior to his association with Mr. Lundy in the firm, which now carries on a general consulting and constructing electrical and mechanical engineering business, Mr. Sargent was connected with the Edison interests in the West. He is now, in addition to his regular engineering work, consulting engineer for the Chicago Edison Company, for the Chicago & North Shore Electric Railway Company, and other important interests. He is also interested in the Northwestern Elevated Railway Company's project for the construction of another elevated railway in the city of Chicago.

J. H. VAIL,
New York City.

J. H. Vail is well-known as having for many years been actively identified with the Edison

electric interests as chief engineer. Mr. Vail was born in Middlesex County, New Jersey. After finishing his education, his natural inclination for mechanics led him to enter the Empire Machine Works, at New Brunswick, N. J., where he spent nearly seven years. Rising rapidly in his profession, he was appointed superintendent of the works after two years' service, and soon became manager, which position he held until he entered another field. An experience of over two years in the office of the Assistant-Quartermaster-General, U. S. A., New York City, largely assisted in developing and perfecting his natural executive capacity. A further pleasant and profitable experience was gained with the Kansas City, Fort Scott and Gulf Railroad Company, at the Kansas City shops, where he prepared plans and specifications for many kinds of passenger and freight cars, as well as some locomotive work. In the summer of 1880, Mr. Vail entered the employ of Thos. A. Edison at Menlo Park, N. J. During the fall and winter of 1880 and 1881, he was in charge of the original exhibition central station plant at that place, thus deriving an experience that can never be forgotton, and that not a few envy him. He erected the original exhibition plant at 65 Fifth avenue, New York City, in February, 1881, and installed many of the early isolated plants of the Edison Company. He was appointed superintendent, in December, 1881, and later, the chief engineer of the Edison Company for Isolated Lighting. Under his charge the work of the Edison Company received a constant, attentive and absorbing personal care that did much to secure for it a prominent position. Mr. Vail formulated rules and specifications and plans that are recognized standards of practice. His rigid personal inspection, his uncompromising disapproval of bad and shiftless work, and his hearty praise of perfect construction, have resulted in decided advances. In 1885, the Edison central station business was taken over by the Edison Isolated Company, and Mr. Vail became chief engineer of central station construction. Nearly 200 central stations have been constructed under his supervision. A high grade of skilled work, combined with permanency of construction and economy in first cost, as well as in operation, and convenient and compact arrangement of plant and apparatus, have been the leading features of his successful work. The following Edison central stations are a few of the many designed by Mr. Vail: Twenty-sixth street and Thirty-ninth street, New York City; First and Second district stations, Boston; Adams street station, Chicago; Easton, Pa.; Toronto, Canada; Detroit, Mich.; Rochester, N. Y.; New Orleans, La.; Minneapolis, Minn.; Kansas City, Mo., and many others, all of which are successful as well as profitable investments for the stockholders. Mr. Vail was early identified with the Sprague Electric Railway and Motor Company as consulting engineer and for the last two years of that company's existence was its chief engineer. The valuable practical experience already gained in the electric light field he applied with beneficial results to electric railway construction. Mr. Vail has been identified as supervising and consulting engineer with a large amount of successful electric railway work aggregating over 1,100 miles of track, upwards of 1,800 cars and many large generating stations. He possesses the valuable faculty of analyzing the merits of new devices, apparatus or systems, and the ability to unite in a station or system such combination of boilers, engines, dynamos and appurtenances as will best meet local conditions and show good results in economy and net earnings. The results of his engineering work prove that his judgment is sound and unbiased. Mr. Vail's experience in steam plant construction aggregates 40,000 horse power, incorporating the use of all types and sizes of boilers and engines. He has also done much important work with compound condensing and triple expansion condensing engines. Mr. Vail is thoroughly familiar in a practical way with underground electrical systems and possesses an accurate knowledge of the various systems of electrical distribution. Being a constant student of electrical and mechanical engineering progress, he is fully abreast of the times and well posted as to the advances in the art. Mr. Vail is a member of the American Society of Mechanical Engineers, and of the American Institute of Electrical Engineers.

Palatka, Fla.—At the annual meeting of the stockholders of the Palatka & Heights Street Railway Company the following directors were elected for the ensuing year: W. P. Craig, E. S. Crill, Dr. McGregor, Marcus Loeb, W. C. Snow, Thomas Murray and D. A. Boyd. Officers were then elected as follows: W. P. Craig, president; Marcus Loeb, secretary, and E. S. Crill, treasurer. W. C. Snow was appointed general manager and Hon. B. P. Calhoun, counsel. The board voted to issue bonds to the amount of $10,000 to make improvements, extension, etc.

PERFECT ELECTRIC BONDING OF RAIL JOINTS.

BY J. H. VAIL.

This subject is one that is forcing itself upon the notice of street railway companies because of deficiencies that practical use has developed in the methods heretofore and even now practiced. The mechanical troubles of rail joints have existed since the inauguration of the first railway, and great improvements have been made, but now comes the electrical bond, and the two combined have not diminished, but increased the difficulties. It has been found that a system of track, with faulty rail bonds, will give a shock to animals, and possibly to human beings, should the same be brought into actual contact, in such a manner as to complete through them the broken circuit.

It will be readily understood how difficult it is to maintain proper inspection of the electric bonding where the bonds are covered up by the street pavement. Under such conditions, the track circuit and the bonding escape inspection until excessive coal consumption, loss of current and other troubles force themselves upon the attention of the street railway management. My object is not now to set forth well known troubles, but to describe how they may be specifically remedied by an improved system of electric bonding, using the Vail multiple rail bond.

The sectional area of the rail bonds heretofore used has been much less in conductive capacity than the sectional area of the rail so bonded, and the mechanical work has not been of substantial and durable character. As a result, the flow of current through the rails has at the rail joints been greatly restricted, because of the high resistance of the rail bond itself, and additionally the defective electrical connection made by the small rivets used. By reduced conductivity and increased resistance of the circuit, the flow of current is restricted, the speed of the cars is reduced and the working of the motors at best efficiency is impossible. These combined defects make serious inroads in the coal pile, largely increasing the fuel requirements beyond what they would be if normal conditions prevailed.

The only perfect bond is one which will furnish at the joint a conductivity nearly equal to that of the first rail itself. The mechanical and electrical connection must be far superior to existing methods. Careful calculations prove that the rails themselves if properly bonded have large conductivity when properly utilized. As an illustration, a single track of 56 pound rails, reduced to the basis of copper, is equivalent to a copper rod whose diameter is 1.533 inches. The same rails have a safe carrying capacity of current equal to 786 amperes.

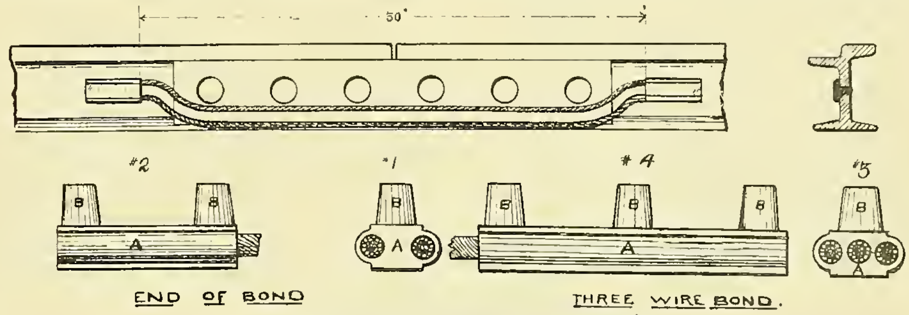
The rail joints are frequently bonded with No. 0 galvanized iron wire, whose greatest ampere capacity is 67 amperes, or if No. 0 copper wire is used, the ampere capacity is 180 amperes. The relative restriction of current capacity is easily perceived. The relative resistance of the bonds can be readily determined.

In the new rail bond under consideration, my object is to provide a system of rail bonding by the use of which the rail joints may be made of nearly equal electrical conducting capacity with the body of the rails themselves, whereby there will be no unusual resistance to the flow of current at the joints, and the equalization of potential throughout the system is largely assisted; also to provide the necessary high degree of electrical contact between the rail bonds and the rails, which in the arrangements heretofore employed has been lacking.

The rail bond heads A, shown in Figs. 1, 2, 3, 4 and 5, are substantial pieces of metal, each having formed in one piece with the studs B, adapted to be driven into holes in the rails, the studs B of one head being driven into one rail and the studs B of the opposite head being driven into the adjacent rail. The heads are made of such length as to enable the employment of two or more studs B, and the inner side of each is provided with a wide shoulder $a\ a$, which, when the rail bond is in position, comes into close electrical contact with the rail. Thus the head of the bond for its whole length is in close contact with an equal area of the rail, and this large area of contact increases the efficiency of the electrical connection additionally to the increased contact provided by the two or more extra large studs.

The two heads of the rail bond are connected together by parallel conductors of such number as may be required for different weights of rails, with the object of making the conducting capacity of the bond substantially equal to that of the rail. By employing a plurality of wires connected with common heads, I obtain the necessary conductivity in a single "unitary" rail bond, and at the same time by using stranded cables between the bond heads, preserve such flexibility as is required in manipulating the bond when applied and also during its permanent service. The number and size of cables will vary according to the car service and the current carrying capacity of the rails; and the number of studs and area of contact of the heads are also varied so that the conducting capacity of the attached bonds shall be very great. For rails of small cross section, say of 40 to 56 pounds per yard, the bond having two studs at each end and two large stranded cables in parallel will be made of sufficient conductivity. For heavy rails from 70 to 90 pounds per yard, bonds will be made with three stranded cables in parallel.

In the process of manufacture of these rail bonds, the flexible conductors will be so manipulated, that when the head of the rail bond is cast, the metal will form itself completely around the cable, thus assuring a perfect union of metals and continuity of conductive capacity. Further, in order to avoid electrolytic action, we can completely insulate the cables in any suitable manner, the insulation being preferably such as will withstand the action of the moist soil throughout their exposed portions between the heads A.



FIGS. 1 TO 5. VAIL'S METHOD OF RAIL BONDING.

In addition to the bonding of the rail joints, the cross bond between the opposite rails of the track at intervals is easily and thoroughly accomplished. I employ for this purpose a double or compound bond. The short portion is employed at the rail joint, and a longer section continues for the cross bond to the opposite rail. The bonding of the rail joint and the cross bonding are thus affected by the use of a single continuous head, whereby the labor of constructing the track is reduced and the efficiency of operation is improved.

The mechanical connection of the rail bond to the rail is very important, for herein rests the electrical vitality or efficiency of the union. This mechanical connection must be as near a perfect metallic union as it is possible to secure. As a result of many years' personal experience with electrical work, it is found that we must make our mechanical joint very large in area of contact (compared with the circular mils of conductors) if we would have a low resistance joint. The contact head of the rail bond under consideration provides this large area in an eminent degree. We not only have the very large studs in multiple but also an ample surface contact on under side of bond head that is of permanent value. The value of this surface contact will be improved by cleaning the surface of rail (under bond head) free from rust and scale. The work should be so well executed as to draw these surfaces tight together in contact, and when finished, the joint can be hermetically sealed by one or more coats of plastic asphaltum varnish. Perfect union is essential to avoid electrolytic action at the surface contact between iron and copper.

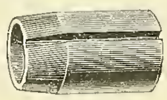
With this bond, the act of riveting thoroughly expands the metal of the stud and positively fills the hole in the web of the rail like a hot rivet upset in a boiler plate. We thus secure perfect mechanical union and at the same time the desired flexibility.

The style of bond having a single rivet or stud at the end, permits a movement at the joint caused by constant track vibration. This movement seriously loosens the contact, eventually creating a high resistance joint, and the bond frequently breaks off at the head. The heavy double and triple studs in the improved form of multiple bond absolutely prevent this trouble.

Close supervision over the work of rail bonding is of utmost importance, as the ordinary workman does not always appreciate the care required to make a good electrical connection. There is no reason why this rail bond should not be as lasting as the track itself. These multiple rail bonds contain much more copper than the usual form, but are not excessive in cost. Their real economy is obvious because of great durability and the largely increased conductivity obtained through the track. In many systems the drop in potential can be reduced 75 to 100 volts by the application of these rail bonds, and a higher general efficiency of the system surely results.

Acme Rail Bond.

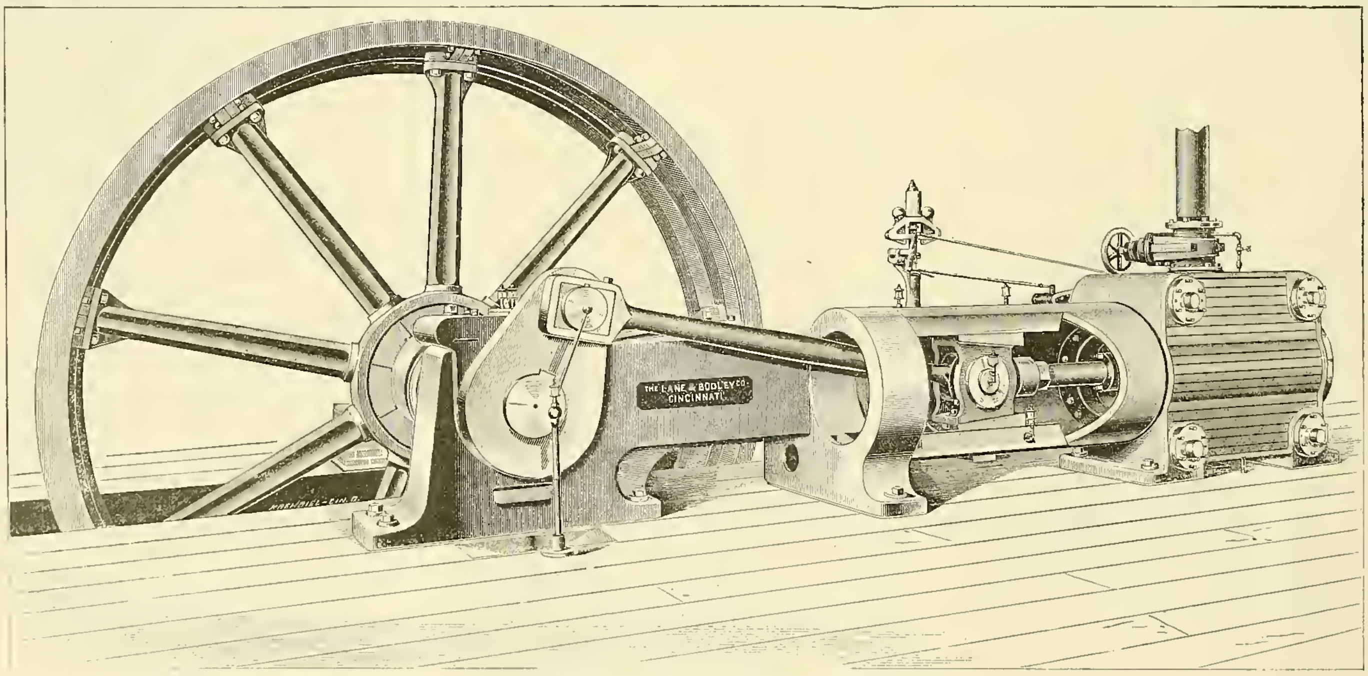
The accompanying illustration shows a new device used in bonding rails for electric roads and designed to take the place of the old style channel pins, which have been so long in use. This device is called the Acme bond cap. As shown by the illustration, it is cylindrical in shape and closed at the bottom like a cartridge, with a slot running part way through the wall and the entire length of the cap. The bond wire being inserted, the cap is driven through a hole in the rail, made, in all cases, 1-32 of an inch smaller than the largest diameter of the cap. When the



THE ACME RAIL BOND.

boud wire is inserted and the cap driven into the rail the weakest point of the cap, which is where the slot is cut, collapses, and the two sides are forced together, forming a burr on the inside, which engages with the copper wire and holds it firmly in position.

It is claimed for this cap that it possesses a number of advantages, among which are that it is thoroughly waterproof and makes absolute contact on all sides of the bond wire, is easily inserted and holds the wire with a vise-like grip.



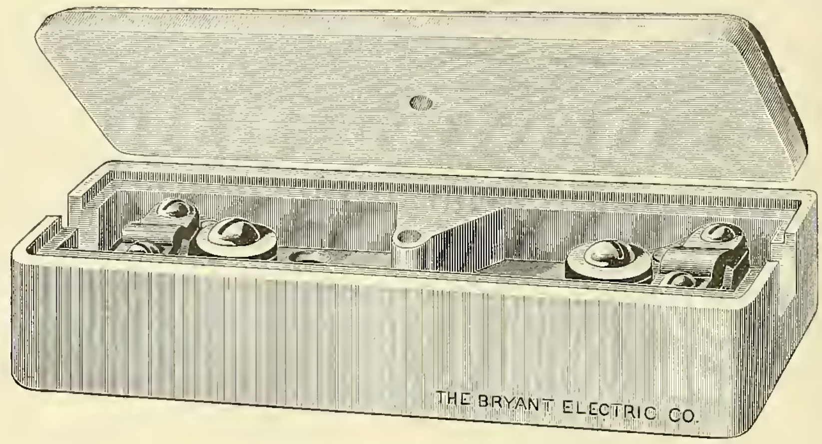
THE LANE & BODLEY ENGINE.

This pin is being placed upon the market by Goodbue & Lincoln, 1561 Monadnock Block, Chicago, from whom samples can be obtained upon application.

General Electric Removal.—The Chicago offices of the General Electric Company were moved this week from 173 Adams street to the tenth floor of the Monadnock Block where they will occupy commodious offices on the Van Buren street side of the building.

Bryant Electric Company's 500-Volt Cut-out.

Cut-outs for use on 500 volt circuits have not been developed until recently. The Bryant Electric Company of Bridgeport, Conn, has lately placed on the market, a cut-out designed especially for 500-volt circuits. This cut-out is shown in the accompanying illustration. It is oblong,



CUT-OUT FOR 500-VOLT CIRCUITS.

the distance between the terminals being sufficent to prevent the carrying of an arc. A bridge in the center also acts as a safeguard. The entire block is covered by a porcelain cap. Thos. G. Grier and Edward R. Grier represent the western office of the Bryant Company in Chicago, where a stock of all the company's goods is kept.

LANE & BODLEY CORLISS ENGINE.

The Corliss engine has for many years followed closely the lines of the first designers. That type of design was satisfactory under low pressures and slow speeds common to the first twenty years of Corliss engine practice. The first departure was the location of a support under the slides. Later designers have continued the use of the support but have broadened its bearing upon the foundation, developing it from a simple leg to a bearing having an area of several square feet and extending entirely across the foundation.

The engine represented in the accompanying engraving, made by the Lane & Bodley Company, of Cincinnati, not only has this support of the extreme width but the company has also adopted a new form for the frame, giving it a box shape, which is certainly an excellent design to resist the twisting strains, particularly noticeable in weak engines when heavily loaded.

The slides are concave and bored to a large radius, giving unusual wearing surface upon the cross-head. The square corners have been omitted upon the cylinder, which serve no purpose but to make unnecessary machining. The entire top of the cylinder is covered with cast iron plate, so that the necessity for lagging the top is obviated. When lagged with wood it may become unsightly and is often burned. In valve gear and regulating mechanisms the same fixtures are used as formerly employed by this company in its older pattern of engine, the regulating device having proved thoroughly satisfactory for delicacy of adjustment, and hence the closest regulation.

Chicago, Ill.—The city authorities have approved the plans of the Metropolitan West Side Elevated Railroad Company for a bridge to cross the Chicago River between Van Buren and Jackson Streets. It is made in two sections, which join in the center and is opened by lifting the two sections vertically. The parts are counter-balanced so that comparatively little effort is required to move them. An electric motor of twenty-four horse-power is provided for the opening and closing the bridge. The clear space between the piers for the passage of vessels is 108 feet. From city datum to top of tracks is thirty-seven feet nine inches. The bridge will have four tracks. The cost will be $150,000.

Toledo, O.—The grand jury has returned indictments against Albion E. Lang, general manager of the Consolidated Street Railway, and James J. Robinson, general manager of the Toledo Electric Street Railroad Company, because of their alleged failure to provide their cars with vestibules, as provided by a law passed by the general assembly last winter.

FINANCIAL DEPARTMENT.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers 184 Dearborn street, Chicago, said yesterday: "All the stock exchanges are looking toward the Chicago Board of Trade and watching closely the price of wheat for, if the market can hold its advance, then will come the salvation of the bulls. In West Chicago Street Railway the short interest is not lessened to any great extent and there has been some stock absorbed by the investment interests. North Chicago can scarcely be called a speculative stock any longer as the stock is nearly all in good hands. We look for higher prices in all stocks at the turning of the present account. The short interest in Diamond Match seems nervous; this being the most prominent stock on the Chicago Exchange at present, it will soon spread to the cables if the covering continues pronounced. This has been the dullest week yet in Tractions; on two days this week there were no transactions whatever in Philadelphia Traction, but the stock has been steady around 92 to 93. The usual crowds have been hammering at Baltimore but with little success and it was steady enough around 15½. Metropolitan quoted 101¼ and 101⅜; no sales to-day. People's, 28 sales and the bonds strong and advancing on constant investment buying up to 85½. Consolidated traction 5's 85. Any good sized orders to buy any of these stocks would probably send them very much higher."

City and South London Railway.—At the annual meeting of the City & South London Railway Company it was stated that while the report showed an apparent decrease in traffic on its underground electric road during the last six months, the number of holders of season tickets had increased. As a result the receipts showed an increase of £65 on the half year. The receipts per passenger were 1.65d., against 1.60d. in the previous corresponding half-year, showing a slight increase per passenger. As far as the working of the line was concerned, the president said that the railway had now been open for three years, and had shown that the electrical system is especially adapted to the special class of traffic. He thought it was pretty clear that electricity for metropolitan railways was going to be, and is, a cheaper mode than that of steam. Doubts were expressed in its early days as to the success of the system, but this has now proved beyond question. Their position as a company was a very solid one, wanting only the increase of dividend on the ordinary shares to make them rank as one of the first railways in the Kingdom.

Two Pennsylvania Roads Purchased.—After having bought up all the electric lines of the Lancaster Traction Company, the Pennsylvania Traction Company last week added two more lines to its system, purchasing the Columbia and Ironville Railway, which includes all of the lines in Columbia, and the Columbia and Donegal Railway, which connects Columbia and Marietta. For the Columbia and Donegal the Traction Company paid $75,000, $30,000 in cash and the rest to be paid April 1. For the other line $90 per share were paid, being $40 above the par value. The company takes possession of this road on July 1, but has already entered into possession of the other line.

Sioux City Railway Judgment.—In the District Court in Sioux City, February 21, judgment was given in favor of the Fidelity Loan & Trust Company against the Sioux City Street Railway Company for $558,000 on its bond issue. A decree foreclosing the trust deed was given to secure the bonds issued. The bondholders have until one year from date to file their bonds with the trustee, at the end of which time the bondholders will reorganize the company and capitalize it for an amount equal to the bond issue.

Westinghouse Preferred.—The *Boston Beacon* says: Westinghouse preferred is the best and cheapest electric security on the list. It is practically a 7 per cent. bond selling at 90 and 95. Every day it becomes more and more clear that the only money to be made in the electrical field is by confining operations to the legitimate. The Westinghouse confines its business strictly to the manufacturing of electrical apparatus for money, and the wisdom of the Westinghouse policy is abundantly justified by the success of the company to-day.

Portland, Ore.—Persons who reside in the territory between Portland and Beaverton have agreed to give a bonus of $75,000 if the railway to be built on First street is extended to the latter place. It is stated that the amount has been almost entirely subscribed.

Kansas City, Mo.—The Kansas City Railway Company has increased its capital stock from $10,000 to $200,000.

Elkhart, (Ind.) Railway Sold.—The property of the Elkhart Electric Street Railway was sold recently by Receiver Fish, on order of the court to satisfy first claims of something like $20,000. The property was bid in by O. N. Lumbert for $21,000.

New Incorporations.

Rockford, Ill.—The Rock River Electric Railway Company has been incorporated to build an electric railway from Rockford to Dixon. The capital stock of the company is $500,000 and the officers are: President, James S. Ticknor; secretary, Harry B. Andrews, and treasurer, George E. King. Mr. Ticknor is the president of the West End Street Railway Company of Rockford. He is responsible for the statement that work will be begun on the line in the spring. The distance to Dixon by the river route is 38 miles. The company proposes to carry mail and express as well as passengers and it is its purpose eventually to carry freight.

Burlington, Vt.—The Mt. Mansfield Electric Railroad Company has been incorporated to construct and operate an electric railway between Waterbury and Stowe, a distance of ten miles. The estimated cost of the enterprise is $150,000. The road is to be equipped for both freight and passenger service, and water power will be utilized. The directors are: E. D. Blackwell, O. E. Luce, W. P. Dillingham, G. E. Moody, Charles Dewey, F. O. Burt, M. C. Lovejoy. E. D. Blackwell is president; O. E. Luce, vice-president; L. A. Pike, clerk; L. Moody, treasurer.

Conneaut, O.—The Kinsman & Farmdale Railway Company has been incorporated with a capital stock of $10,000. The company proposes to build a two-mile road and operate it either by horses or electricity.

NEWS OF THE WEEK.

Chicago, Ill.—One man was killed and three women were injured in an accident in the La Salle street tunnel on February 19. The brakes on a combination car belonging to the North Chicago Street Railroad Company failed to work when the car struck the steep grade of the tunnel. As the speed increased the passengers became alarmed and four jumped from the car. Mr. H. S. Holden leaped from the rear platform just as the car reached the foot of the grade, and as he struck his head on the wall he fell unconscious across the track. The car had acquired sufficient momentum to carry it for a short distance up the incline leading to the south end of the tunnel. It then started back again, with sufficient force to carry it beyond the point where Mr. Holden lay. It struck him and killed him instantly. The other passengers who were hurt sustained their injuries in jumping from the car.

Montreal, Que.—A party of property owners recently accepted an invitation to inspect the line of the Park and Island Railway. Mr. Williams on behalf of the company stated that before the present year was finished the road would be extended from Montreal to Lachine, through Kensington, around the two mountains and cemeteries, ending at Sherbrooke street, Cote St. Antoine, making about 45 miles of completed line. It is also the intention of the company to construct a route to Lachine from Sherbrooke street and Victoria avenue, Cote St. Antoine, to Kensington on Sherbrooke street level, thence west to Lachine, with the ultimate object of reaching St. Anne and other points on the shore.

New York, N. Y.—The special committee of the Chamber of Commerce appointed to consider the subject of rapid transit and what action the Chamber should take toward securing it made its report last week. The report is in favor of the city lending its credit to corporate enterprise for the construction of a rapid transit system, the loan not to exceed two-thirds the cost of construction, or in the aggregate the sum of thirty million dollars. The committee points out the pressing necessity of rapid transit and the incalculable value which its realization will be to the city. "Further delay," it says, "is so dangerous that exceptional measures are necessary to insure success."

Philadelphia, Pa.—The management of the Delaware River and Lancaster railroad, which runs from French Creek Junction, on the Pickering Valley branch of the Reading, to the Falls of French Creek, there connecting with the Wilmington and Northern, is considering the advisability of operating the road by trolley. Steam has proven too expensive as the motive power, and for the past two months the road has not been operated. It is said that the electric power will be secured from a station to be built at Falls of French Creek, and it will be run by the waters of the creek.

Camden, N. J.—Overtures have been made looking to the extension of the electric railway from Merchantsville to Stanwick, and the Camden Horse Railroad Co. has expressed its willingness to co-operate with local capital looking to this extension. A number of prominent men have pledged from $1,000 upward toward building the road, and assurances are given that the road will be in operation during the coming summer.

Need of a Railway in Marion.—The necessity in Marion is daily growing, and at any time during the past five years one operated here would have been a straight 20 per cent. investment on the stock if the income would not all be used up by paying a few pets double the salary that any business man or firm could pay them and leave the stockholders to hold the bag.—*Marion (O.) Independent.*

Philadelphia, Pa.—The Electric Traction Company has purchased property on Delaware avenue near Laurel street for a power-house site. The engines will be furnished by the Southwark Foundry & Machine Company. The contract for girder rails has been let to the Pennsylvania Steel Company.

Brooklyn, N. Y.—The highway commissioners of the town of Flatbush have granted franchises on several streets to the Brooklyn City Railroad Company and the allied Broadway Railroad Company.

Freeport, Ill.—A site for the electric street railway has been purchased, and it is stated that work on the building will be begun within two months.

Harrisburg, Pa.—Ordinances have been passed and approved, giving the Valley Passenger Railway Company the right to make three extensions.

St. Louis, Mo.—Work is to be begun at once on the Manchester electric railway. The power house will be located at Benton.

Norwalk, O.—The Sandusky, Milan & Norwalk Electric Railway Company has decided to conduct an express business.

Belleville, Ill.—Construction was begun on the electric railway last week. It is expected that the line will be extended to East St. Louis next summer.

PERSONAL.

H. Ward Leonard read a paper before the American Institute of Electrical Engineers on Wednesday evening of this week on "How shall we operate an electric railway extending 100 miles from the power station?" It was announced that a proposed arrangement of apparatus for this purpose would be shown in operation at the meeting.

Wilbur M. Stine, head of the electrical engineering department of the Armour Institute, has gone to Florida where he will probably remain for some time on account of the illness of his wife.

E. F. Seixas has accepted a position with J. L. Barclay, 1645 Monadnock Building, Chicago, who will represent the Walker Manufacturing Company of Cleveland.

F. E. Degenhardt, manager of the Chicago office of the Standard Underground Cable Company, has returned after a five weeks' trip in the West.

G. J. Meims, formerly superintendent of the Hinsey Street Railway of Milwaukee has returned from his trip to Europe.

TRADE NOTES.

H. F. J. Porter, who was first assistant mechanical engineer at the World's Fair during its period of construction, and afterward assistant chief of the mechanical department, has formed a partnership with Albert Fisher, formerly Chicago representative of the Ball, Watertown and Greene engine companies, and together they have opened an office at 1025 Monadnock Block where under the name of Fisher & Porter, they will carry on a contracting engineering business in the line of complete equipment of steam plants, giving especial attention to large work. They have been made western representatives of the Providence Steam Engine Company, sole builder of the improved Greene engine, and of the Altoona Manufacturing Company, builder of the M. A. Greene engine. Thus handling high grade engines of both the slow and high speed types, they are prepared to meet any demand for work in that direction. They are making arrangements with other Eastern manufacturers as agents, and expect to be ready in other lines to take advantage of the recuperation of business, of which they report that they already see indications.

The Berlin Iron Bridge Co. of East Berlin, Conn., will furnish the roof for the new electric light station of the Citizens' Electric Light, Heat & Power Company, of Lancaster, Pa. The same company will furnish the iron roof over the dye house of Geo. C. Hetzel & Co. of Chester, Pa.

RECORD OF STREET RAILWAY PATENTS.

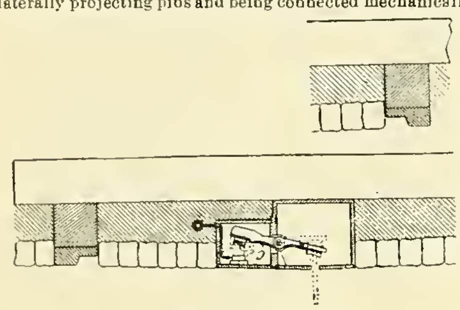
Patents Issued February 6, 1894.

513,982. Electric Conductor. Horace F. Chick, Watertown, assignor of two thirds to Frank A. Spooner and Ronald A. Stuart, Boston, Mass. Filed May 1, 1893.

This is an electric conductor comprising one or more insulated conducting strands or groups of wire, a braided fibrous jacket enveloping the same, and a braided wire protecting jacket.

514,037. Railway Switch. Augustin F. Schinner, Milwaukee, Wis. Filed June 5, 1893.

In a device for shifting a railroad switch, the combination with a plurality of electro magnets, and a metal core reciprocative endwise in the magnets, said core having laterally projecting pins and being connected mechanically to and so as by its movement to actuate the switch point, of a sliding and tilting bar provided with fingers adapted to engage the core pins and in its alternate positions to close and complete electric circuits through the magnets for actuating the core.



NO. 514,056.

514,047. Dynamo and Motor. Montgomery Waddell, Bridgeport, Conn. Filed March 13, 1893.

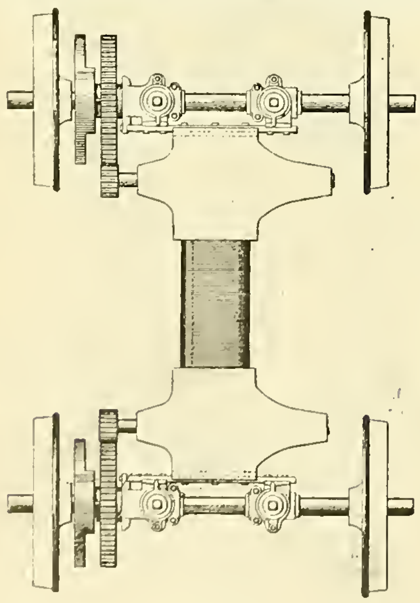
This is the combination with an armature shaft, of an extension thereof on the commutator side of the armature, the end of the extension forming a bearing, a device adapted to support commutator brushes on said bearing, and means preventing rotation of said device.

514,056. Conduit Electric Railway. Rufus C. Beardsley, Lafayette, Ind. Filed April 26, 1892.

In an electric railway system, the combination of a slotted conduit, electric switches arranged alongside the same at intervals, a traveling vehicle and an operating device connected with said vehicle and consisting of a rod connected solely at its ends with the car and bent downward to extend into the slotted conduit and of sufficient length to bridge two or more of the switches. (See illustration.)

514,109. Electric Car Truck. Chas. F. Winkler, Kingston, N. Y. Filed May 22, 1893.

In a car truck, the combination of an axle, a disk rigidly fixed thereon, two pairs of parallel rods flexibly connected with the disk and located upon opposite sides of the center, a gear wheel loosely mounted upon the axle and provided with two pins at diametrically opposite points, said pins projecting between the rods on the disk for the purpose of connecting the disk and gear wheel together. (See illustration.)



NO. 514,109.

514,112. Closed Conduit Electric Railway. Frank M. Ashley, Hawthorne, N. J. Filed December 23, 1892.

This is the combination of a closed conduit, a traveling switching apparatus moving therein, a railway track forming a portion of the working circuit and supplied with current through the said traveling switching apparatus, a car moving on said track, a trolley carried by the car but running on the car track and an electro magnet carried by the trolley and acting upon the traveling switching apparatus.

514,113. Electric Railway. Frank M. Ashley, Hawthorne, N. J. Filed December 23, 1892.

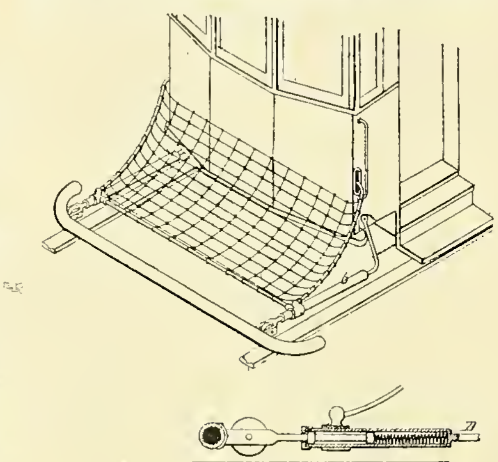
This invention covers the combination of an overhead wire divided into sections, an underground wire divided into corresponding sections, branch wires connecting the corresponding sections of the two wires together, and a hanger located at the joints, between the sections of the overhead wires, the same consisting of two metallic plates bolted to the opposite sides of a block of insulating material, the ends of the wire sections being connected respectively to the two metallic plates and a said branch wire connected to one of said metallic plates.

514,114. Electric Railway Conduit. Frank M. Ashley, Hawthorne, N. J. Filed December 23, 1892.

This is a conduit divided into two compartments located in the same horizontal plane, one of which is closed and the other open, a traveling switch moving in the closed conduit and rails located above and below the switch upon which the latter runs, one of said rails being sectional, and a sectional conductor located in the open compartment with its sections connected respectively with the sections of the sectional rails.

514,120. Electric Railway. Oscar A. Enholm, New York, N. Y., assignor to Edward C. Reiss and John J. Ashley, Brooklyn, N. Y., and Frank M. Ashley, Hawthorne, N. J. Filed October 3, 1892.

The first claim of this patent reads as follows: "In a conduit system for electric railways a conduit divided into two longitudinal compartments, one sealed and the other open, a circuit-controller running in the sealed compartment, a collector running in the open compartment, and electro-magnetic apparatus carried with the collector and controlling the movements of the circuit-controller."



NO. 514,121.

514,121. Safety Guards for Street Cars. Geo. T. Foster, Rochester, N. Y. Filed May 6, 1893.

This comprises the combination of cranked arms pivoted to the car, curved rods attached to said arms at one end, and connected with slotted keepers at the other, a cross rod connecting the arms, a network attached to the frame, a pneumatic fender, shafts provided with rollers, said shafts entering sockets of the arms, and springs for forcing the fender forward. (See illustration.)

514,133. Underground Electric Conductor. Henry A. Seymour, Washington, D. C., assignor to the Short Electric Railway Company, Cleveland, O. Filed August 30, 1890.

This covers the combination with a tube flexible on its under side, of an electrical conductor located within the tube and supported therein out of contact with the inner walls of the tube, and electrical contacts secured to the under side of the tube and adapted to be lifted into contact with the electrical conductor by an under running trolley.

514 134. Closed Conduit for Electric Railways. Henry A. Seymour, Washington, D. C., assignor to the Short Electric Railway Company, Cleveland, Ohio. Filed August 29, 1892.

This is the combination with a conduit, an inverted rigid shell located within the conduit and beneath the slot therein, of an electric conductor secured within the shell, a flexible diaphragm attached to the depending edges of the shell, electrical contacts fastened to the diaphragm, and an under running trolley for lifting the electrical contacts into engagement with the conductor within the shell.

514,135 Motor Controlling Device for Electric Locomotives. Sidney H. Short, Cleveland, Ohio., assignor to the Short Electric Railway Company, same place. Filed January 6, 1890.

This invention covers the combination with the hollow post or stand, shafts mounted in said post and a crank arm secured to the lower end of one shaft and a crank arm secured to the lower end of the other shaft, of an electro-motor, a reversing switch, rheostat, a rod pivoted at one end to crank arm and at its opposite end pivoted to movable contacts of the reversing switch and another rod pivoted at one end to the crank arm and at its opposite end to the free end of the movable contact of the rheostat. (See illustration).

514,150. Commutator Brush. Jesse F. Kester, Buffalo, N. Y., assignor to the F. P. Little Electrical Construction & Supply Co., same place. Filed November 23, 1893.

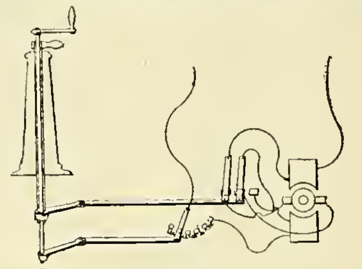
This is a lubricator leaf for commutator brushes provided with interstices filled with a lubricating material composed of beeswax, spermaceti, graphite and stearic acid.

514,221. Insulator. Lawrence B. Gray, Boston, Mass. Filed June 22, 1893.

The first claim of this patent reads: "In an insulator, the combination of the peg having the threaded end and its support, the main section of an insulator having the thread to engage the threaded end of the peg, and a supplemental insulating section clamped or held by the main section when screwed upon the peg between it and the peg support."

514,224. Rail Joint. Reinhold Herman, Crafton, Pa. Filed June 23, 1893.

A chair or shoe for rail joints having in combination a base plate, a side plate, an abutment adapted to form an end bearing for a rail and its upper surface to form a continuation of the rail tread, and a stop plate for preventing a movement of the chair across its support. (See illustration).



NO. 514,135.

514,234. Safety Car Fender. George Latz, Baltimore, Md. Filed August 24, 1893.

The combination with the truck-frame of a car, of a safety fender constructed with spaced slats the higher portion of which is placed horizontally and the lower portion projecting forwardly and downwardly-inclined with an eye at the lower end thereof; and a connecting bar which extends through the eyes of all the slats.

514,274. Electric Trolley Wheel Shield. Henry S. Pruyn, Hoosick Falls, N. Y. Filed May 10, 1893.

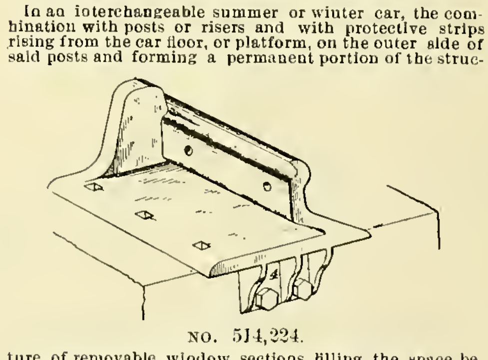
This is a trolley wheel for electric railways provided with a shield covering its upper side, the shield provided with a gutter to carry off water.

514,303. Series Electric Railway. Michael A. Cattori, Rome, Italy. Filed May 18, 1893.

The fourth claim of this patent reads as follows: "In an electric railway comprising a conductor of the kind described, a track crossing comprising a movable conducting piece located at the point of intersection of the tracks and adapted to be brought in line with the conductor of either track, electric connections between the opposite sections of each conductor adjacent to the crossing point, and means for electrically connecting the movable conducting piece with that conductor with which it is brought in line."

514,332. Railway Car. Chas. H. Newbury, St. Paul, Minn. Filed November 23, 1893.

In an interchangeable summer or winter car, the combination with posts or risers and with protective strips rising from the car floor, or platform, on the outer side of said posts and forming a permanent portion of the structure, of removable window sections filling the space between the upper edges of said protective strips and the upper portion of the sides of the car.



NO. 514,224.

514,353. Trolley Wire Shield. Louis Eschner, Philadelphia, Pa. Filed April 30, 1892.

This is the combination of an open bottomed shield or guard, an internal insulating block mounted upon one side of said shield, and a conductor secured to said insulating block and having both an upwardly projecting and a downwardly projecting flange beyond the same whereby it is adapted for receiving a trolley either from above or from below.

514,389. Cable Grip. Jno. A. Tauberschmidt, Washington, D. C. Filed August 16, 1893.

In a cable grip the combination with pivoted jaws forming the lower grip member, said jaws having lateral openings with upper inclined walls, of an upper grip member having lateral locking projections adapted to engage said inclines to open the jaws.

514,429 Regulator for Electric Motors. Sidney N. Short, Cleveland, Ohio, assignor to the Short Electric Company, same place. Filed January 26, 1891.

The combination with the driving axles of a car, of a propelling electric motor connected with each axle, two field commutating switches, one for each motor, loops from the switch contacts including the coils of the field-magnets whereby the coils may be connected in series or in parallel, a rheostat, and means whereby the rheostat and field commutating switches are actuated by the same appliances.

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CONTENTS.

Return Circuit Troubles. The discussion on rail bonding and allied topics, brought out by Mr. Vail's paper before the Washington Convention of the National Electric Light Association was of considerable interest. Both Mr. Vail's paper and the discussion are given elsewhere in our columns. Mr. Vail certainly succeeded in bringing out some important facts relating to the unsatisfactory and expensive methods of rail bonding now in use on many, in fact, nearly all, electric roads. The method proposed by Mr. Vail to assure a better return circuit is a step in the right direction for the prevention of the electrolytic effects of return currents. A more nearly complete metallic circuit will beyond a doubt greatly assist in establishing a more satisfactory and economical service. On the other hand it is evident that the plan of welding the track into continuous rails is to be given a thorough test and it will be of interest to see how far this method, as commercially carried out, will go toward avoiding electrolytic effects.

The Vestibule Question. Motormen and gripmen as a rule certainly favor the equipment of their cars with vestibules, and legislatures seem to sympathize with them in their desire for protection in winter. Bills compelling companies to equip cable and electric cars have been introduced in several states, and in Ohio and Minnesota acts have already been operative this year. Recently a measure of this sort has been under consideration in the Maryland legislature and it is noticeable that ex-Governor Bowie of the City Passenger Railway Company, of Baltimore, has appeared at Annapolis in opposition to it on the familiar ground that the storm front would tend to lessen the efficiency of the men in the management of their cars. He thought the danger of accidents would be materially increased. Speaking for the men on his road he said: "My employes do not want the bill; they appreciate the responsibility of their position and do not want to be hampered." Mr. Keiffer, the author of the bill, told a different story of the desire of the men generally. "I have seen them so benumbed by the cold," said he, "that they were really not in fit condition to be in control of the cars." These are the two sides of the question, but we think that as a rule street railway managers are now inclining more to the position assumed by the majority of gripman and motormen. Experience has convinced many of them that protection will not interfere with the men in the discharge of their duties if a proper form of vestibule is provided, and, being convinced, they are willing and anxious to make them as comfortable as possible during the cold weather. A number of experiments have been made in this direction during the last winter and the vestibule should not be unconditionally condemned without investigation.

Washington Convention. In the opinion of those present at the Washington meeting of the National Electric Light Association during the week the gathering was one of the most satisfactory that the association has ever held. Although the delegation from the west was not as large as it might have been, had the general conditions of business been more favorable, the representation from eastern cities was all that could have been expected. There was about the entire affair an air of business that placed the meeting, so far as this particular feature was concerned, far in advance of its predecessors, and this too in the face of the adverse conditions that surround the general business of the country. Another encouraging feature was the large attendance at the sessions of the convention. These were probably as satisfactory as any of the sessions of former conventions, and there was evidence that the more experience the managers of central stations acquire the better able they are to take part in and profit by the discussions brought up at the annual meetings. The exhibits were not extensive in character but were made not merely for exhibition purposes, but with the idea of giving possible customers an idea of the character of the goods and an opportunity of examining and becoming thoroughly acquainted with their prominent features. It was not an exhibit to attract the eye of the general public but was exactly what the central station man wanted, and for this reason was thoroughly appreciated. The meeting of the National Electric Light Association like those of the American Street Railway Association, are getting down to a business basis and the results obtained are much more satisfactory.

Minneapolis Transfer Ordinance Sustained. The city of Minneapolis has been successful in the proceeding to establish the validity of an ordinance providing that the street railway company should issue transfers on its cars at all junctions and at all intersections of its lines. The company has maintained for some time a new transfer system. It has confined the distribution of transfer slips to certain stations which it had established, being influenced by considerations of economy and by a desire to escape losses resulting from the carelessness or dishonesty of employes. The city council maintaining that this method of issuing tickets resulted in the crowding of streets at transfer points and that it was unsatisfactory to the public for a variety of reasons asserted its right to interfere by adopting an ordinance ordering a radical change. The court has sustained it in this contention. The case is one of great interest, not so much on account of the finding in the controversy, as because of the broad grounds on which the decision is based. Speaking of the city's right to regulate the street railway company's business the court says: "We are clearly of the opinion that the resolution and ordinance under which the respondent is now operating its road, is not a contract between it and the city, which cannot be modified or changed without the respondent's consent, that it is nothing more than a license or permit on the part of the city, to the respondent, to use certain streets of the city for street railway purposes, upon the conditions named and provided for in the ordinance and on such other reasonable conditions as the city may in future see fit to impose, and if the ordinance in question does not impose unreasonable conditions upon the respondent, it is valid and may be enforced." In other words the court holds that any interference with the affairs of the company is justifiable so long as it may be considered reasonable. How far a city council can go if this is the law, cannot be conjectured. It opens a wide field for speculation. A decision of this kind causes one to understand the statement attributed to Mr. Henry M. Whitney, formerly president of the West End Road, of Boston, that he was tired of investments in properties that were subject to constant attacks from public authorities. If a franchise from a city is nothing more than a permit which may be daily modified according to the whim of the grantor, its value is not what it is ordinarily assumed to be. The street railway company will appeal from the judgment of the Minneapolis court and according to the local papers, the case may be finally carried to the United States Supreme Court. We shall not be surprised if the sweeping decision is not sustained by courts of appeal.

Electric Power for Elevated Roads. It has been stated more than once that the Metropolitan West Side Elevated Railroad Company would operate by electric power the road which it will open in Chicago within a few months. Positive statements to this effect on investigation prove to be unwarranted, but at the same time it is not at all unlikely that electricity will be adopted. The officers have had the matter of motive power under consideration for a long time, and although at one time they had decided in favor of compound locomotives, they subsequently countermanded an order for engines as their investigations led them to believe that economy in operation would follow the installation of an electric system. If this conclusion is acted upon, as now seems probable, it may be considered one of the direct results of the successful working of the Intramural railway at the World's Fair, though just how successful that road proved in operation it has thus far been impossible to determine, for the simple reason that the data bearing on the question have been withheld. Within the last few days however one of the officers of the Metropolitan company has made the statement that the cost of carrying passengers was 1.4 cents each on the Intramural, and while this figure cannot be verified there are reasons for believing it to be exact, as the Metropolitan company has enjoyed exceptional facilities for securing information from reliable sources. The showing is certainly a good one when the cost is compared with the cost per passenger on the steam operated elevated road on the South Side in Chicago. Despite the fact that this latter elevated road had treble the patronage the cost per passenger during the World's Fair period is stated to have been 1.75 cents, or 20 per cent. more than the cost on the Intramural. The conditions under which the two roads were operated during the Fair, however, were so dissimilar that comparison may not be justified in all respects. The traffic on the Intramural belonged to a very large extent to the short haul class; while the reverse was true in the case of the Alley L road. This advantage was offset on the other hand in a great measure by the fact that the electric elevated road was subject to many expenses that were extraordinarily high because it was merely a temporary enterprise; at the same time the power plant was installed partially for exhibition purposes and its operation and maintenance were much more expensive than would have been necessary had its size been limited to the actual requirements of the road. But under the conditions favorable and adverse the road made such a showing in point of economy, that it is not surprising that the Metropolitan requires only a few more assurances regarding reliability before deciding upon an electrical system for the operation of its road.

STREET RAILWAY ACCIDENTS.

The monthly record of street railway accidents is presented herewith. The number of accidents during February was less than during the previous month when the record was 137. During the month the number of accidents noted in the principal cities was as follows: New York 7, Philadelphia 11, Brooklyn 11, Boston 10, Chicago 9, Minneapolis 3, St. Louis 5, Albany 3, Louisville 3. The February list is as follows:

Number of places in which accidents were noted	62
Total number of accidents	125
Accidents to electric cars	107
Accidents to cable cars	15
Accidents to horse cars	3
Number of fatalities	22
Fatalities due to electric cars	19
Fatalities due to cable cars	2
Fatalities due to horse cars	1
Number of persons injured	140
Persons seriously injured by electric cars	42
Persons seriously injured by cable cars	7
Persons seriously injured by horse cars	1
Persons slightly injured by electric cars	82
Persons slightly injured by cable cars	8
Persons slightly injured by horse cars	None.
Number of passengers injured	50
Number of employes injured	18

CAUSES OF ACCIDENTS.

Attempting to cross in front of cars	32
Collision with vehicles	28
Collisions of cars	15
Attempting to board car	7
Alighting from a car	4
Fell from a car	4
Collisions with Sleds	3
Brakes failed to work	5
Cars jumped the tracks	4
Collision with train	2

NATIONAL ELECTRIC LIGHT CONVENTION.

The annual convention of the National Electric Light Association, which was held this week at Washington, D. C., was a successful meeting in every respect. The attendance was large, and while the Western delegation numbered fewer members than had been anticipated the East was well represented. The business meetings were held in the G. A. R. Hall, and the first session was opened Tuesday morning by an address by the president, Judge E. A. Armstrong, of Camden, N. J. The president spoke at length against the growing tendency towards municipal ownership, and the disregard shown by the advocates of that doctrine of the rights and property of private companies. Following is an extract from the address:

"The history of the past year has not been varied, except for the rocks and difficulties to which I referred, from the history of those that have preceded us. There has been a tendency in the last few months, however, for a revival, largely instigated, I am afraid we will have to say, by the representatives from large manufacturing corporations, of the agitation of municipal ownership of electrical light plants. I sincerely believe that to be a bad policy for the city, as I have always maintained. I believe it to be a worse policy for the manufacturing concerns that advocate it. But no city can ever afford to do an unfair thing."

Judge Armstrong concluded his address by referring somewhat at length to the property of the Association.

C. H. Wilmerding of Chicago made an informal report of progress for the committee on legislation. A discussion followed regarding the best means of investigating electric light legislation, and of opposing measures inimical to the industry. The matter was referred to the executive session.

Dr. Gatling, the famous gun inventor, president of the American Inventors' Association, was introduced and made a brief address in which he commented upon the marvelous progress science had made within the last few years, and called attention to the necessity of guarding the patent system and protecting the rights of inventors.

At the afternoon session reports of the committees on data, underground conduits and conductors and rules on safe wiring were presented. A paper was read by Walter E. Harrington on "Faults Incident to the Protection of Lighting and Power Circuits." Prof. T. C. Mendenhall, superintendent of the coast survey, made a brief address in which he requested the coöperation of the association and the members individually in securing the passage of an act legalizing the electrical units adopted by the congress at Chicago. A resolution favoring the act in question was adopted.

At the morning session on Wednesday J. H. Vail read a paper on "The Importance of Complete Metallic Circuits for Electric Railways," which appears in full elsewhere in this issue together with a synopsis of the discussion which followed it. A discussion on storage batteries followed. During the remainder of the session and in the afternoon topics relating to arc lamps were discussed.

On Thursday the following officers were elected:

President, M. J. Francisco.

First Vice-President, C. H. Wilmerding.

Second Vice-President, Frederick Nicholls.

Executive Committee, Charles R. Huntley, W. W. Carnes, A. Markle.

TRANSFER ORDINANCE SUSTAINED IN MINNEAPOLIS.

The District Court in Minneapolis has sustained the city in its contention with the street railway company in reference to transfer slips. The Harvey ordinance, so called, which provides for the issue of transfers on cars instead of at transfer points is indorsed by the court and a peremptory writ of mandamus was ordered to compel the company to conform to its provisions.

The court finds, in substance, that the street railway company is operating its railway on certain streets by virtue of a license or permit from the city council and not by virtue of any contract, and that the city has reserved the right in the ordinance granting the permit to regulate by further ordinances the conduct of the street railway company in operating its lines. In the findings of fact the court goes on to cite the present manner of issuing transfers at the central station by agents standing in the streets or on the sidewalks. In the summer months, the court says, when the travel over the street car lines is heaviest, it finds that 1,800 passengers per hour arrive and leave the central transfer station and that passengers thus arriving and departing are exposed to peril and danger in getting their transfers. Continuing the court finds:

"That as the mode of issuing transfers is now regulated by respondent, as aforesaid, large numbers of passengers are daily and constantly compelled, in order to obtain transfers to connecting lines, to ride from the point where the line on which such passenger then is, first joins or intersects the line on and to which such passenger is entitled to and desires a transfer, to said central station, and back to the point of intersection, thus subjecting the passenger to unnecessary inconvenience and loss of time, and resulting in the crowding of respondent's cars between said points beyond what they would be were the transfer checks issued to the passenger, and he permitted to proceed on his journey from the point of intersection. That it is frequently the case that respondent's cars leaving said transfer station, where transfers are issued as aforesaid on the street, are crowded far beyond their seating capacity, and to the extent that many passengers are compelled to stand in the aisles of the cars and even on the platforms, and are thereby subjected to inconvenience and danger; and that said present mode of giving transfers contributes to produce this crowded condition of the car, with its attendant inconvenience and danger to the passengers thereon.

"That the said central transfer station on Hennepin avenue, between High street and Washington avenue, and said transfer points on the corner of Hennepin and Third street, on the corner of Washington avenue and First avenue south, and at the corner of Washington and Hennepin avenues, are in the business center of said city, and the volume of travel upon the streets at these points, both by foot passengers and vehicles, is very great. That the present method of issuing transfers in the streets largely increases the number of people thereon at the transfer station and points aforesaid, many of whom stand in the street, while the respondent's agent issues the transfer checks, and until the arrival of the next car upon the connecting line, the effect of which is to obstruct the free use of the street and the passage of vehicles and foot passengers thereon.

"That at the intersecting of Third street and Hennepin avenue, Hennepin avenue and Washington avenue, and Washington avenue and First avenue south respectively, respondent has erected in the street, on the sidewalk, structures four feet or more in diameter and several feet in height, for the use and shelter of its transfer agents, which structures are so used by such agents in the course of their employment.

"That the cost of maintaining the transfer stations and issuing transfers as the same are now issued by respondent's agents stationed in the streets, amounts to \$10,000 per annum; which expenditure will be unnecessary if transfers are given on the cars in the manner provided by the ordinance thereby sought to be enforced; and compliance with said ordinance by said respondent will impose no new or other expense upon said respondent, except such as may be incurred by the employment of clerical help to guard against possible fraud or dishonesty on the part of the respondent's conductors, which latter expense will in no event exceed said sum of \$10,000."

BOSTON SUBWAY PLAN.

The subway commission of Boston has just issued a statement which gives the details of its plan for relieving the congested district. The principal points in the document are as follows:

IN GENERAL—The plan provides for the construction of subways, partly for two and partly for four tracks, about 10,000 feet in length, at an estimated cost of \$3,500,000, and the purchase of the necessary real estate for terminals and stations at an estimated cost of \$1,500,000, making a total of \$5,000,000.

SOUTHERN TERMINUS.—A point on Tremont street at or near Pleasant street.

NORTHERN TERMINUS—At or near the new Northern Union Station.

ROUTE BETWEEN TERMINI—Pleasant street to Scollay square via Tremont street, Scollay square to new Washington street, through Haymarket square and the old Boston and Maine Station location to Causeway street. The exact route between Scollay square and New Washington street has not been decided upon. It may be by two double-track subways, one through Cornhill and the other through Brattle street, the two joining on Adam's square; or it may be by carrying the four-track subway under Hanover street.

BRANCH SUBWAY—A branch subway to enter the Tremont street subway at the corner of Boylston and Tremont streets, and move on independent tracks through the city. Into this branch can be gathered all the cars passing through Boylston street.

STATIONS.—Terminal stations to have covered platforms from 200 to 300 feet long, with about 2,000 feet of side track for storing cars. Besides the terminal at Causeway street, stations to be placed on Adams and Scollay Squares, or near by; at or near the corners of Tremont and Park streets, Tremont and Boylston streets, Tremont street and Shawmut avenue, at Park Square, Berkeley street and such other points as further study may indicate as desirable.

THE EXTENSION.—The Subway act of 1893 provided for a subway from Pleasant street to Scollay Square only. The present plan extends the subway to Causeway street, and involves these additional points: To take the abandoned Haymarket Square station; to widen Canal and Haverhill streets with sidewalks from 15 to 20 feet wide; to extend from Market street to Haverhill street, and to bring the subway to the surface at Travers street, with eight tracks between Travers and Causeway streets—four terminal tracks to accommodate traffic to and from the Northern station, two other tracks for Charlestown, and two for Somerville and East Cambridge.

CONSTRUCTION.—A four-track subway, to be in general 46 feet wide by 15 feet high, extending from the northern terminus to the corner of Tremont and Boylston streets. From this point the two easterly tracks will continue along Tremont street to Pleasant, while the two westerly tracks will continue along Boylston street as above described.

ELEVATED ROAD CONNECTIONS.—Subway could be connected with an elevated road beyond its terminals, as well as with the present surface system.

RENTAL.—The plan provides that the rental to be paid by the company leasing the subway shall be finally passed upon by the Railroad Commissioners.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Ninth Article.*)

I next constructed a paper spool on the armature B, similar to those placed on the legs of A, and wound it as full as I could get it of insulated wire. I counted the number of turns and found it to be 421. I may say here, that all of these dimensions were accidental, and are only given to show what actual results were obtainable from them.

The object of placing the coil on the short piece B, which we will hereafter designate as the armature, was to show what effect the snapping of the lines of force which thread a solenoid, or their sudden appearance in the same, would have upon the solenoid. It is evident that if no current be traversing the coils on A there will be no lines of force traveling around them. If, however, we place B in contact with A we have practically a closed magnetic circuit, and if after having detached one of the wires from the battery we touch it to its binding post, the full strength of the magnet will be instantaneously developed, all of the lines of force of which our apparatus is capable will be instantaneously developed in A and will rush out of the north pole, thread their way through the armature B, which is the core of our solenoid, and enter the magnet again at the south pole.

If we now break our electric current again the lines of force traversing the magnet and the armature coil will be as suddenly snapped and disappear, the result being the same, though more effective perhaps, as if the armature B were suddenly jerked away from the magnet while the latter retained its full magnetic properties. To discover the effect of the sudden introduction within, or withdrawal from the armature coil of these lines of force, let us connect its two ends with our solenoid, Fig. 2. Next, take a very small needle that has been previously magnetized and suspend it at its center, so that it will hang horizontally. Use a coarse spiderweb for suspension if possible, as even the finest thread is a little stiff and has a twist which will interfere more or less with the action we are looking for. Hold the solenoid up to the needle so that the latter projects for about one-third of its length into the solenoid. If one of the battery wires is discon-

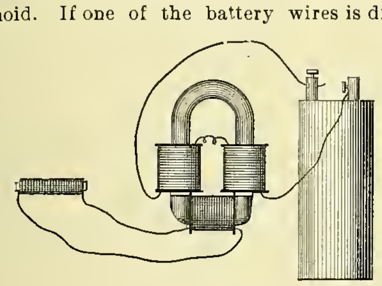


FIG. 19.

nected from the battery, make the connection by touching it to its binding post. This, as we have seen, will cause a rush of lines of force through the armature core. Note the behavior of the needle as this rush occurs. It will give a sudden kick, either outwardly or inwardly, showing that the solenoid has momentarily exerted upon it either a force of attraction or one of repulsion. But it is only momentarily for if the conditions remain the same, the needle after swaying back and forth a few times will come to rest again in exactly the same position that it assumed before the lines of force traversed the armature core. The lines of force are still there, but there is neither attraction nor repulsion of the solenoid. Now break the battery circuit so as to suddenly withdraw the lines of force. Another kick will be noticed in the needle, but in the opposite direction. If the solenoid exerted an impulse of *attraction* when the lines of force passed into the armature core, it will exert an impulse of *repulsion* when they are suddenly withdrawn. Next reverse the ends of the armature and repeat the experiment without changing the position of the solenoid or its connections. In the reversed position of the armature, the end that was before in contact with the north pole of the magnet will be in contact with its south pole and that which was in contact with the south pole will be against the north pole, so that the lines of force as they enter and withdraw in the same directions with regard to the magnet have opposite directions with respect to the coil. As they enter, the solenoid will be found to *repel* and to attract where they withdraw.

Now modify the experiment a little. While the magnet remains excited, jerk off the armature

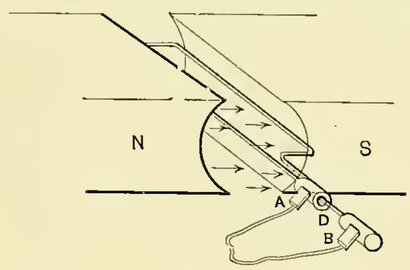


FIG. 20.

and then replace it. Exactly the same effect will be produced upon the needle by the solenoid as before when the current was alternately broken and closed. Next disconnect the solenoid and connect in its place in the armature circuit the flat coil, Fig. 6, which we employed in our galvanometer. Hold this directly beneath the needle with its wires parallel with the latter. Upon breaking and making the battery circuit or pulling off or putting on the armature we will find that the needle receives momentary impulses which cause it to deviate alternately to the east and to the west. As with the solenoid the effect is only momentary and not sufficient in the present resistance to cause the needle to swing far, but by timing the makes and breaks, remembering that they give impulses in opposite directions, the needle may be caused to swing through gradually increasing arcs and finally to rotate completely around on its support.

We will have recognized before this that the action of both the solenoid and flat coil upon the needle was due to an electric current caused by the sudden introduction and withdrawal of the lines of force through the armature coil and that the direction of the resulting current changed as the number of the lines of force threading the coil, is increasing or decreasing. In fact had we a machine by which the armature could be rapidly approached to or removed from the magnet poles, we would have an alternating current generator producing currents in the armature circuit exactly similar to those employed in lighting by alternating currents, and if, further, we had a device by which the reverse currents after they are generated could be changed in direction to correspond with those which both precede and follow them, we would have in all respects a direct current generator. In fact almost before we have been aware of it, we have actually developed experimentally an electrical generator. It now only remains to develop the details by which the current generated is rendered continuous in one direction instead of alternating and practically steady instead of pulsatory as it would be were the currents we have just generated all sent in the same direction. We have also discovered that the electromotive force is not due to the actual number of lines threading the coil, for the same effect was produced when there were no lines—when the magnet was not excited—as when there was the greatest number—that is to say, there was no effect in either case, but the current flowed only when the number of lines was changing. The rule is that the potential difference, which gives rise to the current, is proportional not to the number of lines included by the coil but to the rate of change of the number of lines. In our experiments it was an almost instantaneous change from no lines to the full number we were able to generate and from that number to none again.

THE CONTINUOUS CURRENT DYNAMO.

In the dynamo of to-day a much more convenient method of varying the number of lines included in the coil is obtained by revolving that coil around an axis in a uniform magnet field.

In Fig 20 we have a representation of a single turn of wire revolving around one of its sides as an axis in a uniform magnetic field. In the position shown none of the arrows will be embraced by the coil but as we revolve it in the direction of the arrow it gradually will allow more and more lines of force to pass through it until it arrives at a position at right angles to the one shown when it will embrace the maximum number, but in this position its motion will be for a moment parallel with the lines of force, so that for a very small portion of its revolution near this position it will cut no more and no fewer lines. Its rate of cutting lines at this point being zero, no electromotive force and consequently no current will be generated. As it proceeds around through another right angle, the number of lines which the loop will include diminishes, gradually at first but more and more rapidly until the position of the loop is directly opposite that shown in the cut when it again becomes parallel with the lines and for a moment includes no lines, but as it passes this position the loop turns its other side to the north pole and commences to take in lines from the opposite side—that is to say, that with respect to the loop the direction of the lines is reversed. At this point the rate of change of the number of lines embraced by the coil is a maximum, because at one instant there were a few lines going through the coil in one direction and at the next there were the same number going through in the opposite direction, or there were just that many less than nothing going through in the original direction the second moment. The greatest rate of change in the number of lines embraced by the coil that can possibly occur takes place at this part of the revolution, and therefore at this point, in its path, the greatest electromotive force is generated. From this point to the vertical position of the loop at right angles to the lines of force, the rate of change becomes slower and slower, and the electromotive force less until the loop arrives at the latter position, when for a moment there is no change since its motion is for the time again parallel with the lines of force. No electromotive force is, therefore,

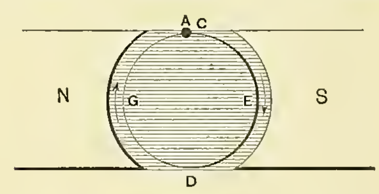


FIG. 21.

developed at this point in the revolution, but from here to the original position, shown in Fig. 20, the rate of change gradually increases again until it becomes a maximum once more in the position shown. It will be observed, therefore, that as the coil is revolved between the two poles of the magnet, the electromotive force generated twice reaches a maximum, once when the coil is in the position shown and again when 180 degrees from this position, and twice becomes zero, viz: when it is in the two positions at right angles to this plane. In each case as the electromotive force passes through zero, the current resulting changes its direction, so that in each revolution of the coil the current will flow, half the time, through the outside circuit from *A* to *B* and during the other half, in the contrary direction, from *B* to *A*.

The more usual way of explaining this generation of electromotive force is to speak of the rate at which a wire represented in section by the dot

C. Fig. 21 cuts the lines of force when revolved in a circular path A, E, D, C in a uniform magnetic field represented by the parallel lines. Referring to the figure, when the wire is at C, it is traveling for the moment parallel with the lines of force and therefore cutting none and generating no electromotive force. As it proceeds around from left to right it cuts these lines more and more rapidly. until at E it is moving at right angles to them where it cuts them at the maximum rate of its course. At this part of its path the highest electromotive force is generated. From E to D it cuts them less and less rapidly until it arrives at D, where its motion is again parallel to the lines and no electromotive force is generated. From D to C the rate again increases and from G to C decreases, but the direction of the current during this half of its excursion is in the opposite direction to that resulting from its course in the first half—the changes of direction of the electromotive force or pressure upon which the current and its direction depend, taking place as the wire passes through the positions where it cuts no lines, called the neutral positions, A and D.

While the same results are reached by explaining the action of a moving wire in a magnetic field in this way as in the other it is not strictly a correct explanation, for according to it the generation of electromotive force is made to depend upon the actual cutting of the lines of force by

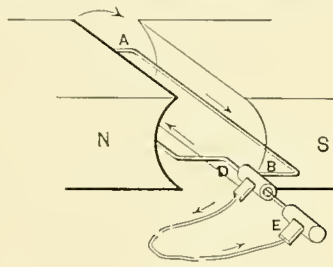


FIG. 22.

the moving wire. We have seen that this is not a fact, for in our experiment with the electromagnet, Fig. 19, we found that with our coil on B perfectly stationary we generated an electromotive force simply by making and breaking the battery connection with the magnet coils, thereby rapidly changing the number of lines from zero to a maximum and *vice versa*, that threaded through the armature core. In this case there was absolutely no cutting of lines. But as before stated, the same results follow both methods of explanation and the latter, although strictly speaking, not correct, is simpler and for that reason will be used hereafter.

Fig. 20 represents an electromagnetic generator in its simplest form.

It is more usual, however, instead of having a narrow coil revolving around one of its sides as an axis, to employ a larger coil and revolve it around an imaginary axis in its center as shown in Fig. 22. In this case when the coil revolves in the direction indicated, while the side AB cuts the lines in one direction, the other side, AD cuts them in the opposite direction. In the cut the end B is represented as terminating in the hollow cylinder B, through the axis of which passes the other end of the coil also terminating in a cylinder. Upon these two cylinders copper brushes are pressed to which are attached the two ends of the external circuit DGE.

CAR HEATING.—As a rule the street railway company has succeeded in keeping somewhere near the right degree of temperature in the cars which are provided with stoves. It seems to have been the aim to keep the cars from becoming over-heated even at the risk of allowing the temperature to fall lower than most of the passengers desire. This seems to us the proper policy. There is less danger in it. Even though the cars are not always as comfortable as a private parlor should be, it is better thus than that they should be heated to such a temperature as to render it dangerous to pass from them to the air outside.—*Buffalo Inquirer.*

HOW SHALL WE OPERATE AN ELECTRIC RAILWAY EXTENDING ONE HUNDRED MILES FROM THE POWER STATION?*

BY H. WARD LEONARD.

Let us suppose that we are called upon to act as engineers for a steam railway desiring to operate its line by electric locomotives. There exists a very economical source of power, possibly a water power, so situated that the length of railway to be operated in either direction is one hundred miles.

Let us determine the leading points of the specification for such a road based upon our experience to this date, and after making the specification, let us see whether we are to-day able to comply with the specification, and if not, what must be done before we can comply with it.

The following features seem desirable, if not essential, in such a railway:

1. A single trolley contact shall be used for supplying current to the locomotive.
2. The electromotive force upon the trolley shall not exceed 500 volts.
3. There shall be no apparatus in motion and requiring attention, between the power station and the locomotive.
4. No commutator, rheostat or controlling device on the locomotive shall be subjected to a higher electromotive force than 250 volts, and there shall be no sparking on any of the apparatus under any normal conditions.
5. The entire control of the locomotive in either direction shall be effected by the movement of one lever.
6. The load shall be started from dead rest by an amount of energy taken from the source of supply, which shall not exceed one quarter of the energy required to operate at full speed on the level.
7. The retardation of the load in coming down grades, and in stopping, shall be effected by converting the motors into generators, which shall feed back current to the line, and thereby assist the power stations in operating other locomotives.
8. The motor must be reversible when operating at full speed, without damage to the motors or other apparatus.
9. The efficiency of the system from power on the generator shaft to the draw bar pull of the locomotive, shall be at least 50 per cent.
10. The locomotive shall produce at least 500 horse power when operating at a speed of 80 miles per hour.

It will be evident that we must use a high electromotive force for operating over such great distances. The average distance over which the power is to be transmitted is 50 miles, and we find that in order to operate with a loss in conductors of 20 per cent., we must have an initial electromotive force of 20,000 volts, in order to make the cost of copper about $20 per kilowatt, which is about the best figure for cost of copper under the conditions.

The alternating current must evidently be used for such an electromotive force as this, and the single phase alternating, since we have but one trolley contact.

Let us start (see Fig. 1) with the standard 1,000-volt single phase alternators in our power station, and convert by step-up transformers from 1,000 to 20,000 volts required for the transmission circuit. Since we are limited to 500 volts upon the trolley, we must insert at suitable points, say every two miles, a converter, which will transform the energy at 20,000 volts in the transmission circuit, to energy at 500 volts in the trolley circuit, one pole of which latter circuit will be the rails.

We have our energy delivered at our point of use with reasonable cost and efficiency and by simple and well-tried apparatus. But the energy is in the form of a single phase alternating current which is not very flexible.

We can operate a synchronous alternating current motor by this current, but it cannot be regulated in speed or reversed in direction, and cannot be started under load, and will be thrown out of step if a large load be suddenly applied. As all of these conditions are required of locomotives, a motor operating by the alternating current evidently cannot be used directly.

But it is a simple matter to start the synchronous motor without load and when it reaches its synchronous speed it will perform work efficiently and satisfactorily, provided it be not subjected to violent fluctuations in the load applied to it.

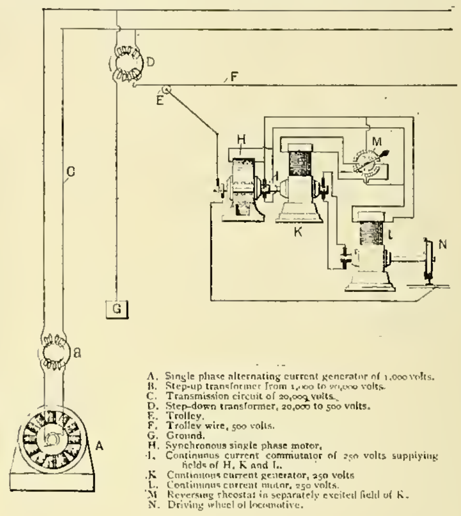
Evidently, then, what we need is some form of gearing between the synchronous motor and the axle, which will give us the desired control and enable us to operate at any speed and in either direction.

It is quite possible that this can be accomplished mechanically, and many ingenious devices for this purpose have been invented, but none seem to be sufficiently simple, reliable and lasting for use on such a large scale.

The equivalent of such a mechanical gear can, however, be secured if we will make use of the synchronous motor merely to drive a continuous current generator on the same shaft at a constant speed, and use the continuous current so generated to supply the propelling motors connected with the axles of the locomotives.

Since the generator is used for the motors on one particular locomotive only, we can vary its electromotive force at pleasure, and hence can produce a low electromotive force for low speeds, and increase the electromotive force to increase the speed and by this means avoid the loss of energy which is wasted in rheostats when motors are started under load, and when connected as usual upon a source of constant electromotive force.

In order to secure rapid changes in the electromotive force of this continuous current generator at will, it will be best to have its field separately excited which will also enable us to reverse its field at pleasure. The propelling motors can be series, shunt, or separately excited. The best results will be obtained by separately exciting the field, and keeping it fully and constantly excited



A. Single phase alternating current generator of 1,000 volts.
B. Step-up transformer from 1,000 to 20,000 volts.
C. Transmission circuit of 20,000 volts.
D. Step-down transformer, 20,000 to 500 volts.
E. Trolley.
F. Trolley wire, 500 volts.
G. Ground.
H. Synchronous single phase motor.
I. Continuous current commutator of 250 volts supplying fields of H, K and L.
K. Continuous current generator, 250 volts
L. Continuous current motor, 250 volts.
M. Reversing rheostat in separately excited field of K.
N. Driving wheel of locomotive.

and reversing the motors by reversing the field of the generator. which of course will reverse the current in the armature alone of the motor.

To secure this exciting current for the synchronous alternating motor. and also for the fields of the continuous current generator and motor, it will be best to drive by means of the alternating motor armature, and if desired in the same field, a continuous current winding connected to a commutator, from which will be led the current for exciting the fields of all three machines.

Let us wind the fields for 250 volts, and also use this voltage for the continuous current armatures. This pressure is perfectly safe and can be handled with impunity.

Suppose now the locomotive to be at rest. The synchronous motor is running and driving the generator armature at full speed in a field of no intensity, hence the propelling motors receive no current. We now make the first contact upon the rheostat in the generator field circuit and let the resistance in the rheostat be such as to produce say 25 volts at the generator brushes.

This 25 volts will supply a very large current to the motor armature at rest in its saturated field, and consequently will produce a sufficient torque to start the entire load and continue to move it at a slow speed.

We are using 25 volts and let us say 2,500 amperes in this circuit; this means 62,500 watts and disregarding transformation losses for simplicity this means a current of 125 amperes from the trolley. When operating at the rate of 500 horse power at full speed we shall need say 1,800 amperes and 250 volts in our propelling circuit, which is 150 kilowatts and means roughly 900 amperes from the trolley. It is evident therefore, that we can start the load with but a small fraction of the energy required for operation at full speed, and that there will be no danger of throwing the alternator out of step by applying but about one-sixth of its full load and applying that gradually as will be the case, as the load will follow the increase of the generator field strength, which although rapid, is gradual and not instantaneous.

If we are operating at full speed, and desire to bring the locomotive to rest, we gradually but rapidly reduce the strength of the generator field by manipulating the rheostat in its field circuit so as to reduce to zero the current exciting this field; the electromotive force produced by the

*Read before the American Institute of Electrical Engineers, February 21, 1894.

generator then rapidly falls below the counter electromotive force of the motors, which are being driven in a constant field by the momentum of the moving load, and the motors consequently become generators, and supply current to the former generator which now becomes a motor, and driving the alternator, feeds current back through the trolley, thereby not only bringing the locomotive smoothly and rapidly to rest, but saving the energy usually wasted upon the brake shoes.

Under this arrangement, if we are using steam engines as the source of power, we never subject the engines to the violent fluctuations ordinarily met with in electric railways, and by reason of having a comparatively steady load, can secure very high economy in the consumption of steam, and since we have eliminated the excessive load in starting, we can very much reduce the capacity of the engines, generators and conductors over usual requirements.

The reversal of the motors is very simple and smooth by this method. The lever of the rheostat in the generator field circuit is moved, so as first to reduce the current to zero, and then increase it again to its maximum but in the opposite direction around the field. The reversal of the motor armature, following the gradual change in the strength of the generator field, is extremely smooth, and the armature is not subjected to any sudden strain. No sparking will be met with under any condition, upon either the generator or motor commutators, or upon the field rheostat.

The combination of apparatus, and method of use I have described, enable us to conform fully with the specification given above, and while it is possible that the future may make this arrangement appear clumsy and crude, it has the present advantage of making use of apparatus we are all familiar with, and manufactured by a score of different concerns, and such an arrangement as I have described will serve a useful purpose until we can get the perfect single phase alternating motor, or the motionless transformer for continuous currents, which we have needed and waited for so long, and which many people even yet expect will eventually be realized.

Personally, I have for some years believed firmly that the transmission of large amounts of energy over long distances must be done by the alternating current, and that the continuous current is the only suitable one for the efficient operation of motors, which must be varied in speed, torque and direction.

Hence, I believe that the lines I have described above will be the lines of future practice; namely, the use initially of an alternating current which will be converted upon the locomotive to a continuous current, and used in this form in the propelling motors.

Rapid Transit for Boston.

In a recent speech before the Beacon Society Mayor Mathews of Boston made the following reference to rapid transit:

As to the proposed subway, I don't advocate it particularly, and I am not opposed to it. I believe we shall never have real rapid transit until we have an elevated road.

But we will never have an elevated road till the people are ready to put it right across the Common, and the community is not ready for that yet, so I suppose the subway is the best thing we can have at present, and the only solution of the difficulty we shall have for years.

The subway will not give rapid transit, though. It will simply, as I understand it, at a cost of $3,000,000 or more, exclusive of terminal facilities, enable us to get electric cars removed entirely from the streets in the congested districts and put them under ground, thus giving the streets up wholly to their legitimate object, pedestrianism and driving.

The actual saving in running time of the cars by the subway will not be much—perhaps from five to ten minutes in the trip through the heart of the city. Such an expense as is entailed by the subway, in my opinion, will not be justified unless the advantage of entirely freeing the surface from cars in the heart of the city is to be gained.

If, after the work is all done and the cars removed, after a lapse of a year or two the cars are to be restored to the surface to obstruct not only all other travel, but their own progress as well, then you will simply bury your $3,000,000 or $5,000,000 in the ground by building the subway at all. This is the question for the people to consider carefully and settle at the state house this winter.

The most practical solution of the present problem growing out of the crowding of the streets is, in my opinion, to take up all the tracks in the congested streets, and let all cars stop at the edge of this crowded district.

IMPORTANCE OF COMPLETE METALLIC CIRCUIT FOR ELECTRIC RAILWAYS.*

BY J. H. VAIL.

In the early days of electric railway construction two distinctly different systems were devised and competed for public favor, the one being the overhead double trolley system, affording a complete metallic circuit for the outgoing and return of all the electric current required to move the motor cars: and the other being the single trolley system, using the track and earth as a common conductor for one side of the circuit, and the trolley wire and parallel mains for the opposite side. The double trolley system was found impracticable of operation in many of its details, and the single trolley, because of its simplicity and convenience, has made rapid advances in public favor. The single trolley system has depended largely upon the earth and buried pipe systems for completing the circuit.

Many devices for making the track and earth combined a more complete and low-resistance circuit have been resorted to, such as burying copper or iron plates, old rails or old car wheels, and connecting the same to the track; or, at frequent intervals, driving iron rods down in the earth and connecting by wires to the track; or by making actual connection with wire from tracks to gas and water pipe systems. Also, for *supposed* reinforcement of the track we have used a bare wire of iron or copper, buried in the earth, laid parallel to the track, and connected at frequent intervals; also the *supposed* electrical connection of rails at joints by bond wires of iron or copper, only having a small frac-ional part of the capacity of the rail as a conductor. In the early days of electric railway construction it was assumed by experts that the earth and the buried pipe systems would, when combined, form an ample return for the electric current. At that age of the art experts did not fully appreciate the immense quantities of current that would be carried, and therefore did not foresee that these currents when disseminated would produce the serious results that have been caused by electrolytic action on systems of pipes buried in the earth and owned by other companies. Frequent tests prove that the earth itself cannot afford the free path for the current that was anticipated. Earth conductivity has been overestimated. Iron and lead pipes, being better conductors than earth, must of necessity carry the current, if no superior path is offered by the method of construction. The natural moisture of the earth hastens the destructive electrolytic action of the current on these pipes. In some soils electrolysis is more rapid than in others. The rapidity of action depends upon the chemical constituents of the soil.

It has been found that illuminating gas leakage held in such soils as underlie the cities of New York, Brooklyn, Boston, Philadelphia and elsewhere, hastens electrolytic action. To prove that the methods of work mentioned are still in vogue, I quote the following section from specifications recently sent out from the office of a prominent electric railway company:

"*Bonds and Supplementary Wire:* Each rail shall be connected together by two bonds, made of No. 4 galvanized iron wire (Roebling gauge), to each end of which shall be brazed two nine-sixteenth inch Norway iron rivets. Both of the bonds shall be separately connected with a No. 0 galvanized iron supplementary wire, by means of No. 4 galvanized iron wire connections, which shall receive at least four turns around both the bonds and supplementary wire and be thoroughly soldered to the same. Ground plates shall be placed about 1,000 feet apart. They shall be buried not less than eight feet in the ground, preferably in damp places, and two No. 0 galvanized iron wires shall be brazed to the ground plate and connected one to each supplementary wire in each track, by thorough wrapping and soldering. The ground plates shall be of galvanized sheet iron, two feet square and one-eighth inch thick, bent around in the form of a spiral."

It is evident that electricians had then perfect faith in the earth as a conducting medium. Evidence had not been produced that Mother Earth was incapable of carrying the enormous quantities of current required; neither had an opportunity been afforded to demonstrate her capacity. That some still have faith in the earth's ability in this direction is attested by above specifications and other constructions being executed at this date.

Having briefly reviewed the practice for the past few years, let us now have a look at the resultant effects. In cities provided with electric railways destructive electrolytic corrosion is now acting upon gas and water pipes, and will inevitably produce serious impairment of all such underground pipe systems within a brief period, unless prompt measures are taken to prevent further damage. Within the past year strong evidence of damaging electrolytic action has been produced. Simply for the sake of fixing the evidence on your memory I will mention only seven instances of electrolytic action of railway currents on gas and water pipes, in different cities.

1st. A section of iron water pipe shows complete perforation, caused in four weeks' time. The lead covering of telephone cables also show serious damage. A large number of additional items will be found in the report to Board of Electric Subways for 1893.

2d. A plumber in a city in Pennsylvania was repairing a water pipe in a house, and on breaking joint, an electric arc formed across the separating ends of the pipe. This house was not in the direct path of the railway circuit. Investigation followed, proving beyond question the insufficient electric conductivity of the track system: also that the earth did not afford a good return though the tracks were well grounded. It was found that the railway current was traveling all pipe systems in its effort to complete the circuit to the dynamos in the power station. Actual tests were here made by an expert, using standard instruments. From 135 readings of the ampere meter it was found that the feed water pipes leading in the station carried an average current of ninety-three amperes. Further careful test proved that with twenty-three cars in operation on the system forty per cent. of the total current was carried on the underground pipe systems.

3rd. December 15, 1893, a fire occurred in the basement of James Sutherland's house. After being extinguished, investigation showed that the current of the electric railway system had been carried along the iron water pipe, and that probably by vibration causing the pipe to come in contact an arc formed between the water pipe and gas pipe, burning a hole through the gas pipe, and thus set fire to the gas. The house was saved by prompt action.

4th. Tests show the electric railway current present on the water pipes. In the generating station the fireman gets a shock when he opens the furnace doors of his boiler with the bare hand.

5th. A test recently made by an expert engineer developed the fact of a loss of 24 per cent. on the system, and a difference of twenty-five volts potential between parallel tracks opposite the power station.

6th. Prof. Barrett, in an exhaustive report to the Mayor of Chicago, states that "this destructive action is not alone confined to the lead covering of telephone cables, but is acting on gas and water pipes and almost all buried metal work," and that it can only be a question of time when more disastrous results will manifest themselves.

As further and substantial evidence, I here exhibit for actual examination a section of six inch water main from city No. 7. This pipe has been entirely corroded through by the action of the electric current of the street railway system, which was constructed under my direction about four years ago. This effect was produced in about two and one-half years; another section was rendered useless in six months. Abundance of additional and substantial evidence can be produced. These serve to prove the case, which can not longer be successfully denied nor assigned to other causes.

It has been stated that in an electric railway system where a connection has been made to water pipes, the pipes have carried as much as 28 per cent. of the total current. Instances are known where as much as 40 per cent. is carried on the pipe systems. It is the opinion of the writer that any gas or water pipe system used as a carrier of electric currents will not only be corroded through the body of the pipes, but will surely in due time show defects at joints, as here will occur higher resistance than in any other portions of the pipe system. It has been proven by test that the electrolytic action of even five amperes of current on an iron pipe is considerable, and that much damage will result in one year. The rapidity of action depends upon character of soil, amount of moisture and quantity of current; the destructive action is constant and sure.

I do not wish to create unnecessary alarm, but there can be no question that a grave danger confronts us and must be surmounted. Instances are numerous proving that the electric railway current is present on the gas and water pipes in buildings contiguous to electric railway lines. Even those of us who are familiar with handling the electric current hesitate to draw a combination of electricity with our gas or water. We know that the gas and water pipes entering our houses may be charged with such a current, and that it only remains for the circuit to be completed by a possible accident through our bodies, or the occurrence of a fire by automatic action between vibrating pipes. City engineers, water companies

*Read before the National Electric Light Association, Washington, February 27, 1894.

and gas companies are placing the responsibility upon the railway companies for the damage caused on pipes by electrolysis.

Any system using ground plates, ground rods or substitutes therefor, or bare return track wire buried in the earth, is constructed primarily to utilize the earth as return circuit; when the earth does not afford good return the current is sure to follow the water pipes, gas pipes or other buried conductors offering the path of least resistance. We now see that these prove to have been only make-shift methods to reduce the cost of construction. We find that the evidence thus produced and the troubles constantly occurring in existing street railway systems are sufficient to show that all methods of grounding the track circuit or connecting to pipe systems should be entirely discontinued; it therefore becomes of vital importance to so construct the electrical railway system as to avoid all electrolytic action on buried systems of metal work that are the property of other concerns.

Having produced the evidence and established the case, let us briefly analyze the matter and ascertain the reason for these results. The whole case may be stated in the single sentence, that *the electric current must under natural laws follow the path of least resistance.* What was intended to be good has proved to be defective electrical work executed in connection with track systems, has not given to that side of the system a perfect path for the travel of the current, the conductivity of the rail circuit being impaired to such an extent that the electric current must force itself through the earth or through metal pipe lines buried therein.

We must here diverge for a moment to show how the incandescent electric light system operated in multiple arc compares with the railway system. An electric railway system may in some degree be compared with a system of electrical distribution for incandescent lighting, the groups of lamps in buildings connected in multiple arc, comparing with each car and its motors demanding current. The systems otherwise differ in important particulars; the load on the electric light system is not subject to such violent fluctuations as on the electric railway, where the instantaneous demands for current and its equally prompt release must be controlled. The current required for the car is a moving load as the car progresses on its route; this and all other differences of conditions must be duly considered when laying out the system of distribution. With the electric lighting system, the current for consumption is derived from the mains, the equalization of pressure is maintained through the feeders: the mains are of equal capacity on either side of the system.

With the electric railway, the track forms one side of the consumption circuit, and must be so treated in regard to distribution of current as to utilize its carrying capacity equally with the other side, and thus equalize the delivery of current. The electric conductors composing a system of distribution for electric railways should be so thoroughly well proportioned as to show the minimum variation of pressure throughout the system, even when the entire number of cars are in operation. This equality of pressure is an important requisite for the economical working of the motors. The writer has tested electric railway systems operating with a station pressure of from 500 to 550 volts, and showing only 300 to 325 volts on various divisions of the system. Here is a direct loss between dynamos and motor car of over 40 per cent. Is it, therefore, any wonder that some roads report extraordinary coal consumption? Such loss in pressure indicates radical faults in the original planning of the system and the distribution of copper. When operating under low voltage, the motors demand an increased quantity of current above what should be the normal supply, thus augmenting the heating effect in the armatures and fields, the efficiency of the motors being reduced in corresponding ratio.

A further examination into other features of construction requires some consideration of the bonding of rail joints. The existing methods of utilizing railway tracks for conducting large quantities of current are faulty in at least three particulars.

First. Restricted conductivity at joint, due to insufficiency of the rail bonds.

Second. Neglecting to properly utilize the track as a conducting medium.

Third. Failure to provide a complete circuit of low resistance,

For electrical purposes we cannot regard the joint plates and bolts as of any permanent value; the contact is electrically imperfect, the metal surfaces oxydized and under constant movement, due to passing cars pounding the rail joints. The rail sections are in many systems of ample conductivity to carry more than the requisite current provided they are perfectly bonded and properly connected by feeders with the dynamos. We must, therefo e, bond the rail joint in such a mechanicat manner as to maintain perfect electrical contact, and with sufficient metal to restore at the joint nearly the full conductivity as of the rail itself; and at the same time to give the existing joint plates their present freedom of motion.

It has been found that a system of track with faulty rail bonds will give a shock to animals and, possibly, to human beings, should the same be brought into actual contact in such a manner as to complete through them the broken circuit. It will be readily understood how difficult it is to maintain proper inspection of the electric bonding where the bonds are covered up by the street pavement. Under such conditions the ground circuit and the bonding escape inspection until excessive coal consumption, loss of current and other troubles force themselves upon the attention of the street railway management.

Observation proves that a faulty rail bond will show its location in winter by heating, due to high resistance, and if snow be present on the ground around the joints the snow is partially melted, thus indicating location of fault.

Let us turn our attention for a few moments to the question of the conductivity of the rails.

For the purpose of comparison, we will assume that iron has six times the resistance of copper. (The actual proportion being 1 to 5 63.)

CARRYING CAPACITY OF RAILS.*

	56 POUND RAIL.		70 POUND RAIL.	
	One Rail.	Single Track of Two Rails.	One Rail.	Single Track of Two Rails.
Area in sq. inches..	5.4874	10.9748	6.8593	13.7186
Equal in area to circle whose diameter is in inches..	2.642	3.735	2.95	5.90
Equivalent in cir. mils. to.....	6,980,000	13,960,000	8,702,500	17,405,000
Resistance per foot B. A. units..	.00000845	.00000422	.00000679	.00000339
Equivalent to copper resistance in in cir. mils.......	1,175,000	2,350,000	1,463,000	2,926,000
Equivaleot to copper rod whose diameter is......	1.13	1.533	1.21	1.71
Safe carrying capacity of iron reckoned at ⅓ that of copper in amperes...	390	780	488	976

*Prepared by G. F. Sandt, E. E.

NOTE.—In the above statement the areas of rails have been determined by use of the planimeter. The ampere capacity of iron has been based upon the most reliable data obtainable. The author believes that the figures submitted are sufficient for comparisons, but cannot guarantee their absolute accuracy.

The following table gives the current strength that can be carried by iron wire, within doors, in still air, and without becoming unbearably warm to the hand; that is, not to exceed a temperature of 50° Centigrade:

B. & S. GAUGE.	AMPERES.
10	16
9	19
8	21
7	25
6	28
5	32
4	37
3	43
2	50
1	58
0	67
00	77
000	90
0000	105
½″	117
¾″	203
1″	302

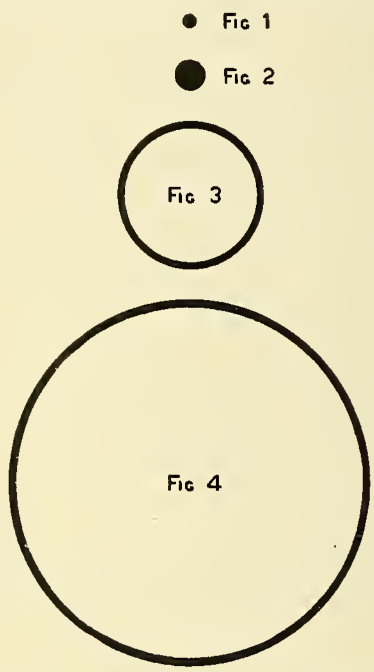
Data furnished by A. E. Kennelly, February 12, 1894.

These figures serve to show how utterly absurd it is to bond a track of seventy pound T rails with iron rail bonds No. 4 or No. 0 in size, and to pretend to reinforce their conductivity with a No. 0 iron or even a No. 0 copper wire. It is like laying a twelve inch water main and then putting a one-half inch pipe alongside to help it out. The No. 0 B. W. G. copper wire has a resistance of over twenty times the single track of fifty-six pound T rails per foot and the No. 0 B. W. G. iron wire over 112 times the resistance per foot of the same track. How, then, can either of these be of any adequate assistance for conducting current?

The following diagrams indicate the small value of a supplementary wire of either iron or copper when compared with the conductive capacity of a properly bonded single track of fifty-six pound rails. All the areas are in accurate proportion for comparison. Fig. 1 shows the area of a circle indicating the single track of fifty-six pound rails. Fig. 2 represents the iron reduced to resistance of copper. Fig. 3 shows the No. 1-0 supplementary copper wire and Fig. 4 the No. 1-0 supplementary iron wire reduced to resistance of copper.

The writer knows personally of several instances where the copper supplementary wire has absolutely disappeared. The writer believes that ninety-nine per cent. of the money expended for so-called supplementary wire is absolutely thrown away. The same money expended in other directions will give more adequate return.

Does not this show conclusively that we should give our attention to the more perfect bonding of the rail joints, and also to apply track feeders in such a manner as to fully utilize the conductivity of the track and thereby make it fulfill the service of which it is capable when properly treated? We are in error when the track system is named as a return circuit. The track system of all electric railways should really be the positive side or outgoing circuit. The writer fully explained this in a brief article in the *Street Railway Journal* about a year ago. It will be readily understood that as the current travels from positive to negative, therefore any arc which occurs between the trolley wheel and the trolley wire will carry metal from the trolley wheel and deposit the same on the trolley wire. If the reverse method



of connection is made, the trolley wire will lose the metal, the same being deposited on the trolley wheel, and in time the strength and conductivity of the wire must be seriously impaired, eventually resulting in breakages.

It is also important that existing systems of operating electric railways should be promptly taken in hand and the proper remedies intelligently applied. The three-wire system has been mentioned by some engineers as a possible solution.

I will here diverge for a minute to state that a trial was made four years ago under favorable conditions—not to avoid electrolysis, but to save copper. We developed physical difficulties of operation which warned us to avoid the three-wire system in future electric railway work.

I believe I am safe in stating that 90 per cent. of the electric railways have their systems so constructed as to largely restrict the conductivity of the rail circuit.

A one-sided system is fundamentally wrong. The quantity of current to be controlled is so enormous that ordinary make-shift methods will not answer.

Having carefully analyzed the whole matter, I feel justified in recommending that we must adopt the complete metallic circuit as the standard for the best electric railway practice. This can best be obtained by the following method:

First. By so bonding the track as to render the rail joints of as low resistance and nearly equal conductivity to the rails, and to execute this work so as to maintain this improved condition; and

Second. The track system must be supplied with insulated feeders leading direct from the bus bars in the station to predetermined points of the track system, and thus offer a perfect low resistance path for this side of the electric circuit, the same as obtained with the trolley line and the overhead system. All of these features and improved methods have been put in practice by the writer.

The only proper system is one that affords a well insulated and complete metallic circuit of low resistance, that will give an ample path for the complete unrestricted circulation of the entire current from pole to pole of the dynamo, thus offering no inducement for the current to follow such conductors as gas or water pipes, but, as it were, actually robbing the earth of any desire to carry the current. I am not recommending extravagant methods, but only such as are deemed essential for economy, and of a practical nature for reducing expenses and augmenting dividends. The item of cost cannot properly be urged as an objection, because where the whole construction requires a large investment, every detail of the work should be so executed as to be permanent and enduring. If the details are carefully analyzed it will be found that the cost of frequent reconstruction, maintenance and renewals of rail bonds and bare wire amount to an excessive rate of interest on original investment, and would soon pay the small additional cost to build a complete metallic circuit. The superior service obtained from a complete metallic system of low resistance with the proper application of insulated track feeders will, within a brief period, more than refund a reasonable interest on the investment through the saving of fuel alone, not counting other economies in renewals and maintenance. The track feeder system will be far less costly than the double trolley system.

Whether track feeders should be laid underground or erected overhead is a question largely controlled by local conditions and capital available. I express a preference for underground work as being more permanent and subject to the least cost for repairs. The original construction is certainly more costly for underground. The actual cost of copper is the same in either. The necessity of constant repairs, under existing methods, and the damage to water and gas pipes by electrolytic action, simply proves that it is but a question of time as to how long before electric railway companies will be forced to adopt the complete metallic circuit. Where experience and practical knowledge is applied, the cost will not be excessive. It is not difficult to arrive at an exact method of doing the work and an accurate estimate of its cost.

The writer has observed on some roads that large quantities of copper for return circuits have been placed at great expense, apparently without a proper conception of how to obtain the best results. Frequently a far less amount of copper, judiciously applied for improved distribution by the feeder system, would give superior equalization of pressure at reduced cost.

If for the movement of cars singly or in quantities at a high rate of speed the electric current is to be distributed uniformly over an electric railway system, the subject must be handled with as much scientific accuracy as is always used for a perfect system of incandescent lighting, in order to obtain equal distribution and free flow of current in both sides of the system.

The writer has fully and completely provided for all contingencies in the following manner:

First. By a careful study of the conditions under which a system will be operated; these important points being ascertained with reasonable accuracy, the requisite supply and distribution of current for the service is determined, and the system of conductors arranged to meet the requirements. For the proper supply of electric current, the important underlying principles of the feeder system must be thoroughly understood.

Second. The conductivity and current-carrying capacity of the track system is calculated, and a system of insulated track feeders is provided, leading from the switchboard in station and connecting at predetermined points, and with a calculated fall of potential.

Each feeder must be determined for its maximum current requirements at a stated drop in potential. The actual work required of the feeder and number of track feeders necessary is determined upon such factors as:

The cars in service—their weight, speed and headway; the position of power station and the geographical lay of the railway system; the weight of rails, and whether double or single track, and the amount of load concentrated on sections of track between feeder junctions.

The carrying capacity or conductivity of the sum total of all the feeders of the system will be found to give complete and ample circuit for the free flow of the entire current required, and to take care of extra heavy traffic and blockades at any point.

The parallel track main is only applied in sections of systems extending over very large territories and long distances.

The conductivity of the rails is calculated with as much care as the overhead system, and when the track needs reinforcing, the purpose is accomplished by laying a thoroughly insulated main line (not a bare line) and making frequent subfeeder connections bonded to the track. If used at all this main will be of large size.

Such a system, accurately worked out, will show by actual test with instruments on the cars a surprising equality of electromotive force throughout a large territory.

A very careful test has been made with instruments on moving cars, throughout a system covering forty miles of streets, with double tracks, equal to eighty miles single track. The readings showed—maximum volts, 512; minimum volts, 420, average of electromotive force over entire system, 460 volts, the electromotive force in station, at bus bars, being 520 volts. The feeders were calculated for 10 per cent. drop. The actual average drop from dynamo to motor does not exceed 12 per cent.

This will be found to result in reduced fuel consumption, better working of the motors, a most satisfactory reduction in repair accounts, and an improved general economy of the entire system.

In the system of distribution secured by the above method, the use of ground plates, rods or other insufficient methods is needless; the current travels only over the paths provided for it, and electrolysis of gas and water mains is entirely obviated.

DISCUSSION.

During the reading of this paper Mr. Vail took occasion to exhibit a piece of the six-inch water main from city No. 7 to which he had referred. The piece shown was about two feet long and was corroded entirely through its shell, making a hole about 3 inches in diameter besides the eating away of a large part of the adjoining portions. He also exhibited two pieces of lead pipe, received just before the reading of the paper from Trenton, N. J. Both were badly corroded by the currents from the circuits of the Trenton Passenger Railway Company from the vicinity of whose tracks they were taken.

Mr. Vail also explained that corrosion was often started in iron water pipes by the action of the current upon the lead with which the joints were calked. The corrosion thus started soon developed into more serious trouble and caused a leak in the pipe.

In addition to his remarks in the body of the paper Mr. Vail said that the three-wire system, proposed for obviating the electrolytic efforts of return currents, was impracticable. He had tried to operate a road on this plan but found that it did not prevent these effects as it was thought it would. A very bad specimen of corroded pipe was taken from a water-main near the tracks. It was also impossible to maintain a balance on the two sides of the circuit and after much expense the system was abandoned.

J. J. Burleigh, of Camden, N. J., asked Mr. Vail if he regarded fishplates as of any value in increasing the conductivity of the rail circuit. The reply was that they could not be considered of any *permanent* value, owing to the movement of the rails at the joints, the consequent loosening of the fishplates and the inevitable oxidation of the surfaces of contact.

When asked about the process of electrically welding the rails to secure a greater conductivity, Mr. Vail said he had had no experience with that method, and added that he regarded the work in that line on the tracks of the West End road in Boston as only experimental in character.

C. W. Wason, of Cleveland, O., said that he had talked recently with Mr. Moxham, of the Johnson Company, upon the subject of that company's experiments in the welding of rail joints. Their first attempts were not a success as carried out on the West End lines in Boston and they were inclined to abandon the work, but were urged on by the West End Company; they had continued their experiments and had later on obtained much more satisfactory results. Mr. Wason said that he was assured by Mr. Moxham that the Johnson Company was now in a position to guarantee perfect work in the welding of rails. They now have two machines made especially for the purpose at a cost of thirty or forty thousand dollars each, and had ordered two more of the same kind. The company is now under contract to weld 150 miles of track into continuous rails and some of the work is to be done in Cleveland. The experience obtained in Brooklyn had led to a change of method.

M. D. Law, of Washington, called attention to the metallic circuit method employed by the Love system of underground traction as one way of avoiding trouble from the electrolytic effects of the return currents. This, he said, was in line with Mr. Vail's statement that the circuit must be as nearly a complete metallic system as possible. Mr. Vail replied that although the Love system might be all that Mr. Law had claimed for it, it should be remembered that there were hundreds of thousands of dollars invested in overhead trolley systems whose defective working must be remedied without a change in the general character of the system.

A representative of the Commercial Cable Company, of New York, detailed the experience of that company in combatting the bad effects upon the operation of its cables of the railway currents from an electric railway between Brooklyn and Coney Island, and also those of another road in the vicinity of the Bronx river north of New York City. In the former case a difference of potential had been developed of 8 or 10 volts, greatly interfering with the instruments of the telegraph company. In the second case a similar difference was observed and lines between New York City and Bronxville had actually been operated without battery power, depending only on the leakage currents of the railway.

Capt. Brophy, of Boston, spoke of the danger of operating lamps and stationary motors on loop circuits from street railway circuits, and said this was a feature of the business to which he had strenuously objected on account of the fire hazard. He thought this view was supported by the statements in Mr. Vail's paper. Capt. Brophy hazarded the opinion that the electric welding of rail joints would never be a success, since the constant necessity of replacing the chairs, etc., underneath the rails would, if the joints were welded, be too expensive.

T. Carpenter Smith, replying to Capt. Brophy said, that the necessity for replacing rail chairs and making other track repairs would be obviated by the removal of the principal cause of these troubles—the rail joint. Mr. Smith called attention to the Noonan track construction and its success on a piece of steam road.* If this construction was so successful on steam roads he did not see why a similar type of track work would not answer as well for street railway service.

Mr. Wason, replying to Mr. Smith said, that a piece of track 1,200 feet in length had been laid down in Cleveland on the same plan as that used in the Noonan system. The rails were abutted closely together and long fishplates were securely riveted with hot rivets. This track had been in service for two years giving perfect satisfaction and is still straight and in perfect condition. Mr. Moxham he said, had made a blue print showing that the expansion must take place laterally instead of longitudinally. It was shown that when rails were welded into lengths including, say 3 or 4 ordinary rails, a break in the rail might leave an opening full seven-eighths of an inch wide, while if these were in 25 or 30-rail lengths the opening caused by a break at a weld would not be more than an eighth of an inch.

A member suggested welding a flexible bond to a large terminal and electrically welding this terminal to the rail. Mr. Vail replied that he thought this would be too expensive to be practicable.

STREET RAILWAY EARNINGS AT BUFFALO, N. Y. AND COLUMBUS, O.

The net earnings of the Buffalo (N. Y.) Railway Company for the month of January, just made public, show an increase, as compared with 1893, of $18,337.74, as follows:

	1894.	1893.	Difference.
Gross earnings......	$117,881.50	$101,874.44	Inc. $16,007.06
Operating expenses	73,373.56	75,704.24	Dec. 2,330.68
Net earnings......	$ 44,507.94	$ 26,170.20	Inc. $18,337.74

The operations of the Columbus (O.) Street Railway Company make for the month of January a showing which is certainly satisfactory because there was an increase of $10,086 39 in net earnings, as compared with the corresponding month of 1893. Recent reports of other street railway earnings have also been of the same encouraging character, and are an indication of returning normal conditions. The statement of operations of the Columbus road for the month of January is as follows:

	1894.	1893.	Difference.
Gross earnings......	$42,193.36	$38,198.29	Inc. $ 3,995.07
Operating expenses	22,678.34	28,769.66	Dec. 6,091.32
Net earnings.......	$19,515.02	$ 9,428.63	Inc. $10,086.39

Chicago, Ill.—At the meeting of the Chicago City Council, February 26, an ordinance was passed giving the North Chicago Electric Railroad Company a franchise to operate an electric railway on Milwaukee avenue between Armitage and Lawrence avenues and on Lincoln avenue between Wrightwood avenue and North Fifty-ninth street. D. H. Louderback is interested in the proposed road.

*For full description and comments see the STREET RAILWAY GAZETTE, of August 26, 1893.

CABLE RAILROAD ELECTRIC SIGNALING SYSTEM.

The Third Avenue Cable Railroad of New York, which was opened a few days since, extends from the postoffice to 130th street, through Park row, the Bowery and Third avenue. There are two power houses, one located at Bayard street and the other at Sixty-fifth street. From the former the cable extends to the postoffice and to Sixth street, about a mile in each direction; from the latter run two lines—one to Sixth street, a distance of $2\frac{3}{4}$ miles, and the other to 130th street, a distance of $3\frac{1}{2}$ miles.

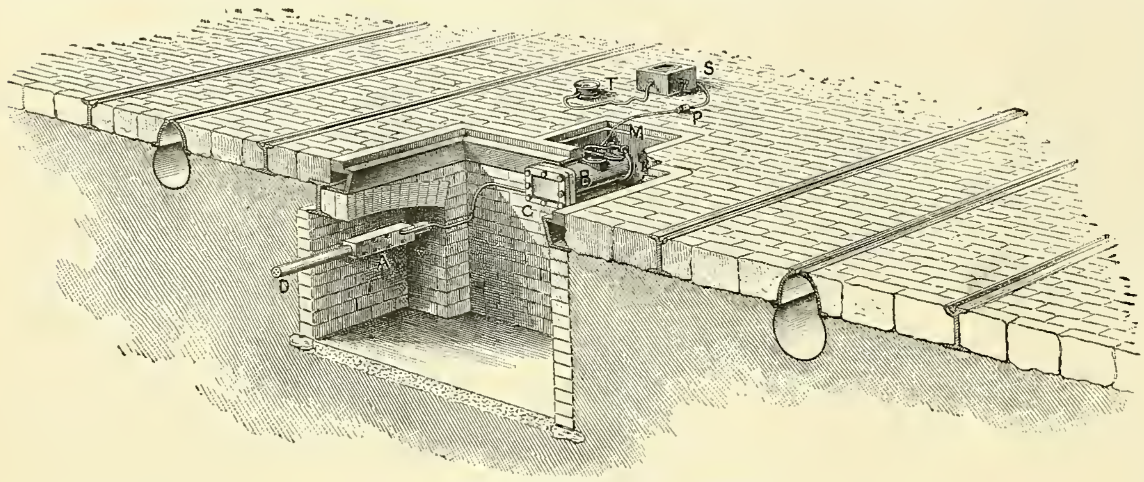


FIG 1. VIEW OF MANHOLE AND AUTOMATIC.

It is not the purpose of this article to describe the road in general, but to illustrate an electric signaling system embodying many new and novel points, which is now being installed by Mr. Fred. Pearce, the inventor and manufacturer, of New York City. With this apparatus it is possible to signal either power house from any point on the road. There is practically but one warning that a car conductor is called upon to send and that is "stop the cable." In every other case where this is not necessary he can drop the cable from his grip and bring his car to a standstill. This is not the only signal that may be sent; the signals can be increased indefinitely in number and in addition communication by telephone can be had with any one of five stations.

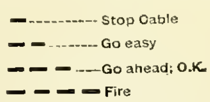


FIG. 3. CODE OF SIGNALS.

GENERAL FEATURES.

Placed between the tracks, at regular distances from each other, are manholes, the arrangement of which is shown in Fig. 1. As far as possible, these manholes are located on the north side of every other cross street, and where the streets are numbered they are placed at those bearing even numbers. Where practicable, the boxes or manholes bear the same numbers as the streets they are nearest to; for instance, the box at Thirty-second street is numbered 32. Each manhole contains a so called "automatic," *B*, from which lead the wires of the cables *D* to the power house and telephone stations. Plug switches are provided at *M*, where the wires of the telephone *S T* can be attached when it is necessary to talk from any manhole to any other manhole or to any of the stations.

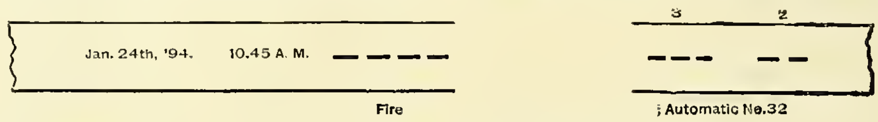


FIG. 4. RECORD AS PRINTED ON TAPE.

Each signal sent consists of a certain number of strokes on a gong, each having an arbitrary meaning. One stroke means "stop the cable;" two strokes "go easy:" three strokes "go ahead: O. K.;" four strokes, "fire," as indicated by Figs. 3 and 4. In the engine room of each power house are two gongs, a large one and a small one, and on these gongs the signals are sounded. Two gongs are used in order to distinguish between the different portions of the road. By referring to Fig. 6 it will be seen that the road is operated by three distinct sets of cable—one from the Bayard street power house and the other from the Sixty-fifth street house. It would be manifestly foolish to stop the cables operated from the Sixty-fifth street house when the trouble occurs at the postoffice and, therefore, only affects the Bayard street cable. For this reason two different gongs are employed. When the larger gong rings it means that one of the Sixty-fifth street cables must be stopped instantly and the engineer at the Bayard street house knows that the difficulty is not with his line. At the same time an annunciator is dropped at the signal box in the Sixty-fifth street house to indicate whether the "up" or "down" cable from that house is in trouble, as shown in Fig. 5. When the smaller gong rings the Bayard cable is stopped and the Sixty-fifth street house ignores the signal. So far, this only provides for the stopping of either cable and is done, presumably, by either the gripman or conductor of a car.

When the conductor raises the cover of the box, Fig. 1, he lifts the automatic *B* by means of its handle, shown in Fig. 2. This strikes one in each power house on either the large or small gong, according to the location of the automatic sending the signal. This is all he is expected to do, except to replace the cover, which he cannot do without first depressing the handle of the automatic to the position indicated in Fig. 2. Then when the cover is put in place the mechanism of the automatic is tripped, and the particular number of that box is rung upon the gong. Raising the automatic to send the first signal "winds up," so to speak, the mechanism of the automatic so that it is prepared to send its own number automatically when the tripping occurs.

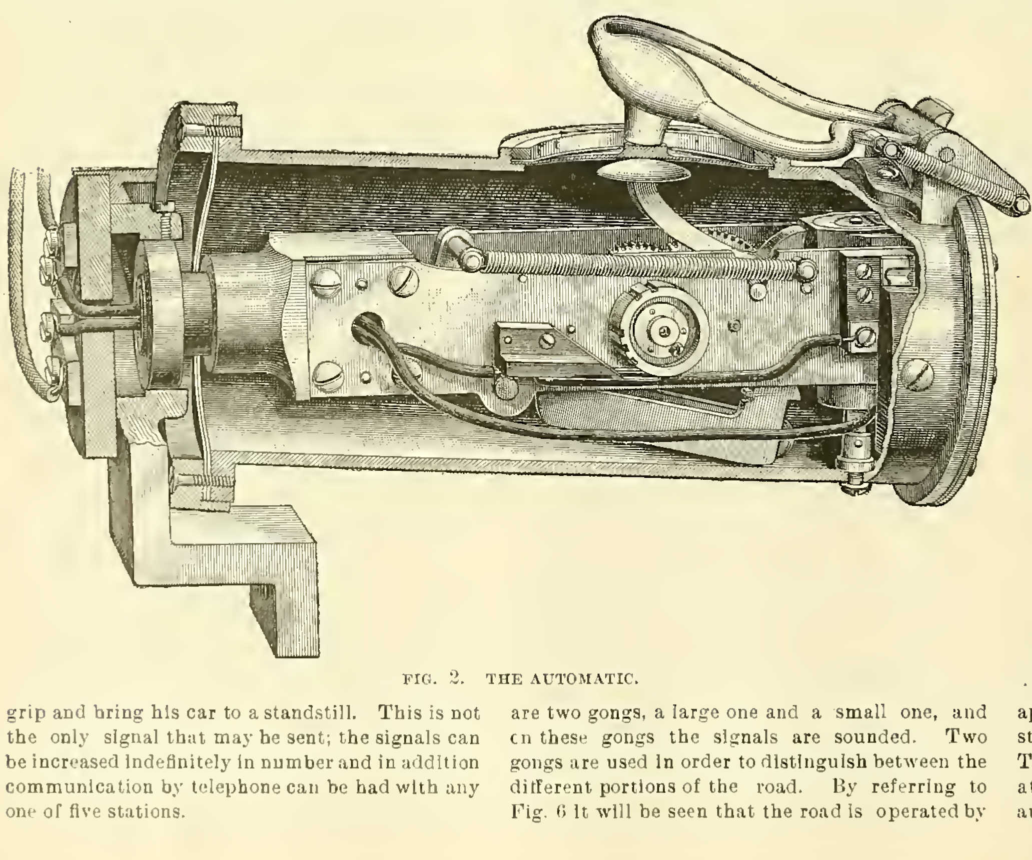


FIG. 2. THE AUTOMATIC.

Every signal sent is printed upon a tape and the time of its receipt is also recorded. The general appearance of the signal box at the Sixty-fifth street house is shown in the engraving, Fig. 5. The tape, Fig. 4, shows that on January 24, 1894, at 10:45 A. M., a signal of fire was sent from the automatic No. 32. On the signal box are placed cards

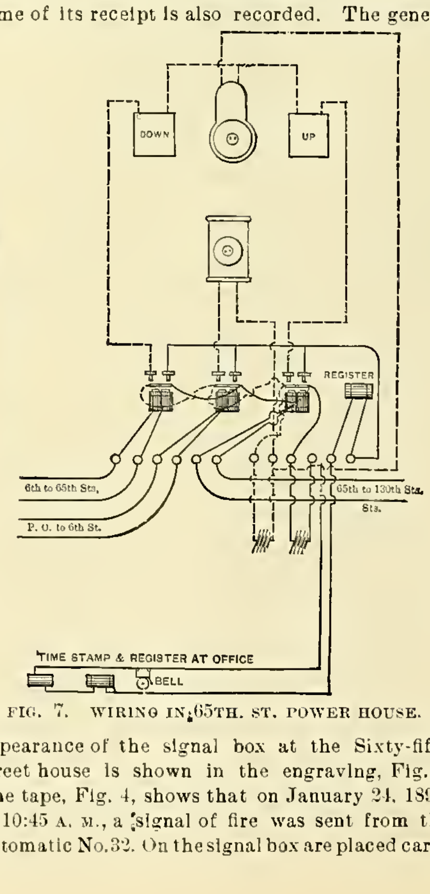


FIG. 7. WIRING IN 65TH. ST. POWER HOUSE.

showing the locations of all the automatics and general notices and instructions. The recording apparatus is similar to the stock tickers.

When a signal is received, the wrecking wagon from the nearest station is sent to the automatic

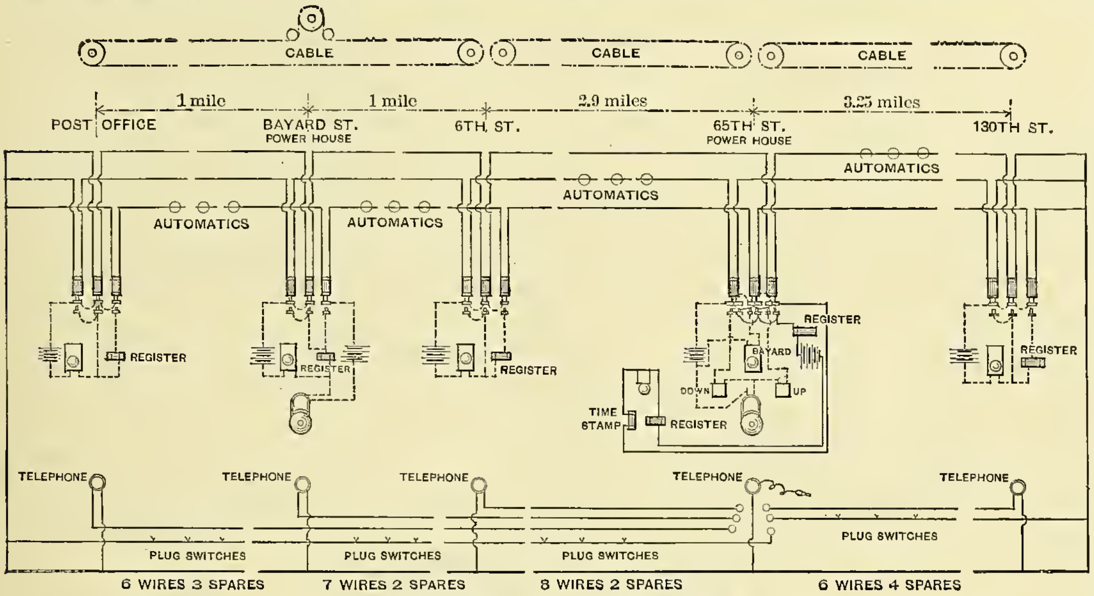


FIG. 6. CABLE RAILROAD SIGNALING SYSTEM.

from which the signal was sent. This carries a telephone by means of which conversation can be carried on with either telephone station or either power house. After the trouble has been remedied the automatic is again brought into use to signal the engine room, the symbols used being those shown in Fig. 3. The automatic is raised

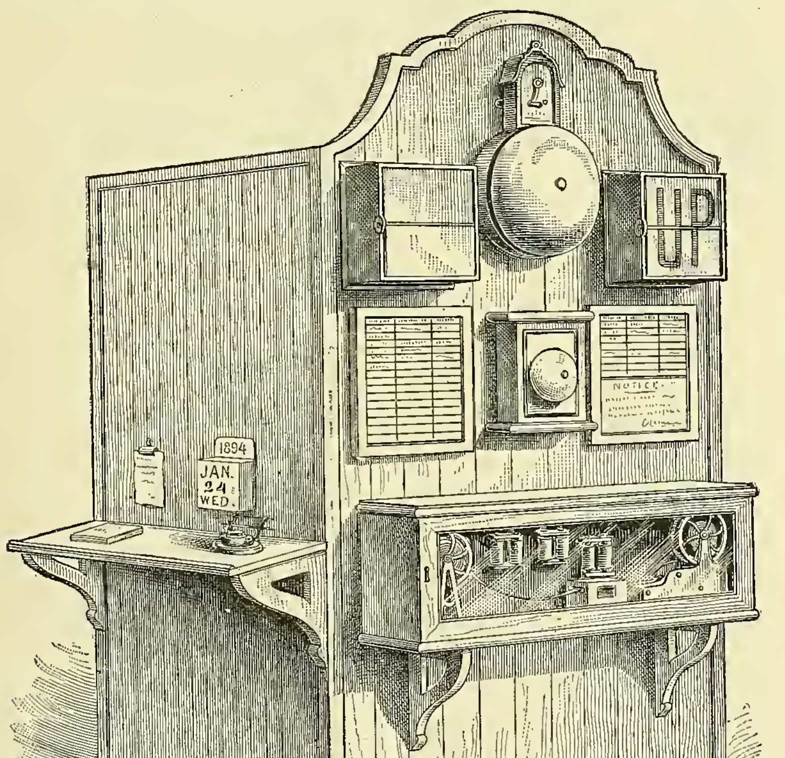


FIG. 5. SIGNAL BOX IN 65TH. STREET POWER HOUSE.

once for each time it is desired to strike the gong.

From the foregoing it will be seen that the cable can be quickly stopped by any employe of the company, the engineers considering the notice to stop as imperative. Unless the conductor willfully neglects to replace the cover on the box of the automatic, the number is sent in; that he will neglect this duty is not probable. His work, therefore, is simple in the extreme and is always the same: he lifts the cover, raises a handle and replaces the cover, when he waits for those in the wrecking wagon, who take charge. It would seem, under these conditions, that the only error he could make would be one of judgment in stopping the cable unnecessarily; but as this would only cause a cessation of traffic for a few moments it would not be serious.

THE AUTOMATIC.

The automatic shown in the broken view, Fig. 2, consists of a bronze cylinder about 9 inches long by $3\frac{1}{2}$ inches in diameter, provided at each end with a cap. The cap to the left in the engraving consists of a rubber covered metallic diaphragm through the center of which passes the end of a frame carrying in its inner portion the train of gears by means of which the number of the automatic is signaled. The outer end of the frame is held rigidly in a cast-iron spider bolted to the box containing the device. At the opposite end of the cylindrical case is a handle which is so influenced by the spring shown as to be held in either its lowered position, as indicated, or in its raised position. Remembering that the frame carrying the gearing is immovable, it will be seen that the free end of the cylinder can be raised a short distance by means of its handle, this being made possible by reason of the flexibility of the diaphragm mentioned.

Centrally in front of the apparatus will be noticed two conductors, one of which leads to a contact piece secured to the frame while the other leads to a second contact piece held to the inside of the cylinder by the screw shown. When the free end of the cylinder is depressed these contact pieces touch aech other and the electrical circuit through the automatic and the several stations is closed. When the end of the cylinder is raised the contact pieces are separated, the circuit is broken and the gongs are struck once.

This raising of the free end of the cylinder winds up the train of gears against the tension of a spring. This is accomplished by means of a segmental gear, which engages with the train and which is raised to wind the train by the movement of the cylinder. In the upper part of the cylinder is a diaphragm, under the center of which is the end of a lever, the depression of which releases a catch and sets the train in motion. On the handle is a lug, which rests upon the center of the top of the diaphragm, directly over the end of the lever. The handle can be depressed and the train released by hand; but should this be forgotten it will be readily understood that the cover of the box cannot be replaced without forcing the handle down and thereby affecting the release. The train operates the mutilated wheel, shown in the center of the engraving, the notches in which are arranged to send the signal 32, the circuit being broken every time the brushes enter the notches. By properly arranging the notches and the spaces between each set any desired number can be transmitted.

In the free end of the cylinder is placed a small dash pot, the plunger of which is united to the under side of the case. This is provided in order to guard against the mechanism being injured by a too violent jerking up of the handle.

It is to be noted that the vital part of the device is inclosed in an air-tight sealed case, protected from dampness and dust. This is an important point, as it adds to the durability of the device and lessens the danger of accidents.

The wiring in the street and in the Sixty-fifth street power house is clearly indicated in Figs. 6 and 7, respectively. The course of the circuit can be readily followed from any particular automatic to the several stations. The second telephone from the right indicates the central office, which can be rung up in the usual way from any automatic and connection made with any desired point.

The fact that the automatics are operated by the breaking of a closed circuit is a point of the greatest value. As is well known, it means that upon the breaking of the circuit at any point and from any cause, the signal is instantly transmitted to each station. If this signal is not followed within a reasonable time by the number of an automatic, the conclusion is reached that the circuit is broken and repair to the line is needed.

Any derangement is instantly made known, and until a signal from an unknown source is received, the line is certain to be in perfect working shape. All parts of the system are extremely simple and present few features liable to accident. By its use each engine room is practically placed under the control of every gripman on the road, no matter at what point he may be; and in case of accident it provides means of communication from the scene of the accident to headquarters and to all the branch offices.

THE RAIL RETURN.

B. WILLARD,
Electrical Engineer, New Orleans Traction Company.

The most efficient methods of constructing the rail return circuits through the rails in electric railway practice involve problems of which the importance has been recently realized. It is somewhat surprising that this very important subject has received so little attention, while others of a comparatively trivial nature have been the cause of extended argument. I can conceive of no single detail in electric railway construction at the present time which is susceptible of greater improvement, and which at the same time is so little improved. We meet engineers who have been in the field since the first days of the single trolley system, and who have advanced ideas of modern construction but who are still firm in the belief that the original ideas of completing track return circuits have not as yet been improved upon, and that the first methods are those that should be adopted to-day.

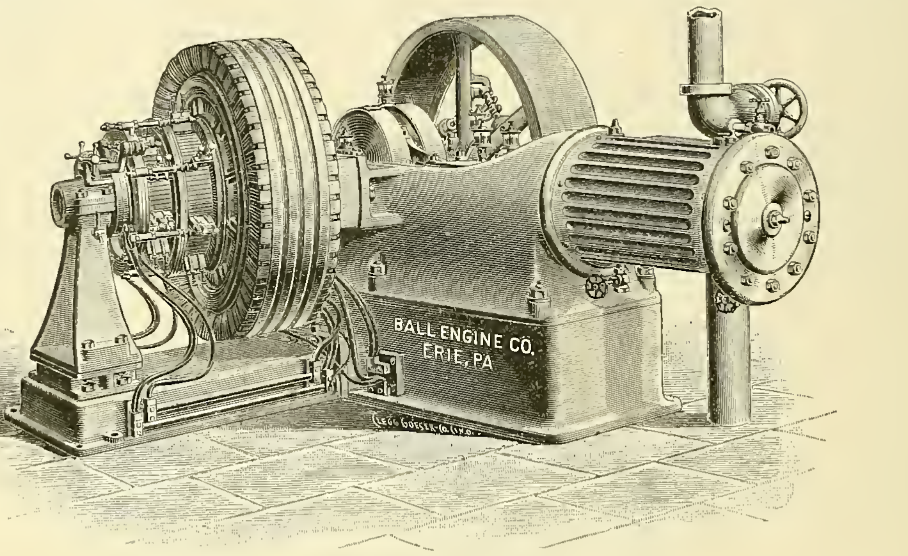
I believe that 50 per cent. of the electric roads in operation at the present time are sufferers from losses of energy which, if the facts were known, would be directly traceable to the rail return circuits. Many roads which are sufferers in this way are totally ignorant of where the trouble lies, although they are conscious of the fact that a loss does exist. Simple tests, and excessive expense for operation constitute plain demonstrations. In most instances where this loss has been discovered it has been erroneously ascribed to the overhead circuit. The consequent adoption of a mass of overhead copper conductors has helped to remedy the difficulty but not to the extent of our calculations.

When we stop to think of the condition of our rail return circuit, and consider its conductivity compared with that of the overhead feeder system, we will see at once, that here is a subject for serious consideration. Reflection will lead us to believe that we have been ignorant. We shall recall how carefully we did our overhead construction in order to avoid useless resistances, and leakage, how we made long connections in our feeder wires, and how particular we were to have each joint perfectly soldered and taped, and properly tied to glass insulators. All seems to be nearly perfection here, but we now turn to the rail circuits, and consider how negligent we were in making a circuit for the return current. We admit at once that we have in our rails conductivity sufficient to carry many times the quantity of current in our overhead feeder system, and at less loss, but when we find that the current for the entire system is supplied through perhaps two small bond wires very poorly connected to the rails at best, we see that we have two courses for conductivity analogous to a piece of wet string and a copper wire. Rail joints when new can be considered auxilary to bond wires, but should not be depended upon or considered in practical construction. The theory of using the earth as an auxiliary to the rail circuit should have been exploded at the time of its origin, although it is necessary to have ground plates to neutralize the potential between the earth and rails, as well as to form a connection with the lightning arrester.

The electrolysis of water pipes is a very clear proof of imperfect rail circuits, and indicates an expenditure of energy which if the resistance of the rail circuit was reduced would not have occurred. We must endeavor to secure the least possible resistance in our track circuit and reduce it to much less than that of our overhead conductors, and in order to do this let us look to better bonding of our rail joints, not necessarily using heavier bond wires, but paying more attention to the best methods of attachment, and using for bonds such dimensions of wire as may be necessary to carry a surplus of current—more than is necessary for closely estimated wants. Copper bond wires have been found to give the best results for general use in the different characters of soils and I am of the opinion that No 2 O wire is as small as should be used to resist deteriorations.

Direct Coupled Ball Engine.

The accompanying illustration represents an 80-horse power Ball engine directly connected to a Waddell-Entz dynamo. It shows the armature mounted on the engine crank shaft, which is supported on the end by an outboard bearing resting on an extended sub base. This is a compact, durable, and efficient arrangement, and has given the greatest satisfaction in practice. The distinctive features of this well-known engine, which is made by the Ball Engine Company of Erie Pa., are beauty of design, simplicity and compactness, solidity and strength of frame, large bearings and wearing surfaces, excellence of materials and workmanship. The engine, is economical and



BALL ENGINE COUPLED TO A WADDELL-ENTZ DYNAMO.

durable, and being perfectly balanced will run quietly and smoothly under the heaviest and most widely varying loads. The regulation is such that the engine will not vary to exceed one per cent. in speed. Every detail of construction receives the most careful inspection, and every engine is thoroughly tested before shipment is made.

Comments and Views of Contemporaries.

IMPROVEMENT IN STREET RAILWAY SERVICE.—Many conditions still limit the electric car in its service to the public, although the dangers attending the application of electricity to street railways have been greatly diminished. We have become accustomed to the electric cars and are ready to look out for them. The men who run them are also better trained to do their duty. But the present methods of running these cars are likely to be greatly changed in a short time. To all appearances the overhead wires will soon be buried in the earth, and a method of using electricity will be in operation that is under better control than that now in use, and able to do better service.—*Boston Herald.*

LONG DISTANCE TROLLEY LINE.—The proposed line between New York and Philadelphia is expected to establish the fact that a trolley line of indefinite length built through a populous country may be a paying investment. Chicago will watch with peculiar interest the result. No city in the country is more favorably situated to receive the advantages offered by suburban lines of this character, and the opportunity here offered for the successful operation of several systems is unexcelled. The effect would be in every way advantageous. The great wastes which now lie between suburban stations all about Chicago would be filled up. Now the suburban residents huddle about the stations until they are nearly as badly crowded together as the denizens of the metropolis. Homes would be built upon acres instead of feet of ground, and comfort and health in many ways encouraged. Neighboring villages now strangers to each other would be brought into closer touch, the cheapened fare would make frequent visitations possible to those with whom closest economy is necessary, and the fact that passengers could get on and off the cars at will, and not be subjected to the irritating mental strain of "catching the train," would encourage travel greatly.—*Chicago Evening Journal.*

SUBURBAN ELECTRIC LINES.—The electric railway has already proved even more important relatively in its application to suburban travel than in its use in city streets. The limit of speed imposed by safety makes the trolley more valuable for its economy and facility than as a means of merely quicker transit. But on country roads this limit is removed, and the great speed that can be attained while keeping the car under perfect control, the ease and promptness of stopping and starting, and the possibility of running single cars as often as the amount of travel may demand, without a proportionate increase of expense, makes the electric line greatly superior to the steam road for suburban use.—*Philadelphia Times.*

SPEED INDICATOR NEEDED.—City authorities may pass ordinances regulating car speeds, without end, but it is asking too much of the motorman to calculate or even to guess at the speed of his car, in addition to his other exacting duties. What is wanted is a simple and reliable speed indicator, which will enable the motorman to tell by a glance how fast he is running. Such an indicator might be of either the visual or the audible type, or both combined, and should be arranged to give warning as soon as the maximum permissible speed is exceeded. The slow horse car, and the cable car limited to a fixed maximum speed, evidently have never required such an indicator; but that it has become a necessary adjunct for electric cars is obvious. We venture to say that its introduction will be followed by a reduction of the number of "trolley accidents," and that the cost will be but a bagatelle compared with the reduction in the amounts now paid for damages. We commend to inventors the designing of an electric car speed indicator of this class. —*Electrical Engineer.*

SPEED OF CARS.—There are several perplexing questions involved in the problem of rapid transit in the cities. The greater the speed of the cars the greater the number of accidents that occur. The people demand rapid transit. While we enjoy rapid transit people will occasionally get killed. And yet we doubt if the people will consent to return to the old system, when it required the better part of a half day to make a trip from the wagon works to Summit street and return. It is not desirable that we return to the old system. The advantages of rapid transit more than overbalance the misfortune of its casualities, in permitting the people to spread out over a larger territory and breathe a purer atmosphere. Rapid transit saves ten lives where one is lost. This does not take into account the innumerable other blessings conferred.—*Toledo Commercial.*

AN IOWA VISIONARY.—Senator Rowen has again attracted attention to himself by introducing a bill requiring street railway companies to pay employes daily. Rowen will render at least one useful service if by his fantastic capers he shall teach the people of Iowa the folly of electing visionary, impractical preachers to the state legislature.—*Dubuque Telegraph.*

FINANCIAL DEPARTMENT.

Financial Notes.

Long Island Traction.—The consolidation of the Brooklyn City Street Railroad Company and the Brooklyn Heights Company with the Long Island Traction was finally consummated last week by the election of one management for the entire property. Daniel F. Lewis resigned the presidency of the Brooklyn City Railroad Company and was elected to succeed Felix Campbell as president of the Long Island Traction Company, the lessee of the lines controlled by the former corporation and run by it. The board of trustees of the Traction Company, which was organized under the laws of Virginia, and has a capital of $30,000,000, has been changed by increasing the number of directors from five to thirteen. The executive committee is comprised of Daniel F. Lewis, E. W. Bliss, Felix Campbell, Crowell Hadden, S. L. Keeney and Martin Joost. Among the new directors are Abraham Abraham, of Abraham & Strauss; W. S. Sloan, of the D. L. & W. Railroad Company, and James Timpson, of the Mutual Life Insurance Company. The other officers, besides President Lewis, are E. W. Bliss, vice-president; W. A. H. Bogardus, general manager, and Cyrus P. Smith, secretary and treasurer. The same officers were chosen for the Brooklyn Heights Railroad Company.

Pittsburgh Central Traction.—The annual meeting of the Central Traction Company of Pittsburgh, Pa., was held last week. The total operating receipts for the year were about 2 per cent. less than those of 1892, or a decrease of $3,400. The operating expenses decreased $4,300, but the expense of maintenance increased about $6,300. About $3,000 of this increased cost was directly chargeable to the electric line. Reference was made to the arrangement with the Duquesne management by which the electric cars are to be run around the down-town loop instead of transfer at Fulton street, and, the cost is to be $4,000 or one-half that for erecting the poles. The treasurer's report shows the total receipts to be $196,040.91 and the total disbursements $195,123 64, leaving a balance in bank of $917.27. The available assets are placed at $26,239.61, and the unavailable at $1,346 240.13, making a total of $1 132,479.74. The liabilities include bonds $375,000, accounts payable $2,448.94 and bills payable $60,000.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn street, said yesterday: "Some improvement in the wheat market has reflected itself in all stock exchanges and we have quite a marked improvement. West Chicago and North Chicago have both advanced on the shorts covering and a better general feeling. This better feeling is not confined to the railroads alone, but is spreading in all directions. The man who waits to buy cheaper stocks may get left, for when the good news comes there will be none, for Wall street always discounts good news a long time ahead."

Nashville United Electric.—Joseph H. Thompson and T. W. Wrenne, receivers of the United Electric, have filed their statement of the nature and amount of the indebtedness of that company on January 9, 1894. The claims filed aggregate nearly $3 000,000, of which only some comparatively small items are disputed. The principal disputed item is the $51,056 of income bonds and interest due on them. The largest claim is that of the first mortgage bondholders. The first mortgage bonds, due in thirty years, and amounting to $2,500,000, were used in part payment for roads now a part of the United Electric system.

Louisville Railway.—At the annual meeting of the Louisville Railway Company last week the treasurer's report was submitted, showing that the gross earnings for the year were $1,281,992.88, and the operating expenses, including taxes, interest and other charges, were $1,208,555.54, leaving a net surplus of $73,437.34. Twenty-nine miles of road were converted into trolley lines during the year. At the present time the company operates 90 miles of road by electricity and 55 miles with horses.

Fort Worth, Tex.—The North Side street railway, which has been in the hands of a receiver for over two years, will be sold to the highest bidder on the first Tuesday in April.

New Incorporations.

Jefferson City, Mo.—The Jefferson City Bridge & Transit Company filed articles of incorporation with the circuit clerk of Cole County. The intention of the projectors is to operate a line of electric railway over the bridge, thus making direct connection with the Chicago and Alton and Missouri, Kansas and Texas railways on the Callaway County side.

Seattle, Wash.—A. M. Brookes, Angus Mackintosh, John Fairfield, F. H. Coe and Charles H. Baker have filed articles of incorporation of the Baker Engineering Company. The concern is capitalized for $500,000 and the incorporators announce their intention of engaging in the construction and equipment of steam railroads, and cable and electric street railways.

Toledo, O.—The Toledo, Maumee & Perrysburg Electric Railroad Company has been incorporated with a capital stock of $150,000. J. K. Tillotson will be president and general manager and Frank M. Ohl secretary and treasurer. It is stated that the road will be in operation by June 1.

Indianapolis, Ind.—The Farmers & Broad Ripple Street Railway Company has been incorporated to build an electric railway in Indianapolis and its suburbs. The directors are Capt W. R. Myers, Judge John C. Green, A. N. Fisher, Henry Malpas and O. C. Myers. The capital stock is $100,000.

Brockton, N. Y.—The Brockton Street Railroad Company of Brockton, Chautauqua county, has been incorporated, capital $10,000; directors Owen W. Powell, T. C. Moss and C. F. Ryckman of Brockton, and others.

Waukegan, Ill.—The Waukegan Electric Railway Company has filed incorporation papers, the capital stock being $500,000. The incorporators are M. C. Van Fleet, B. L. Jones, and W. C. Palmer.

Independence, Ia.—The Independence & Rush Park Street Railway Company has been incorporated with a capital stock of $25,000 to operate an electric and steam railway.

Elizabeth, N. J.—The Suburban Railway & Electric Company has been incorporated with a capital stock of $750,000.

Philadelphia.—The Huntingdon Street Connecting Passenger Railway Company has been incorporated with a capital stock of $6,000.

NEWS OF THE WEEK.

Chattanooga, Tenn.—The Chattanooga Electric Railway Company has filed a bill in chancery against the American Employers' Liability Insurance Company, of New Jersey. The complainant alleges that in March, 1893, a contract was made with the defendant to insure the company against all damages arising from accidents. For the insurance the fee of $1 800 was paid. The amount of premium was based on the gross earnings of the company, the insurance company agreeing to take all risks for 1½ per cent. of the gross earnings. These earnings for the ensuing year were estimated at $120,000. It was agreed at the time that in case the earnings did not amount to that sum the insurance company should refund the difference, and if the earnings should exceed $120,000 the railway company should pay the increase demanded by the per cent. The bill states that the earnings have so far only amounted to $86,908.86, and that the insurance company by the previous agreement is bound to refund to the railway company the sum of $406.31, the difference between the premium paid and what is actually due. It is also alleged that the insurance company has refused to pay two judgments for damages incurred while the policy was in force, amounting to $401 02.

Norristown, Pa.—The Citizens' Passenger Railway Co. have decided on extension to Jeffersonville on the west, and to Conshohocken on the east, the work to begin as soon as the weather opens, in order to have the work completed for the summer travel. The projectors of the enterprise are the Shepp Brothers, of Philadelphia, who own a controlling interest in the Citizens' line. The Conshohocken Company, which as yet exists only on paper, is also controlled by the Messrs. Shepp, recently paid the borough of Conshohocken for a franchise giving them the exclusive privilege of constructing an electric railway in that borough. The present plan is to extend the Citizens' Line to Conshohocken through that borough to Springfield, and thence to Barren Hill, the terminus of the Roxborough Inclined Railway, on which electricity is being introduced.

St. Louis, Mo.—The Missouri Railroad Company has decided to complete the Belt Line for which it secured a franchise some two or three years ago and to equip it with electricity. The route to be traversed by the new line is from Forest Park and Lindell boulevard south to Laclede avenue, thence east on Laclede avenue and Market street to Thirteenth street, north on Thirteenth street to Olive; thence east to Fourth, south to Chestnut, west on Chestnut to Seventeenth, south to Market, then past the Union Depot and west on Market street and Laclede avenue to Lindell boulevard and Forest Park. Poles have already been placed on Olive from Thirteenth to Fourth streets and the work will now be pushed rapidly forward to completion.

Lancaster, Pa.—The stockholders of the Lancaster section of the Pennsylvania Traction Company have elected the following directors: Senator J. J. Patterson, J. Hay Brown, John D. Skiles, B J. McGrann, John Hertzler, Michael Reilly, John S. Graybill, Colonel James Young, Carl F. Espenshade, J. W. B. Bausman and Dr. M. L. Herr. The board organized by electing Senator Patterson president and John Hertzler secretary. It is stated that Lancaster will be the center of the system of electric railways that will reach from the State capital to the metropolis. The line from Harrisburg to Lancaster will be nearly straight. Between there and Philadelphia a number of towns will be touched, the largest of which is West Chester.

Philadelphia, Pa.—An ordinance has been adopted and signed by the mayor giving a franchise to the Market Street, Richmond & Frankford Elevated Electric Railway Company. The road is to begin on the south side of Filbert street, between Eighth and Ninth streets, and occupy small streets all the way to Cheltenham, Montgomery county. It will be eight miles in length and double track, and elevated on iron piers with a clear headway of not less than fourteen feet at all places, and not less than twenty where it crosses the tracks of a steam railroad. Among those interested in the company are G. Frederick Jordan, G. Frederick Keene and Theodore Cramp of Philadelphia; William H. McManus of Chester and John Dougherty of Englewood, N. J.

Northampton, Mass.—At a recent meeting of the Board of Aldermen the Electric Street Railroad was granted a franchise to East Hampton and Williamsburg. East Hampton and Williamsburg have also voted the requisite franchises, so that the company can now build. It will cost the company $50,000 to lay the line to East Hampton and about $70,000 for the Williamsburg extension. An effort will be made to get a portion of the work done this winter to help those who are out of employment.

Richmond, Va.—A bill has been introduced in the legislature to incorporate the Southern Railway & Electric Company and to authorize it to build an electric railway from Richmond to some point on the Potomac river, between Alexandria and Great Falls. The incorporators are: T. N. Kendler, A. Pizzini, Jr., G. D. Patch, M. B. Ramos, Hill Montague, W. C. Trueman, M. L. Dawson and J. W. Gordon.

Pittsburgh, Pa.—The jury in the case of Wm. M. Laird against the Pittsburg Traction Company has returned a verdict of $143 in favor of the plaintiff. The suit was for damages for being put off a car. A conductor refused to accept a transfer ticket, claiming the 10 minute limit had expired. Mr. Laird asserted that the conductor who gave it to him had punched it wrong.

Allentown, Pa.—The Lehigh Valley Traction Company has absorbed the Allentown & Bethlehem Rapid Transit Company. The former company opened its line to Catasauqua last October and its South Bethlehem line has been in operation since January. The Rapid Transit Company has operated an electric railway for three years. The principal owners of the Traction Company are Congressman Tom L. Johnson and A. L. Johnson of Cleveland.

Waterbury, Conn.—Work is to be begun at once on the power station of the Waterbury Traction Company. It is to be a brick structure 182x65 feet. The roof will be furnished by the Berlin Iron Bridge Company. It is expected that electric cars will be in operation by June 1.

Geneva, N. Y.—The Geneva & Waterloo Electric Railway Company, which will build a line to connect Geneva with Seneca Falls and Cayuga Lake Park, has obtained consents from property owners, and it is now considered certain that the road will be built.

Richmond, Va.—A bill has been introduced incorporating the Fairmount Railway Company, of Henrico, to build an electric railway. The incorporators are Fred C. Brauer, Jr., John H. Dinneen, Samuel H. Pulliam, V. Hechler, Jr., and William T. Hechler.

New York, N. Y.—Tests were made recently of the Boynton bicycle railway system at Bellport, L. I., where a track a mile and half in length has been laid. Speeds of 40 miles per hour were made according to the reports.

Chicago, Ill.—The Northwestern Elevated Railroad Company has forwarded a certified check for $100,000 to the city treasurer in compliance with the terms of the ordinance granting the franchise for the North Side elevated system.

Chicago, Ill.—An ordinance has been introduced in the city council granting a franchise to the North Side Electric Street Railway Company, which proposes to build an electric road on the North Side, commencing at Kinzie and Franklin streets.

Pittsburgh, Pa.—Cars are running on the Neville Island and Coraopolis line from Pittsburgh to the foot of Neville Island. When the line is finished to Coraopolis it will be 14 miles in length.

Philadelphia, Pa.—The Philadelphia Traction Company has begun running trolley cars over the North Broad street extension of the Thirteenth and Fifteenth street line.

Cleveland, O.—Within a few months the Cleveland Electric Railway Company will build a new line extending through Burton street and Rhodes avenue to Newburg street.

Altoona, Pa.—The work of constructing a power station on the site of the burned station has been begun by the Logan Valley Electric Railway Company.

Gloversville, N. Y.—The main building of the Cayadutta Electric Railway Company was damaged to the extent of $10,000 by fire on February 26.

Montreal, Que.—It is likely that the Mountain Electric Railway Company will within a short time build a road to Cote St. Antoine.

Springfield, Mass.—C. N. Hall has become interested in a project to build an electric railway to East Longmeadow.

Pittsburgh, Pa.—The Citizens' Traction line will be extended to Aspinwall.

PERSONAL.

Frank W. Child, president of the Suburban Traction Company of Orange, N. J., has sailed for Europe. He will be absent for a few weeks, and his friends trust that the change will greatly improve his health.

Henry C. Payne has resigned his position as manager of the Milwaukee Street Railway system. The announcement was received with great surprise in Milwaukee, although it had been known that Mr. Payne wished to be relieved of the onerous duties of his office.

TRADE NOTES.

The Ohio Brass Company, of Mansfield, Ohio, has just issued its illustrated catalogue which will be examined with interest by those who purchase electric street railway supplies. The catalogue includes construction material, line devices and car appliances. While the company has not heretofore been brought directly into contact with those who purchase for street railway companies, yet it has for a long time been manufacturing electric street railway goods, the supply being put on the market by another company. The company has therefore had abundant experience. It has facilities for manufacturing first-class material, as those who have used it are ready to testify.

The Ball Engine Company, of Erie, Pa., has made a number of recent installations in connection with various types of dynamos. Among the number are two 200 H. P. cross compound engines, directly connected to Siemens & Halske dynamos in the Lumber Exchange Building, Minneapolis, Minn.; one 125 H. P. simple engine in connection with Waddell-Entz dynamo, in the store building of Willoughby, Hill & Co., Chicago; one 80 H. P. engine in connection with Waddell-Entz dynamo in the building of Connor, Craig & Co., Boston, Mass.

The Electrical & Mechanical Engineering & Trading Company, of New York, engages in all branches of electrical work and it has been eminently successful in the enterprises with which it has been identified. The president and chief engineer is J. H. Vail, whose name is a guaranty of sound engineering. The company has had large experience in the design and construction of power stations for electric light or railway systems, and it has been particularly successful in enlarging and reconstructing existing plants. The company furnishes expert service in electrical and steam engineering.

The Sterling Supply and Manufacturing Company, a new company organized under the laws of the State of New York, has recently purchased all the patents, tools, etc., for manufacturing the Sterling fare registers and the Monitor register now in use on a number of roads. This company is also prepared to manufacture all kinds of street railway supplies and specialties. It has now on hand a quantity of orders for the Sterling sand box and fare registers which maintain their popularity with the trade.

The Taylor Electric Truck Company, of Troy N. Y., has just issued a new catalogue describing the Taylor improved electric truck and the Empire state radial truck. The catalogue illustrates the essential features of these trucks which are especially adapted to the severe service inevitable on electric railways.

The Westinghouse Electric & Manufacturing Company opened on March 1 an agency in the Mills Building, San Francisco. The company representative will be H. A. Russell, assisted by Mr. R. B. Elder. Both gentlemen are well known in the electrical business on the Pacific Coast.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued February 13, 1894.

514,544. Track Drill Louis J. Crecilius, St. Louis, Mo., assignor to Andrew Warren, same place. Filed August 1, 1892.

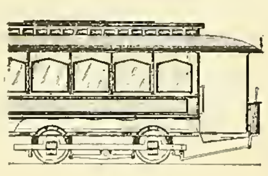
This is the combination of a drill with its block and operating parts and the frame for receiving the block. The block and frame have interlocking parts to allow the block to be adjusted forward and backward, and to hold the block in any desired position.

514,544. Magazine Fuse for Electric Currents. Charles E. Jones, Cincinnati, O, assignor to the Jones Bros. Electric Company, same place. Filed November 10, 1893.

This is the combination of an insulating base, a clamp thereon for a circuit wire, a series of binding posts electrically connected to the clamp, a second series of binding posts insulated from each other and terminating in contact springs arranged in a segmental series, a switch wheel having blades which may come into contact with any of the contact springs, a second binding clamp for a circuit wire electrically connected with the switch wheel and mechanism to serve to turn the wheel.

514,561. Electric Railway. Paul W. Leffler, Minneapolis, Minn., assignor to the Leffler Electro-Magnetic Railway Company, Chicago, Ill. Filed May 13, 1893.

The first claim of this patent reads as follows: "The combination with a car, or other traveling body, of field



NO. 514,655.

magnets in the line of travel, a non-rotating armature on the car, electric connections for the field and armature magnets, and an automatic rotary pole changer carried by the car, located in the connections to the armature magnets and operated by the field magnets."

514,586. Electrical Transmission of Power. Charles S. Bradley, Yonkers, N. Y. Filed June 23, 1890.

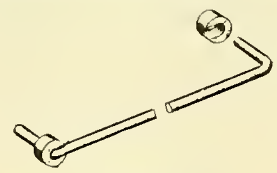
This is the combination in a system for transmitting power of a continuous current generator, a phasing device electrically connected therewith for converting the continuous current into alternating currents of differential phase, and an electric motor, the field magnet of which is charged by a continuous current, and the armature of which is charged by the alternating currents of differential phase.

514,655. Car Brake. John Kerwin, Detroit, Mich., assignor of one-half to Andrew McBride and John Campbell, same place. Filed September 19, 1893.

In this brake bands extend over the tops of the wheels. An evener extending horizontally connects the friction bands. An operating lever is connected with the forward end of the band over the front wheel so that when this band is forced against the wheel the evener will cause the other band to engage with the rear wheel. (See illustration).

514,665. Pole for Electric Railways. Edward W. Serrell, New York, N. Y. Filed January 9, 1893.

This is a metallic pole composed of three or more members having flat or plate bodies wider at one end than at



NO. 514,714.

the other and angle irons uniting the edges of the plates throughout their length at the center of the pole.

514.714. Bond Wire for Electric Conductors. Albert Hoffman and Joseph Brozan, Milwaukee, Wis. Filed July 5, 1893.

The bond comprises aterally bent ends and suitable washers with holes for admitting the bent ends. The washers have radial grooves so that the bond wire may lie flush with the outer surface of the washers. (See illustration).

514.718. Electric Railway System. Paul W. Leffler, Minneapolis, Minn., assignor to the Leffler Electric Magnetic Railway Company, Chicago, Ill.

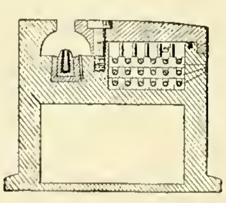
The first claim of the patent reads as follows: "The combination with a car or other traveling body, of a magnetic field extending along the line of travel, a magnetic armature carried by the car, and magnetic pole changing mechanism, operating according to the speed of the car, applied to one of said magnetic members, whereby the forces of attraction and repulsion from said magnetic members will coöperate in the propulsion of the car."

514,749. Life Guard for Street Cars. Theophile Euphrat, Darien, Conn.

The guard consists of a catcher suspended from the bottom of the front end of the car. The front end of the scoop is slightly in advance of the car and the rest under the car.

514,763. Car Brake Handle. John Marrisett, Vancouver, Canada. Filed November 21, 1893.

This is the combination with the brake shaft of a pulley rigidly secured thereon, a bracket loosely supported on the



NO. 814,827.

shaft near the pulley, a handle fulcrumed in the bracket and adapted to frictionally engage the pulley and a stop to limit the movement of the handle in one direction.

514,801. Trolley. John A. Williams, Altoona, Pa. Filed October 7, 1893.

This is the combination with a harp having the edges of its arms curved inwardly of removable shaft blocks sealed in sockets in the sides of the harp and a trolley wheel keyed to the blocks and to integral portions of the harp.

514,816. Car Replacer. Albert S. Debose, Cuero, Tex. Filed July 18, 1893.

The wedge-shaped blocks forming the replacer have ears upon their lower sides and are connected by the rods passing through the ears and beneath the rails.

514,817. Armature Connection for Dynamos. Oza Dufault, Spencer, Mass. Filed October 27, 1893.

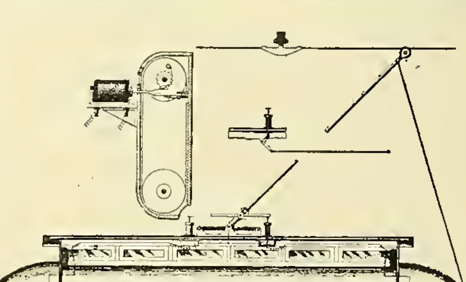
A connector for commutator bars consists of an L shaped piece of metal furnished with a dowel formed of the end of the lead and with a projection for retaining the binding cord.

514,822 Insulating Joint. Emil F. Gennert, Brooklyn, N. Y. Filed August 10, 1893.

This is the combination of the two sections provided at adjacent ends with lateral flanges, with a continuous cup-shaped covering embracing the flanges and an insulation between the ring and sections of the coupling.

514 827. Electric Railway Conduit. Robert I. Hampton, Athens, Ga. Filed May 25, 1893.

The fifth claim of the patent is as follows: "An electric conduit, consisting of a trolley rail chamber, transverse



NO. 814,878.

beams to support the trolley rail and its insulating devices, a drainway located below and communicating with the trolley rail chamber between said beams, and cable ways located on opposite sides of the trolley rail chamber and closed in from said chamber and from the drain way." (See illustration.)

514,878. Electrically Operated Street Indicator for Cars. Henry C. Barker, St. Louis, Mo., assignor to Jacob Stocke, Jr., and Henry C. Beekmann. Same place.

This is the combination in a street indicator, of the rollers carrying a traveling indicator, a magnet, a core in the magnet carrying a catch, a ratchet wheel on the shaft of one of the rollers with which the catch engages, and an electrical conducting wire connected to the magnet, and means whereby the electrical current is opened and closed over the conducting wire in the movement of the trolley or contact piece of an electrically driven car. (See illustration).

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CONTENTS.

Mr. Perry's Series of Articles. Because of the delay on the part of engravers who were to furnish illustrations to accompany Mr. Nelson W. Perry's series of articles on "Electric Railway Motors: Their Construction and Operation," the publication of the tenth installment is postponed to the next issue.

Pennsylvania Street Railways. Pennsylvania has no railway commission, and the only official figures published concerning its street railways are those contained in the report of the Department of Internal Affairs. This document has just been issued, and according to the statements contained in it hard times have not discouraged the projectors of street railway enterprises. There are in operation in the state 124 railways, and 196 companies have either begun work or are merely waiting for local authority before starting construction. This is a somewhat different showing from that which appears in the street railway directories. In one of these, which is supposed to be fairly reliable, only 102 companies are noted, while its list of projected roads enumerates only twelve enterprises.

Buying and Selling Power. A suit of interest alike to companies that sell and companies that buy power for operating street railways has been begun in Chicago, and the facts are presented elsewhere in this issue. A company which leased its power did not agree with the company which operated the generating plant upon items in the bill for the supply. As the disagreement could not be adjusted the latter company threatened to abandon its service. The railway company called upon the court for protection, as it would have been hopelessly disabled if its supply of current were cut off. The court granted its petition for an injunction on the ground that the public would be greatly inconvenienced if the cars ceased to run. Without regard to the merits of this particular controversy such a decision seems rather hard on a company which operates a plant, as it removes its strongest argument to compel payment for its bills, but unquestionably the public has reason to be thoroughly satisfied.

Profitableness of Electric Roads. The utterances of the Massachusetts railroad commission in reference to electric railways have not met with endorsement from any quarter so far as we are aware. The board, so far from considering electric railways as more profitable than horse lines, was inclined to take a diametrically opposite view. It is interesting to notice that financial papers do not share in this opinion. The *Boston News Bureau*, which pays a great deal of attention to all electrical properties, has this to say in a recent issue: "Notwithstanding the attack of the populistic Massachusetts railroad commission upon electric railways as investments, electric affairs are beginning to look up. The recent complete demonstration of the West End and Lynn & Boston roads to the superiority of electric motive power over horses, and in some instances over steam, emphasizes the advance in electric power which has been made in so short a time, and every element in the electric world seems working for increased efficiency and reduced cost of apparatus."

Heating Street Cars. A bill has recently been introduced in the Massachusetts legislature providing that street cars during five months in the year shall be heated to a temperature of 60 degrees. Companies which disregard the regulation are subject to a fine of $25 for every trip made by an unheated car, and police are empowered to enforce the provisions of the proposed law. It is now generally recognized by street railway men that cars should be heated during cold weather, and the only grave question relates to the means which will best serve the purpose. In this view of the matter they are influenced by purely business considerations for they have found that whatever adds to the comforts and convenience of passengers increases the profits of a company, Such a measure as that which we have referred to is unreasonable. When cars make frequent stops, and doors are kept open while several passengers are entering or alighting it is out of the question to keep the temperature at the proper height with any means that has yet been devised for warming street cars.

The Strike at Youngstown. A strike of street railway employes took place at Youngstown, O., a few days ago and a riot occurred when the company attempted to operate its cars. The usual attempts at destruction of property followed and as usual the strikers disclaimed all responsibility for the outrages and shifted it upon their sympathizers. The attacks on the cars assumed a decidedly serious aspect, as the rioters resorted to dynamite to further their ends. It is certainly to be hoped that the company will bring these law-breakers to justice. After a strike is over companies are too likely to be lenient and to abandon the prosecution of men who have attempted the lives of employes and have maliciously destroyed property. When rioters begin to employ dynamite it is time that they were taught a lesson. For the strikers no particular sympathy can be entertained by those who read the dispatches from Youngstown, even if it is assumed that they encouraged in no wise the outrages perpetrated by their fool friends. As nearly as can be learned from the reports they joined the ranks of the unemployed because they feared that their pay was to be reduced, inasmuch as the pay of one employe in another department had been decreased. At the present time when street railway companies are suffering from hard times as well as all other business corporations, and when so many men are clamoring for employment, the proceeding was certainly a foolish one to say the least.

Trolley Lines in Chicago. The trolley system is pushing to the front in Chicago with marvelous persistence. At the last meeting of the city council ordinances were passed giving to the company which controls the surface roads in the South Division the privilege of equipping for electrical operation almost all its lines now traversed by horse cars. The grant of the franchise marks a radical change in public sentiment in Chicago, in reference to overhead wires. Two years ago action of this character would have been out of the question for the public then thoroughly believed in the municipal policy that all electric conductors without distinction should be below the surface of the ground. Since that time most owners of property located more than a mile or two from the center of the city and situated at some little distance from the main cable lines, have become thoroughly dissatisfied with the sort of transportation that animal power can afford, and they are now about convinced that the only hope for improvement lies in the installation of a trolley system. While they still find an unreasonable degree of fault with the overhead wire, they are willing to accept it as it is an essential part of the system that will give them rapid transit. It was not to be supposed, however, that the ordinances could be passed without objection; as a matter of fact the bitterest sort of opposition has been developed. The opposition is of the familiar character that has been manifest whenever an electric railway franchise has been sought for during the last five years, and the same arguments that have been disproved a hundred times are advanced. It seems to be recognized, however, that the trolley is bound to win. As one paper says, "The trolley is here and we must make the best of it;" and again, "it is no use protesting against the inevitable. All argument and appeal seem ineffectual in interrupting the invasion of the trolley." A great deal of pressure has been brought to bear on Mayor Hopkins to induce him to veto the ordinances, but even if this movement succeeds the delay can not be for long, as the public is demanding better street car service and it can be afforded only by the trolley system. When the lines are in operation the South Division will be supplied with an unsurpassed system of transportation, and the mileage of the main cable lines will be small compared with the aggregate length of the electric roads. The company is already operating several electric lines, but it will need a vast deal of new equipment within and without the power stations before the lines are ready for service. The company has prepared for the large outlay which the purchase of equipment will involve by authorizing a new issue of stock.

HENRY C. PAYNE STILL IN CHARGE AT MILWAUKEE.

The dispatch sent from Milwaukee last week that Henry C. Payne would retire from the Milwaukee Street Railway Company, proves to be somewhat inaccurate. It is true that Mr. Payne will no longer discharge the duties of general manager, but he will still be connected with the company as its vice-president, and will shape its financial policy. C. D. Wyman will be the new manager. Upon his return from an eastern trip, Mr. Payne made the following statement:

"Ever since I became one of the receivers of the Northern Pacific I have been trying to find some good man to handle the details of the street car business, as the entire thing was too much for me. Finally I found Mr. Wyman, who is a practical street car man. He will look after the details, relieving me of that work. The story of my retirement from the road is, of course, absurd. I remain at the head of the financial affairs of the company, and am still vice-president. I resign nothing, but secure a man for the detail work. I believe we have by all odds the best-conducted and most complete street car system in the United States at the present time. A total of nearly $5,000,000 in cash was expended on the system, in addition to $2,000,000 more on new equipment. Last year the net earnings of the system were less than half of $550,000, so you see the company is not making an immense fortune. The company had a hard pull during the panic to get through all right. Its management will remain exactly the same as it has, and I shall continue to look after the company's affairs, with a practical man to relieve me of the details."

DISCONTINUANCE OF POWER ENJOINED.

The Siemens & Halske Electric Company, of Chicago, has been enjoined from cutting off the power which it supplies for operating the cars of the Chicago General Street Railway Company on West Twenty-second street. Bills for power were not agreed upon by the two companies and the electric company threatened to cut off the supply. The street railway company then secured the restraining writ. A. W. Wright, of the Siemens & Halske Company, is quoted as saying that the railway company's demand for power was considerably in excess of the original estimate, but when the bill was presented for the extra power, payment was refused. "Several times," he states, "we tried to come to some arrangement, and expressed our willingness to adjust the bill on what they might consider a fair basis. We couldn't get a settlement, so we threatened to cut the power off unless the bill was paid or some arrangement made. To-day we were served with injunction papers."

The counsel for the company made the following statement in supporting its position: "There is a small amount in controversy between the street car line and the Siemens Halske company. We disputed the claim, and because we did so the electric company threatened to shut off our power, much as a gas company deals with delinquent consumers. The difference is that the gas company inflicts discomfort upon only the consumer. Here the electric company would greatly inconvenience some hundreds of people and irreparably damage the road. So we filed a bill and obtained an injunction. The amount at stake is only $1,700. The electric company knows its money is safe and would be paid over when the claim in controversy has been adjusted."

C. C. Bonney, one of the officers of the railway company subsequently filed an affidavit in which he presented the facts as alleged by the company. He alleges that a contract was made between the street railway and electric companies that the latter was to supply the necessary power at the rate of three cents for each motor car mile and one cent for each trailer car mile. Four months' notice was asked by the electric company, as new and powerful machinery would have to be put up in its power house at No. 1168 South Wood street. As a temporary source of power the electric company afterward agreed to make use of exposition apparatus which would supply not to exceed ninety horse power. This plan was agreed to, Mr. Bonney's affidavit states, and up to this time the street railway company has only been receiving ninety horse power. Last November, the defendant says, President Mysenburg, of the electric company, said the power was costing too much money to furnish it at the agreed price and asked that the company pay the actual cost of the power. The electric company accuses the railway company of using a large amount of current for "experimental work." A claim for $1,732 as a balance of account owing the electric company is referred to by Mr. Bonney, who says that it is contrary to the contract held by his company. Eight hundred passengers are carried each day between Lawndale and Lincoln street on Twenty-second street, the court is told, and the stoppage of the system would work a great hardship on these suburban residents.

STRIKE AT YOUNGSTOWN, O.

The conductors and motormen of the Youngstown Street Railway Company of Youngstown, O., struck a few days ago because the pay of the engineer at the power station had been reduced. The men, thinking that their own wages would soon be decreased, determined at once to show their disapproval of any reduction by leaving their places. The street railway service was completely disabled, and on Monday no effort was made to operate the cars. On Tuesday it was decided to send out cars. In charge of the first one was Manager A. A. Anderson, than whom no pluckier man ever faced a mob of cowardly rioters. When the car reached Central Square the trolley wheel left the wire, and Manager Anderson coolly left the car and adjusted it. A crowd of considerable proportions followed the car hooting at the men in charge and throwing stones at the windows. The car had proceeded but a few feet when the wheel struck a dynamite cartridge on the track and a heavy explosion followed. Fortunately no one in the car suffered injury. The car was then run back into the barns. Men in charge of a second car were subjected to similar treatment, but they escaped serious injury, though a second dynamite cartridge was exploded and the glass in the windows and doors was demolished. Subsequently the rioters pushed two of the cars to the top of a grade and released them; they collided and were badly damaged.

The police seemed utterly powerless to prevent trouble and the sheriff was called upon to summon a posse for the protection of the company's men and its property.

It was claimed by the strikers that they were not responsible for the outrages that had been perpetrated, but that the destruction of property and the attacks on the lives of those in charge of the cars were due to zealous sympathizers.

No further rioting occurred on the following day. Manager Anderson announced to the strikers that he would refuse to recognize the union, and stated that if the men returned to work they must do so as individuals and at a 10 per cent. reduction in wages.

Proposed Trolley Lines in Chicago.

At the last meeting of the Chicago City Council ordinances were adopted giving the Chicago City Railway Company franchises for operating by electricity lines in the following streets:

Sixty-third street between Cottage Grove avenue and State street, Wallace street from Thirty-ninth to Root street, Twenty-second, Twenty-sixth, Thirty-first, Thirty-ninth, Fifty-first, Seventy-ninth street, Archer avenue, from State to the intersection of Thirty-eighth street, thence on Thirty-eight street to the terminus, Forty-third street from the eastern terminus west to State street, thence along State street to Root street, thence west along Root street to the terminus; Halsted street from Archer avenue to the southern terminus of the tracks; Wentworth avenue from Archer avenue to the southern terminus; Ashland avenue from Archer avenue to the southern terminus; upon and along Hanover and Wallace streets; upon and along State street and Sixty-third street, south to its intersection with Vincennes avenue, and thence to the terminus.

It is provided the trolley wires are to be suspended from center iron poles.

The passage of the ordinances has excited considerable opposition and the mayor has been urged to interpose a veto.

REORGANIZATION PLAN SUCCESSFUL IN ATLANTA.

The reorganization plan conceived by President Joel Hurt, of the Atlanta Consolidated Street Railway Company, has been scccessful, and the company is now relieved of its floating indebtedness. Mr. Hurt, on his return from a recent conference with bondholders in Boston, gave out the following information for publication:

"It has seemed to be the general impression that the reorganization, if effected, would work to the interest of all parties concerned, and the only question was whether or not the company would be able to put the scheme through in time to avoid litigation. Under the terms of the agreement we had until the 2d of March. On February 24 the required number of bonds were deposited with the trust companies with considerable margin more than the number needed, and we wired the fact to Atlanta late in the afternoon. The telegram was received by the company at 2:30 o'clock, between which time and 5 o'clock, all of the floating indebtedness, consisting of about $350,000, was paid, and a report from an expert examiner was mailed on the 5:15 o'clock train. Some of those bills were paid in Boston by Captain Sanders and myself, but the bulk of the work was done here.

"The company is entirely relieved of its floating indebtedness, except a portion of the January interest on the few bonds that have not come into the agreement. The interest on all the outstanding bonds has been deposited with the trust companies at the rate provided for in the agreement, and it is hoped that all of the bondholders who have not come in will yet do so, thus enabling the company to issue a new unstamped bond.

"The readjustment of the affairs of this company so as to avoid litigation and save the properties to the present stockholders, who are chiefly Atlanta's citizens, means more to Atlanta than one would first imagine. While nearly all of the steam roads in the South have been involved in litigation, and almost without exception the street railways in Southern cities during the past twelve months have failed to earn their fixed charges, and many of them have been involved in expensive litigation, it remains to Atlanta alone to put through a scheme of reorganization involving the payment of a large cash fund by her own citizens, which has avoided expensive litigation, and has placed the railway company on a sound financial basis. This fact will be appreciated by investors generally, and reflecting credit on Atlanta will be worth much to other institutions in this city.

"There is no question of the company's ability to earn the interest on the bonds at the reduced rate, but to provide against any possible doubt on this line the interest has been placed at 3 per cent. for a time, and thereafter at 5 per cent. for the life of the bond, and it is confidently believed that the company will pay all of its fixed charges, and will within a few years be able to earn regular dividends on the stock."

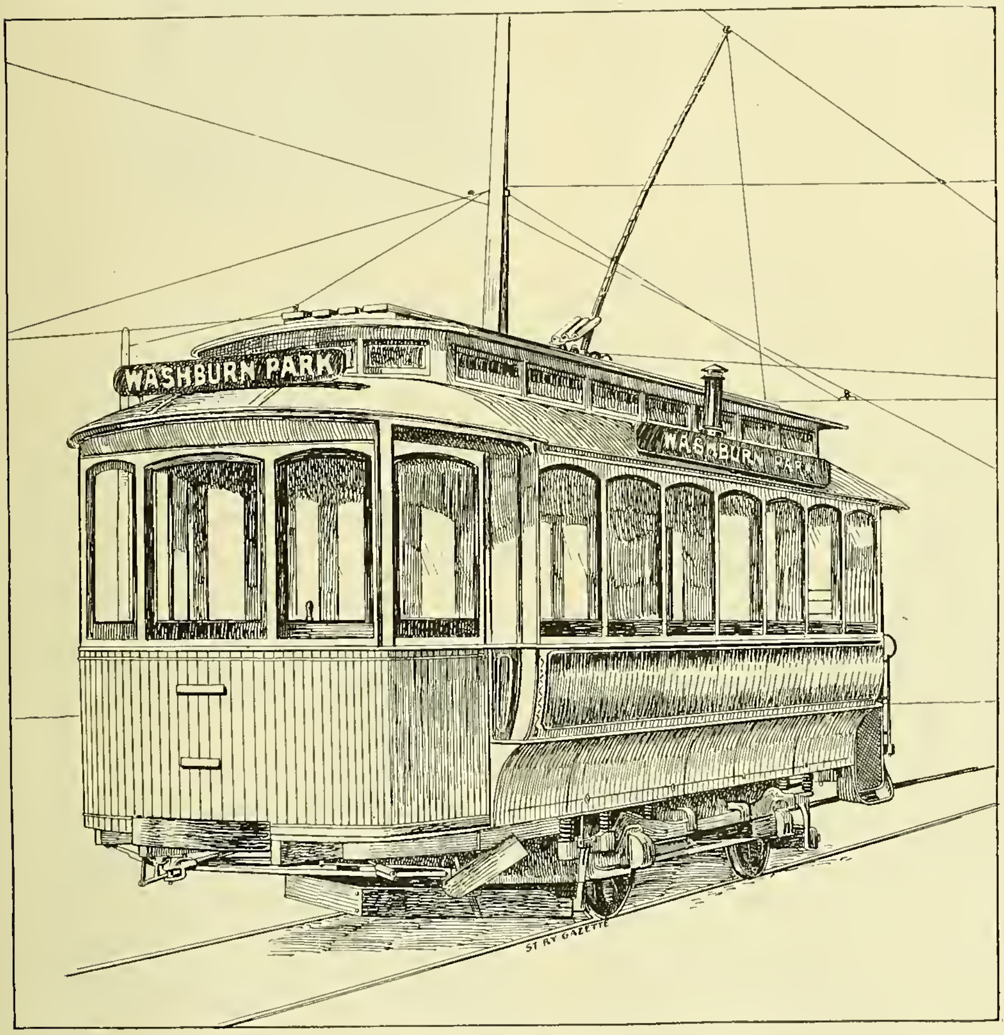
LONG DISTANCE TROLLEY LINES.—The construction of long distance trolley lines is going to be a feature of the application of electric motive force from this time on. If the storage battery is perfected so much the better; so much less the expense. * * * The farmers adjacent to the long trolley lines will have a much shorter haul by wagon to the nearest trolley station. The lines will run in front of many farmers' homes, and produce can be loaded on cars right on the farm. This is no barren ideality. The movement has already commenced. Within the first decade of the next century, now near at hand, the wear and tear of the farmers' animal motive power will be reduced to the minimum through the great extension of long electric trolley lines in the rural regions.—*Minneapolis Journal.*

MINNEAPOLIS VESTIBULED CARS.

The Twin City Rapid Transit Company of Minneapolis has been complying in good faith with the state law which provides that electric cars must be provided with vestibules. Certainly no fault can be found with the type of vestibule which is shown attached to the car in the accompanying illustration. It affords ample protection to the motorman, and it does not detract from the good appearance of the car. As far as can be learned the company has solved the vestibule problem. If the vestibule proves satisfactory in service and the protection for the men does not lead to an increase in the list of accidents, the question may be considered disposed of as far as Minneapolis and St. Paul are concerned.

While the company determined months ago to comply with the law, and while Mr. Lowry had favored the adoption of the measure which made the use of the vestibule compulsory, the equipment of cars did not proceed with as much rapidity as the local authorities wished, and proceedings were instituted against superintendents in both St. Paul and Minneapolis. The cities were successful and fines were imposed for the non-equipment of cars. At the present time there seems to be general satisfaction with the progress which the company is making in vestibuling its cars.

The illustration shows very clearly the style of the vestibule adopted. The equipment was built in the company's shops. When the cars were run into the car house they were stripped of everything with the exception of the hood on the end to which the vestibule was to be attached. New platforms were built with heavier supporting arms in order to carry the increased weight. The iron dashers and old style of crank brakes were discarded and for the latter wheel brakes were substituted. The buffers, platform arms, headers, sub-sills and belts are of white oak. The posts and water table are of Southern ash and the flooring is of Southern pine. The vestibules are provided with double windows throughout and the glass is "A A" double strength. Trap doors are arranged in the flooring to give access to the track switches.



THE MINNEAPOLIS VESTIBULE.

PHILADELPHIA ELEVATED ELECTRIC ROAD.

It is stated that the Market Street, Richmond and Frankford Street Elevated Railway, of Philadelphia, will be modeled in all essential respects after the Intramural road which was in operation at the World's Fair. The iron superstructure will be fourteen feet above grade except at railway crossings where the height will be twenty feet. The structural iron has been designed and will be furnished by the Midvale Steel Company, the Phœnixville Bridge Company, and Pittsburgh companies.

The company will pay to the city as compensation for its privileges one half of one per cent. of of its gross earnings, but this provision in its franchise will not become operative until two years after cars are in operation. The company has filed with the city solicitor a million dollar bond to cover any damages that may result from the construction of the road. It is said that the company expects little opposition from property owners in the northeastern section of the city as most of them seem inclined to believe that the elevated road will benefit their holdings. Work on the line is to be begun at once.

Need of Good Brakes.—As rapid transit is demanded by the people the electric railway companies cannot be justly condemned for trying to accommodate their patrons. But do they provide the best means to stop cars quickly to prevent accidents? The very best brakes should be put on the cars and kept in perfect working order. —*St. Louis Republic.*

PRACTICAL VALUE OF FUEL.

BY CHARLES DESMOND.

The question of the economy of fuel is always an important one among engineers and owners of steam plants as it constitutes the second largest expense in the operation, and endless efforts are being made to secure the best possible results from the plant as it exists; for it is too generally supposed that extensive changes will be required if any great change be made in the kind of fuel used.

As a usual thing too little consideration is given to the actual heat value of the fuel used, for it is customary to appraise it according to its adaptation to the conditions under which it or other fuel has been used in the same furnace. Lump coal is lump coal, to the majority of users; whether it has a high heat value is seldom considered so long as it does not clinker in the furnace and requires but little attention other than keeping the furnace supplied; and the kind that calls for the least attention and will make all the steam required is usually considered the most economical, regardless of the amount of water that can be made into steam at a given cost for fuel and attendance.

A furnace may be adapted to the use of one kind of coal and certain conditions of use and be unsuitable for a different kind of fuel, other methods of firing, or an increased rate of combustion; and any change made in any of these would probably lead to the condemnation of the fuel, without any particular effort having been made to make its use conform to the new conditions.

Analysis of different coals show a different composition for each and it cannot reasonably be expected that equally good results can be obtained from each kind, even though the heat value be about the same, when burned under a similar set of conditions. Draft of chimney, opening in grates, thickness of fire and various other details, each have an effect on the results obtained, and unless a given amount of experimenting be made to ascertain the best set of conditions by which the greatest heat value may be obtained, any good coal might be rejected as unsuitable when the only fault would be that it was not properly handled. So long as economy of fuel is an object, the nature of the fuel should be carefully studied and the furnace arranged to suit, or the method of firing made to correspond with the requirements.

A coal rich in gas—and such coals generally have a high heat value, often greater than if they were pure carbon—must be burned under such conditions as will cause the light gases to combine with the equivalent of oxygen, a condition that is not possible where all of the air supplied for combustion is drawn through the grate bars. The layer of coal being thickest at the time fresh coal is added, the flow of air through the fire is checked and a large portion of this gas passes off unconsumed. There is, consequently, a loss of heat, or rather a portion of the gas is uncombined and the heat that might have been developed by the combination is lost. Lump coal, when the pieces are large, provide sufficient opening for the passage of enough air to complete the combination, but, as a general thing, when the coal is coarse and the air space between the lumps large, the air enters in streams of such size that it fails to mix thoroughly with the gas and the result is as bad as if the supply of air was insufficient, for in either case there will be waste.

Slack coal or screenings contain, pound for pound, the same number of heat units as coal in lumps from the same vein; but the majority of engineers encounter great difficulty in getting satisfactory results from the use of this fuel, while others find it all that might be desired. This difference in results is due to the methods of firing and the arrangement of furnace, although the latter does not really have so much effect as many suppose.

Screenings or slack coal, when properly handled, may be burned with fully as good results for steam making as lump coal from the same mine, but as it is much smaller and lies more closely together, the same amount of air cannot pass through a fire of the same thickness with the same draft, consequently the finer coal must be supplied in smaller quantities and oftener or forced draft must be used. Forced draft is many times of great benefit in steam making for, in the majority of cases where it is used, it is shown that more water can be evaporated per square foot of heating surface in a boiler than when natural draft is used. Forced draft can be applied to almost any furnace at very little expense and the results will be more economically obtained. Changes from natural to forced draft have nearly always shown economy in the use of fuel, as the more intense fire has resulted in a higher rate of evaporation.

The use of screenings or slack coal calls for more constant attention to the work than when lump coal is used and is also productive of greater economy of fuel, for it is not uncommon that 6 to 7 pounds of water is made into steam per pound of such fuel, costing only about $1.50 per ton, as against $8\frac{1}{2}$ to 9 pounds of water evaporated per pound of lump coal costing not less than $2.50 per ton. and requiring no greater expense for handling than does the lump coal, thus making it much the cheaper fuel.

It may be that the closer attention required is the principal reason why there is so much objection to the use of small coal in plants where the duty is heavy and there are no special arrangements for handling such fuel; but with mechanical stokers or self-feeding furnaces there is no trouble and screenings or slack, if of fair quality, is always an economical fuel.

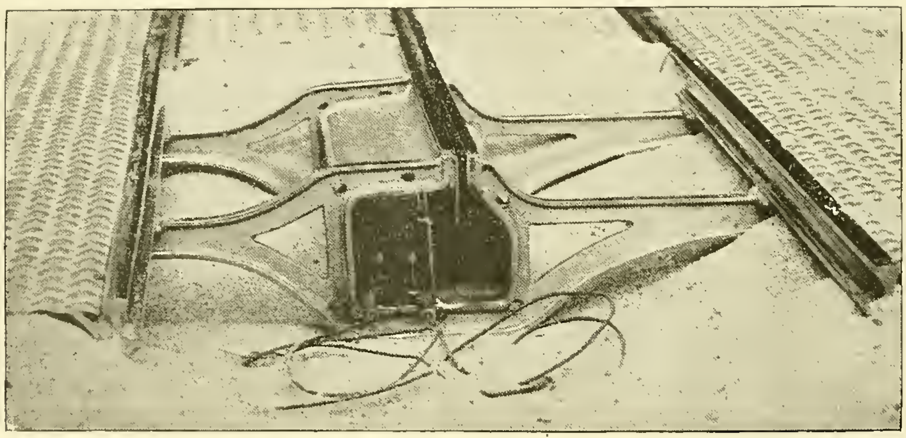
To burn a given quantity of fuel in a specified time requires a chimney draft of suitable strength, and the same weight of small coal will require thinner firing and more constant attention than when lump coal is used. With a good strong draft and the usual style of furnace, screenings can be used with satisfaction and economy if the necessary attention is given to the firing. The firing should be light and often, keeping the fuel thinnest near the center of the grates, allowing the fire to burn fastest there, keeping the sides and corners of the furnace well filled, even making a small bank of coal at these places, because such parts usually burn out the fastest and leave spaces through which cold air enters and cools the furnace, doing no good nor assisting combustion. The center of the fire should be kept at a white heat, as a flaming fire is not the best for steam making; then, by watching the fire, and not the steam gauge, for indications that the fire needs replenishing and adding fuel in small quantities in the places where it burns away the fastest, no great difficulty will be found in making plenty of steam and as fast as required.

It is strange that so much attention is given to the economical points of an engine and so little, usually, to getting the best results from the fuel used. If the fireman knows how to handle the cheaper fuels, and attends to his work, more steam can be obtained for the money expended when the cheaper fuels are used; but if the fireman does not understand the work, no matter how willing he may be, economy and success can not always be obtained with cheap fuel.

In nearly every case where mechanical stokers are employed the cost of steam is materially less than where the firing is done by hand, and this result is so universal that the only reasonable conclusion is that the firing is better done by a machine than by hand, and yet we know of several places where firing is done by hand and screenings are used as fuel and the cost of steam is less than when lump coal was used. In any case a great deal depends on the fireman, for automatic machinery requires more or less attention to keep it in order and make it give best results. The practical value of fuel depends, largely, on the way in which it is handled in the furnace.

PETERSEN CONDUIT SYSTEM.

The conduit system which is illustrated in the accompanying engraving is the invention of H. Petersen of the Petersen Electric Works, of Milwaukee. The system is designed to overcome the difficulties which have been encountered in the operation of conduits for railways because of moisture and dirt. As will be seen from the cut the principal feature of the conduit lies in the fact that it is constructed with two longitutinal compartments, one of which is arranged to contain the conductors while the other is designed to carry off water that may find its way into the conduit. The latter compartment is connected at intervals with sewers. A steel broom is attached to the cars and is so arranged that it will sweep along any accumulation of water or dirt into the sewer.



PETERSEN CONDUIT.

The second compartment is placed out of the line of the slot. In the upper part of the wall between these two compartments is an opening provided with a device by which it is kept closed when the car is not passing, but so arranged as to be automatically opened by the trolley arm. In the conduit shown in the engraving the device consists of vertical strips of metal of considerable length jointed and adapted to be raised between guides. By this means no moisture is permitted to get into the compartment containing the conductors, and the slot rail is extended down far enough to prevent any water getting on the closing device. As the conductor compartment is thus to all practical purposes entirely shut off from the interior compartment, and as, consequently, its temperature is the same as the temperature of the wall of the conduit, it is thought no condensation will take place in this compartment. In a very wet climate, if found necessary, a circulation of air may be supplied to this compartment by means of a fan, but there seems to be hardly any reason why this should be required, especially as the passage of the car will provide a considerable current of air.

Instead of using wires for conductors, it has been considered more reliable to employ iron or steel contact rails, as shown in the cut. These are divided into sections of about 100 feet, or any other convenient length. Such section is tapped on the two main feeders and provided with switch and safety cut-outs placed in manholes, so that if any trouble should occur, one section can be switched off without delaying the traffic on the whole line. These contact rails can be held in position in various ways. The whole compartment is finally coated with waterproof insulating paint. The main feeders are laid in pipes. The depth of the conduit is considerably less than that required for a cable conduit.

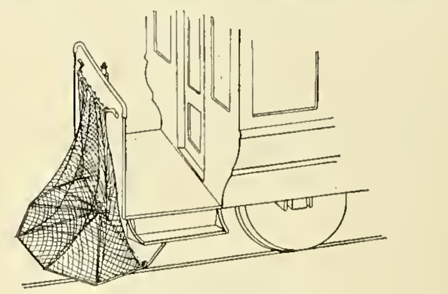


FIG. 1. VAN GESTEL FENDER.

The trolley arm is provided with two contact shoes, which nearly surround the upper part of the contact rail, so that they cannot jump the conductor. The contact shoes are provided with a swivel arrangement so as to take up any unevenness of the track, and by means of springs keep in proper contact with the conductors. From each contact shoe, wire is laid through the hollow arm and extended up to the motor, and at each end the arm is hermetically sealed. The contact carrier is so arranged that the motorman can from his platform, by moving a lever, lift the contact carrier out of the conduit at the manhole, without delaying the car for more than a minute.

VAN GESTEL FENDER.

The accompanying illustrations show a new form of street car fender invented by Jean Th. van Gestel of New York. The fender consists of a fan-like frame which when out of use is retracted by a chain or cord into a sheath. The sheath, *B*, Fig. 2, is pivoted on trunnions bearing in brackets attached to the under side of the car. Springs serve to project the fender into position for service. Attached to the forward end of the fender and also to the dashboard is a guard net which provides means for preventing the person struck by the fender from striking his head against the draw head or end of the car. It also furnishes something for him to grasp and sustain himself till the car is stopped. The rays of the fan are connected by a canvas web or other suitable material. The two outer rays are connected by rods that serve to spread the fan as the fender is projected. The fender is put into service by the motorman striking upon the pin *S*, which may

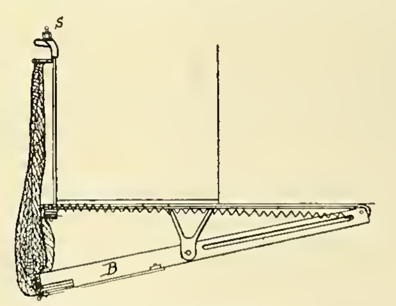


FIG. 2. VAN GESTEL FENDER.

be provided with a broad head. In this way the catches which hold it in position are released and the springs force the fender in front of the car, Fig. 1. After the danger is passed the fender is easily wound back into the original position by a lever.

SERPOLLET STEAM MOTOR CAR.

The Serpollet steam tramcar, which is now in service on the line of the Compagnie des Tramways de Paris from La Madeleine to La Place Clichy, is shown in the accompanying illustra-

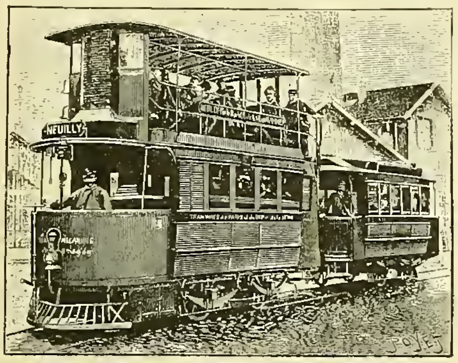


FIG. 3. SERPOLLET STEAM MOTOR CAR.

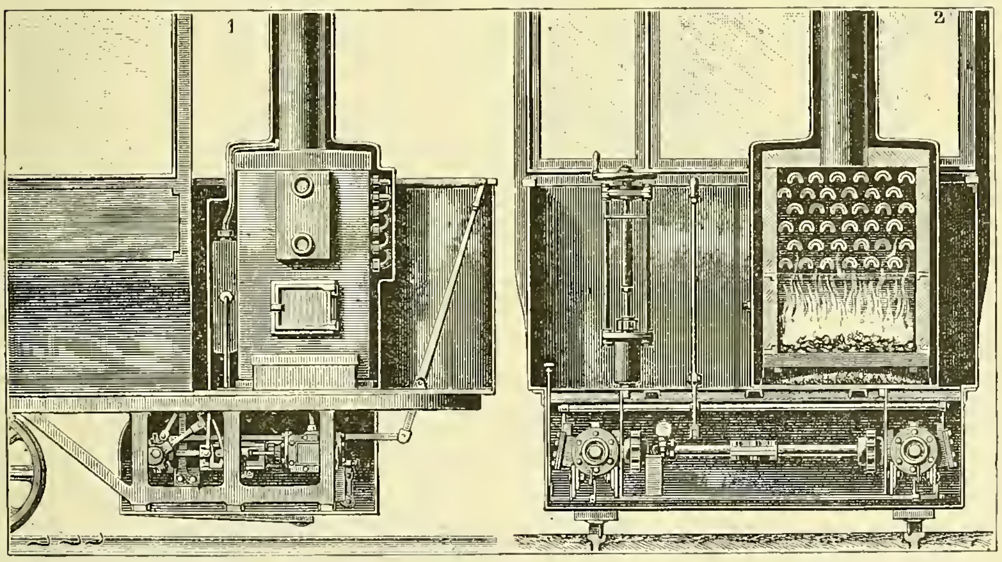
tions. M. Serpollet has been successful in applying steam to several types of road vehicles, some of which have been illustrated in the STREET RAILWAY GAZETTE. Heretofore, however, the high pressure boilers he has used have been limited in size because of the spiral form given to the tubes to five or six horse power. Several modifications were necessary in the boilers before they were applicable to service in which twenty or more horse power were necessary. It is predicted in *La Nature*, from which the cuts are reproduced, that several applications of the steam motor may be expected in Paris, inasmuch as the authorities are decidedly opposed to an electrical system in which overhead wires are employed. It is claimed for the motor that it is powerful, easily controlled, almost noiseless as far as the mechanism is concerned, that there is absolutely no sound of the steam, and that it does not make its presence visible at the exhaust

The weight of the car complete for operation and occupied by forty passengers is about 17,160 lbs.; of this total the engine, boiler, accessories, water and fuel weigh about 3,300 lbs. When a trailer is carried with 32 passengers, as shown in Fig. 3, the total load is 33,528 lbs. The weight of the motor and all the accessories is only one-tenth of the total which is certainly low.

The general arrangements of the front part of the car are shown in Figs. 1 and 2. The tubes in the boiler are of a U-form instead of straight as in previous boilers made by Serpollet. The engine has two cylinders and as already stated its capacity is about 20 horse power although double that power may be obtained by increasing the steam pressure. For fuel coke is burned and about 6 lbs. per mile are consumed. Only a small quantity of coke, sufficient for five or six miles, is carried.

The boiler is surrounded by a sheet iron circular shield forming a chamber which is carried up to the roof of the car where it opens into the air. At a point about five feet below the top the chimney of the boiler opens into this outside chamber. Gases from combustion and exhaust steam cause a vigorous draft in this exterior chamber and diffusion takes place before the exhaust into the open air commences. The flue is perfectly concealed in front of the car. The sound of the exhausting steam is suppressed by a muffler between the exhaust and the flue. The vapor is not visible for the reason that the steam is superheated and the amount of smoke is extremely slight because coke is burned.

The transmission from the engine is effected by means of sprocket chains. As thus equipped the car mounts grades of 5 per cent. on the Avenue de Clichy at a speed of ten miles an hour.



FIGS. 1 AND 2. SERPOLLET TRAMWAY BOILER AND ENGINE.

New York-Philadelphia Trolley Line.

Within a period not longer than a very few weeks there have been developments in the trolley situation between this city and Philadelphia of an exceedingly interesting nature, says the *New York Herald*. From many towns and cities between here and Trenton have come reports of the workings of some hidden movement tending toward a great system of electric roads, and now from Philadelphia comes the news that franchises have been awarded for lines connecting the capitals of Pennsylvania and New Jersey.

It is now perfectly apparent, in spite of the secrecy with which the men who are behind this great scheme have attempted to surround their movements, that the great system of through trolley lines between New York and Philadelphia which was once prophesied is by no means the chimera it was then declared to be, but a substantial fact.

The scheme has now been pushed to such a state of development that secrecy is no longer possible. Nor, indeed, is secrecy any longer necessary to the success of the undertaking, now that the terminal lines at both ends have been secured, and all that remains to be done is to properly lay out and franchise a comparatively small section of road in the western part of New Jersey.

The men who are believed to be behind this gigantic undertaking are capitalists of great wealth and large traffic interests. They already control the street railway business of Philadelphia and the largest and most profitable railway system of this city, and they are also the projectors and owners of those extensive trolley roads that, centering at the Pennsylvania railroad ferry at the foot of Montgomery street in Jersey city, spread out fanlike on a large section of eastern New Jersey, embracing Newark, Elizabeth, Plainfield and the numerous residence towns in the neighborhood of the Orange Mountain.

Electric Station Economics.*

BY PROF. D. C. JACKSON.

A great many of the fires in electric stations start at the switchboard. These can be made almost absolutely safe, and, with proper construction switchboard fires should be almost unknown. How many stations have properly constructed switchboards? And how many stations pay a fairly low rate of insurance? A saving of 25 cents on insurance rates will pay for considerable improvement in the switchboard. By making the improvements and insisting upon intelligent inspection by the insurance companies, the improved rates can be secured. At the same time a guarantee against fire is obtained.

This is better than insurance, for, however well the insurance companies may treat one after a fire, they will never repay all the losses incurred. Build switchboards of non-combustible material. Marble is not very expensive and is better than slate. If combustible material is used for the board, never make it solid, but arrange it simply as a skeleton upon which the instruments may be secured. Set the switchboard at least two feet (three feet is better) from the wall, and have all the wiring done in the best possible manner and in plain sight. Under no circumstances close the ends of the space back of the board, making it into a sort of rubbish closet. Keep the space all around the board light and clean. Nothing will guarantee neat, safe wiring and safe storage of material except the entire absence from the station of dark corners and closets. There are, by the way, few station hands who will wire a switchboard in a neat and safe manner without excessive expense unless they are carefully directed. The switchboard should be located conveniently and the instruments conveniently placed thereon. The dynamo instruments should be bunched together, and the different devices belonging to each individual dynamo circuit should be placed in vertical rows. This avoids the probability of the accidents to machinery which are bound to occur when the instruments are irregularly distributed. System at the switchboard is just as important to economy as is system in the accounting methods. Pressure indicators, cutting-in galvanometers, ground detectors and other instruments which are common to all the dynamos should be placed where they are easily seen by a man at the dynamo regulators. Devices placed in the feeder circuits may be placed either above or at one side of the dynamo instruments. In any case, the arrangement should be such that extensions may be readily made.

The number of instruments on the dynamo and feeder circuits should never be multiplied unnecessarily. Their type and number in any case depend upon the type of the apparatus and the purpose for which it is used. Thus arc light plants require an arrangement which differs completely from that which is required in alternating incandescent stations, and the latter differs from that required in stations supplying a continuous-current constant pressure distribution. If arc light dynamos with separate regulators or controllers are used, these should be solidly mounted near the dynamos to which they belong. In each case the maximum of safety and convenience should be sought in the choice and arrangement of the instruments. The arrangement of the standard panel switchboards of two or three

*Abstract of an article in *Cassier's Magazine*.

prominent manufacturing companies may be followed with profit. Where two or more classes of machinery are used, the different types of dynamos should be set together and the switchboards should be distinct, but side by side.

Let us drop the electrical question now and go over to the steam side. We will start with the coal bin and simply touch upon the instruments or tools not generally used, but which can usually be advantageously added to the equipment—that is, which are likely to add to the dividend-paying capacity of the station. The first instrument on this list is a platform scale for weighing in the coal. Daily records of coal consumed should be carefully kept and compared with records of the electrical output, day by day, week by week, and month by month. Complete daily records enable a station manager to readily determine whether he is getting the results with the least expense. The coal records also enable a direct comparison of the economy of the different grades of coal. Many station managers give too little attention to this matter, simply purchasing the grade of coal which happens to have the lowest price per ton. This is frequently all right, but sometimes it is not economical.

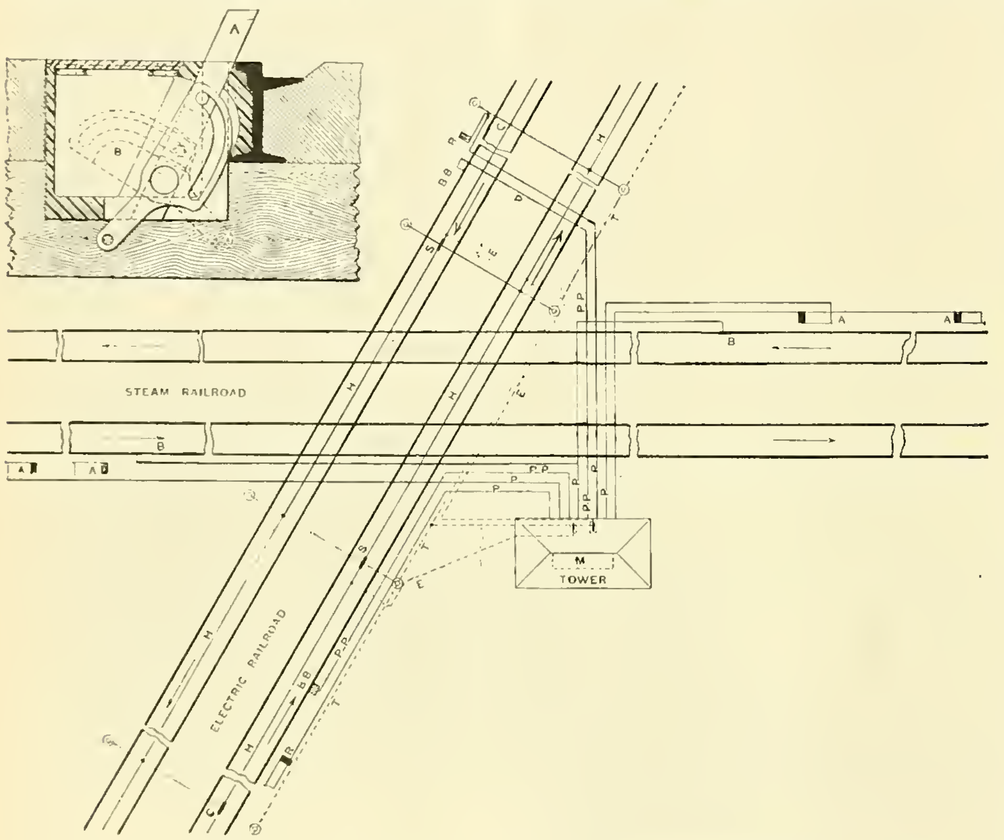
The coal shovel is an instrument which requires a great deal of careful supervision. The coal records and automatic records of steam pressure serve this purpose. An automatic steam pressure recorder is not an expensive instrument. If one is properly installed and its indications are acted upon by the manager, it will soon save its cost. Those who have operated stations, both where pressure recorders are and are not used, will doubtless be ready to bear witness to their advantages. Thermometers in the feed water pipe and in the steam pipe are not essential to the operation of a station, but they are certainly advantageous. A throttling calorimeter made of ordinary fittings is also serviceable. The use of the thermometer and calorimeter may look like kid glove engineering, but if one is anxious to get the best result from a steam plant for the least cost, they should be employed. They are not kid glove affairs, but good common sense appliances. Steam gauges on the boiler (good reliable ones) all will agree are essential, but it is not usual to put one in the steam pipe near the engine. It is a good idea, however.

GIBBS' INTERLOCKING FOR ELECTRIC STREET RAILROADS.

The rapid increase in the use of electricity as a motive power for street railroads has emphasized the need of more efficient crossing protection than that afforded by the vigilance of a motorman or the bar of the ordinary crossing gate, says the *Railroad Gazette*. The reasons for increased danger at crossings with electric street railroads over those with horse car lines lie in the greatly increased speed of the cars on the former, their great weight and consequent inertia, and the liability of failure of their source of power by blowing out of fuses, and jumping off of trolley wheel by jolting over rough crossing frogs.

The devices shown in the accompanying illustrations are the invention of Mr. George Gibbs, mechanical engineer of the Chicago, Milwaukee & St. Paul Railway, and consist of a Saxby & Farmer or other mechanical interlocking machine, so combined with the electric line as to enable the towerman to cut off the current from the electric cars when necessary to block the line and thus make it impossible to move cars in disobedience of the signals. A derailing device is also provided to be operated in paved streets to prevent cars from coasting onto or over crossings. This is of such a nature that it offers no obstruction to street traffic, and is quite free from liability to clog up with mud, snow or ice. It is apparent that the ordinary form of derailer employed on steam roads would not fulfill these conditions.

In the general plan, Fig. 1, is shown a double track crossing of a steam and an electric railroad. The tower is placed in a convenient location and contains the interlocking machine *M*. The pipe line and wire lead-outs for operating the switches and signals on the steam roads require no explanation. Similar lead-outs are run to the scotch-blocks on the electric lines. These blocks are the equivalent of the derailers on the steam lines and are placed at suitable distances from the crossing, usually about 50 feet. Their construction is such as to derail a car. The signal is placed a few feet in advance of the scotch-block. To effectually control the movement of the electric cars the supply current is placed under control of the tower man, through the interlocking machine.



FIGS. 1 AND 2. GIBBS INTERLOCKING FOR ELECTRIC STREET RAILROADS.

At a suitable distance (500 to 1,000 feet) before reaching the crossing, the trolley wires *H* are broken by the insertion of a circuit breaker or insulating block, *C*, and at a point about 30 feet from the crossing another circuit breaker *S* is inserted. A feed wire from this insulated section *C S* is run to the switch *F* in the tower, and this switch is connected to a lever in the interlocking machine. The switch is supplied with current by means of the wire *E*, which is supplied from the main line feeder T. Thus, by opening or closing the switch *F*, the current may be cut off, or supplied to the insulated trolley wire section at will. It will be noticed that the insulated section is terminated a few feet from the crossing. This is an important provision, as it insures a "live" section over the crossing at all times, making it impossible for a careless towerman to cut the motive power from a car which may happen to be on the frogs when line-clear has been given the steam road.

The details of the scotch-block are shown in Fig. 2. It consists of a strong cast iron box, which is set outside of the rail and bolted securely to the ties, so that its top is flush with the street paving. In the top of the box and close to the rail is a 2-in.×4-in. opening. A wrought iron plug *A* is set in this to form the stop-block. It is raised and lowered by means of the slotted crank, connected by pipe line to the tower. It will be noticed that the line of motion of this plug is oblique to the axis of the rail, and the crank having a throw of 4 inches, the plug will in its derailing position project some distance from the box and over the railhead. The slotted crank has a shoulder; so that in its upper position the square end of the plug will rest upon this shoulder in line with the axis of arm and crank pin. The plug will therefore be locked in its extreme position, and the downward thrust of a car wheel will be taken upon the strong pivot pin without bringing strain upon the pipe-line connection. The construction of the block is such that it clears itself of dirt and snow, and the moving parts are effectually protected from such obstructions, drainage being provided through the open bottom of the box.

Warning of the approach of an electric car is given to the towerman by a novel and simple annunciator; it consists of a local battery bell circuit, actuated by a relay placed in the loop of the trolley wire, which is brought into the tower. As soon as a car using current passes into the insulated trolley wire section, the magnet of the relay is energized and closes the bell circuit, giving the alarm.

This interlocking apparatus has been installed and is in satisfactory working shape at the grade crossings of the Chicago & North Shore Electric road with the Evanston Division of the Chicago, Milwaukee & St. Paul at Calvary and at Sheridan Park, Ill., and it is believed constitutes the first application of the kind in the country.

The cost of the apparatus is less than that of an interlocking plant for a plain crossing between two steam roads, as fewer levers are used and the same pipe line is used to actuate both the stop block and the signal.

PHILADELPHIA-NEW YORK ELECTRIC RAILWAY.—The project of an electric railway to connect Philadelphia and New York not only marks a new departure, but it must be regarded as the most audacious development of the system yet proposed, as the new line would parallel two steam railways which would naturally be its competitors. Daring as the venture may seem in a business sense, it is to be remembered that it will have in its favor the elements of cheaper cost for road construction, rolling stock, running expenses, etc., while there is a reasonable probability that the lower fares and frequent trips would develop and build up a new accommodation travel.—*Philadelphia Record.*

ELECTRIC ELEVATED ROADS.—The time is not far distant when elevated railroads operated by electricity will furnish in part rapid transit to the residents of our own and other cities. It is only a question of time and the perfection of necessary details.—*Philadelphia Times.*

VOGAN SANDING DEVICE AND DRAW BAR.

While the sanding of tracks seems simple enough, the operation is not always successfully accomplished by the means with which cars are provided. The tendency of sand to pack or to cake makes its proper ejectment a matter of some ltle difficulty. If too little sand is thrown out it is useless, while if too much lies on the track considerable power may be necessary to over-

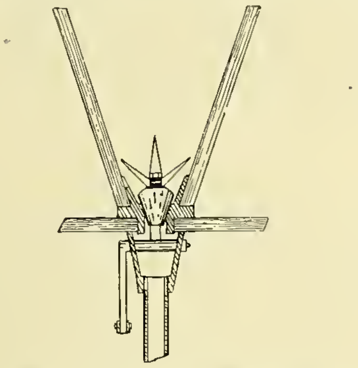


FIG. 2. VOGAN SANDING DEVICE.

come the friction while no more adhesion may be secured than if less sand were used. Fig. 1 represents the Vogan sanding device which was designed with a view to securing the most advantageous distribution of sand on the tracks of motor cars. This cut and Fig. 2 give a side elevation of a portion of a car, and a sectional view of the sand hopper and its valve, with conduit pipe. The valve is arranged to lift vertically off its seat, which movement tends to stir or

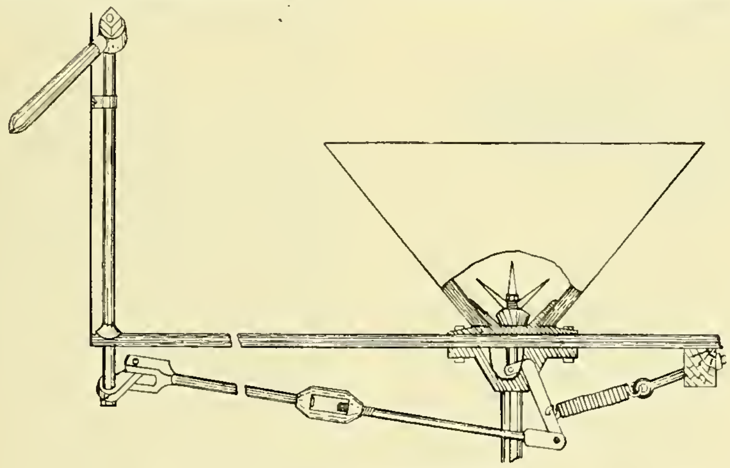


FIG. 1. VOGAN SANDING DEVICE.

disintegrate the mass of sand immediately adjacent, should it become packed. The lever operated by the motorman, enables him to secure a very slight movement of the valve, which is normally held closed by means of a spring. The sand, in its passage through the discharge chute, is deposited closely in front of the wheel, and without waste.

Fig. 3 shows a steel radial draw bar for street railway cars, in which the spiral spring is in the bar, allowing a direct pull upon its spring on

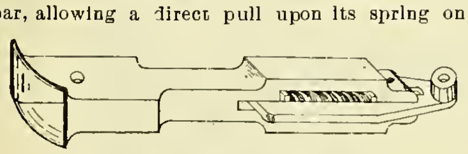


FIG. 3. VOGAN DRAW BAR.

even the shortest curves, and preventing at all times that unpleasant surging and jerking, which is experienced in the operation of trailers. Both the sanding device and draw bar which are patented are introduced by F. Wayland Brown, of Cleveland, O.

Chicago, Ill.—Judge Tuley has vacated the injunction secured by property owners on West Twenty-Second street preventing the Chicago General Street Railway Company from constructing a portion of its road on that street.

NOTES FROM THE WASHINGTON ELECTRIC LIGHT CONVENTION.

The National Water Tube Boiler Company, distributed some very attractive folders giving information in regard to the merits of its boilers.

A new booklet describing Bonnell's Nubian iron enamel for preventing boiler scale was circulated at the convention by the manufacturers of this scale preventive, the National Chemical Works of Craigin, Ill.

The Stirling Company, of Chicago, circulated information regarding its well-known boilers in a handsome little memorandum book and in another circular giving the details of its competition with other boiler manufacturers at the World's Fair. Agent Scheffler of New York represented the company.

The Eureka Tempered Copper Company was represented as usual by John R. Coffman who made an interesting exhibit in one of the hotel parlors.

The interests of McNamara Bros., of Fair Haven, Vt., were taken care of by the distribution of cards and other literature describing their slate and marble for electrical purposes. The company has recently opened offices at 136 Liberty Street, New York, where George W. Zelie is in charge.

The General Incandescent Arc Light Company was represented by H. A. Douglas. The company made a handsome exhibit of switches which it is now placing on the market.

Burr K. Field, vice-president of the company looked after the interests of the Berlin Iron Bridge Company, calling attention at every opportunity to that company's patent corrugated iron roofing in use in the station of the United States Electric Light and Power Company in Washington.

Benj. R. Western, who has always been a familiar figure at the electric light conventions, was on hand as usual looking after the interests of his clients and distributing literature pointing out the advantage of doing business through an established advertising bureau.

C. S. Van Nuis looked out for the interests of "Ajax" switches.

George G. Carter represented the firm of George G. Carter & Co., of Chicago. This firm has just closed a contract with the Storey Electric Motor and Tool Co., of New York, to handle that company's motors in several of the western states. Mr. Carter's office is in the Monadnock Block, Chicago.

The Falls Rivet & Machine Co. had an energetic representative at the convention in the person of E. L. Babcock, who is so well known to the electrical trade that his work could not fail to be effective.

H. Ward Leonard was at the convention looking after the interests of his company, taking every opportunity to explain his new and improved rheostat as well as his new system of operating an electric railway 100 miles from the central station.

J. H. Vail, of the Electrical and Mechanical Engineering and Trading Co., in New York City, looked after the interests of his company by distributing some specially prepared literature. Mr. Vail read a paper before the convention which was printed in full in the last issue.

The interests of the Abendroth & Root water tube boilers were admirably looked after at the convention by P. M. McLaren. In the exhibition parlor, the company's name was one of the most prominent. Quite a variety of descriptive literature was given out by the company's representatives.

F. G. Bolles & Co., of Washington, represented the interests of the Heine boilers of St. Louis.

One of the most interesting exhibits made at the convention was that of the Weston Electrical Instrument Co. Its splendid catalogue was given away to those interested in measuring instruments. The representatives of the company were Edward Weston, R. O. Heinrichs and C. D. Shain.

The Charles Munson Belting Company of Chicago was well represented by A. Groetzinger and Col. Shay, who are among the most familiar representatives of electrical or allied trades. Col. Shay is still in the East looking after the interests of his company by closing up a number of contracts.

The McEwen engines were well represented by F. G. Bolles & Co., of Washington, who circulated very thoroughly some literature describing their special features.

The Standard Paint Company was on hand as usual with its P. & B. cigars, which are now regarded as a permanent feature of the electric light and street railway conventions. Messrs. Shainwald and De Ronde were on hand to look after the interests of the P. & B. specialties.

Charles A. Schieren, Jr., looked after the interests of Schieren belts.

The Page Belting Company, of Concord, N. H., was represented by Geo. T. Moore, who circulated pamphlets and circulars calling attention to the company's belts for central station work and illustrating the St. Gaudens' medal, over which there has recently been so much controversy.

The H. W. Johns Manufacturing Company was represented by W. F. D. Crane, who distributed as a souvenir a handsome set of chips made from the company's insulating material.

The W. S. Hill Electric Co., of Boston, was represented by W. S. Hill and George H. Poor. A splendid exhibition was made of the switches handled by this company.

Much interest was created in the Love electric conduit system in operation on the Rock Creek Railway in Washington. The interests of the system were admirably looked after by A. G. Wheeler and M. D. Law, who did everything in their power to exhibit the road under the conditions met with in actual practice.

The Standard Underground Cable Company, of Pittsburgh, was represented by Secretary Wiley, of the New York office, who made an excellent showing for the company's goods.

Frank R. Ford, well known in the West through his former connection with the Brush-Short interests, represented the La Roche Electric Works.

James I. Ayer was the representative of the firm of James I. Ayer & Co. of St. Louis. Mr. Ayer is the head of that engineering firm and is doing an excellent business.

The New York Insulated Wire Company was well represented by Frank W. Harrington.

The National water tube boilers were represented by some good literature that was well distributed.

The Buckeye Engine Company, of Salem, O., was represented by Mr. Joel Sharp, the venerable president of the company, and G. A. Barnard, superintendent.

Chas. E. Newton and Chas. L. Tolles looked out carefully for the interests of the Jewell Belting Company of Hartford, Conn.

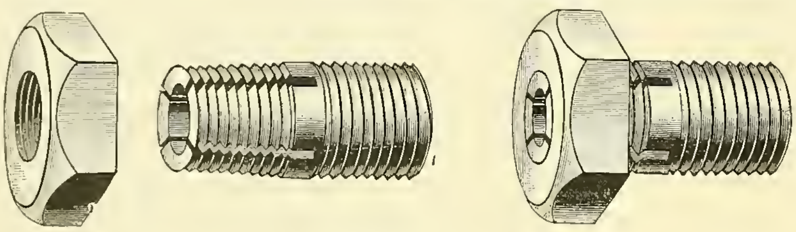
The Westinghouse interests were well cared for by C. Townley and Oscar H. Baldwin, of the lighting department, C. F. Scott and A. J. Wurts, of the technical corps; Messrs. C. A. Bragg, E. F. Seymour and C. B. Humphrey, of the selling department, and L. B. Stillwell, representing the company in general, who were all active in their efforts to advance the interests of their company.

The General Electric Company was well represented by the following gentlemen: S. Dana Greene, A. D. Page, C. B. Davis, F. C. Todd, W. S. Howell, T. Beran, John McGhie, A. B. Herrick and one or two others. Mr. Herrick's paper on switchboards and switchboard work was one of the features of the convention. It was illustrated with numerous views projected on a screen. The company made an exhibit of its new arc lamps for incandescent and railway circuits and of its new wattmeters for arc and railway circuits.

The courtesy of the Metropolitan Railroad Company of Washington in extending, through Supt. Stephenson, free passes over its lines was much appreciated.

Stern & Silverman Bonding Chuck.

To meet the demand for improved devices for decreasing the electrical resistance at rail joints numerous bonds have recently been placed on the market. Among the number is the Stern & Silverman bonding chuck, the principle of which may be seen from a glance at the accompanying cuts. It is claimed that by the use of this device contact is always positive between the bonding chuck and the rail and the wire, and the condition is such that loose contact is practically impossible. It is true that a slightly additional amount of labor is required to install these bonds, but the cost of the labor, it is stated, is a small item in comparison with the increased cost of feeder wires ordinarily required when an inferior bond is used. The bonds are put on the market by Stern & Silverman of Philadelphia.

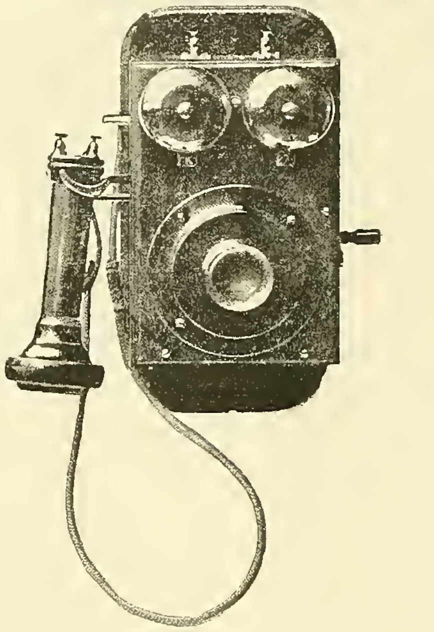


BONDING CHUCK.

Oakland, Cal.—Receiver Bishop, of the Piedmont Cable Company, recently petitioned the court to permit him to issue $16,000 receiver's certificates in order to substitute electricity for the cable system. Secretary Garthwaite stated to the court that if electricity were adopted a saving of $14,000 per year would be effected, and if the petition were granted the road would be on a paying basis within twelve months. Judge Henshaw granted the petition, and the work of equipping the system will be begun at once.

IMPROVED MAGNETO TELEPHONE.

It has for a long time been predicted that street railway companies would utilize the telephone very much more generally to facilitate work in various branches when instruments could be secured at reasonable prices. Since the expiration of the Bell patent it seems likely that the new telephone companies will be patronized quite liberally by street railways. Among the new companies, the Western Telephone Construction Company of Chicago has a telephone which is claimed to be well adapted for the use of street railway companies. The magneto telephone which the company is introducing is shown in the illustration. The company owns the patents of the Stromberg and Carlson magneto telephone instrument, which were granted September 5, 1893. This is the instrument that was tested between Chicago and New York February 10, with satisfactory results. The telephone is compact in every respect and of course requires no battery. The same magnets that are required for ringing the magneto bell, also furnish the current for the magneto transmitter It transmits very clearly on long as well as short distance lines,

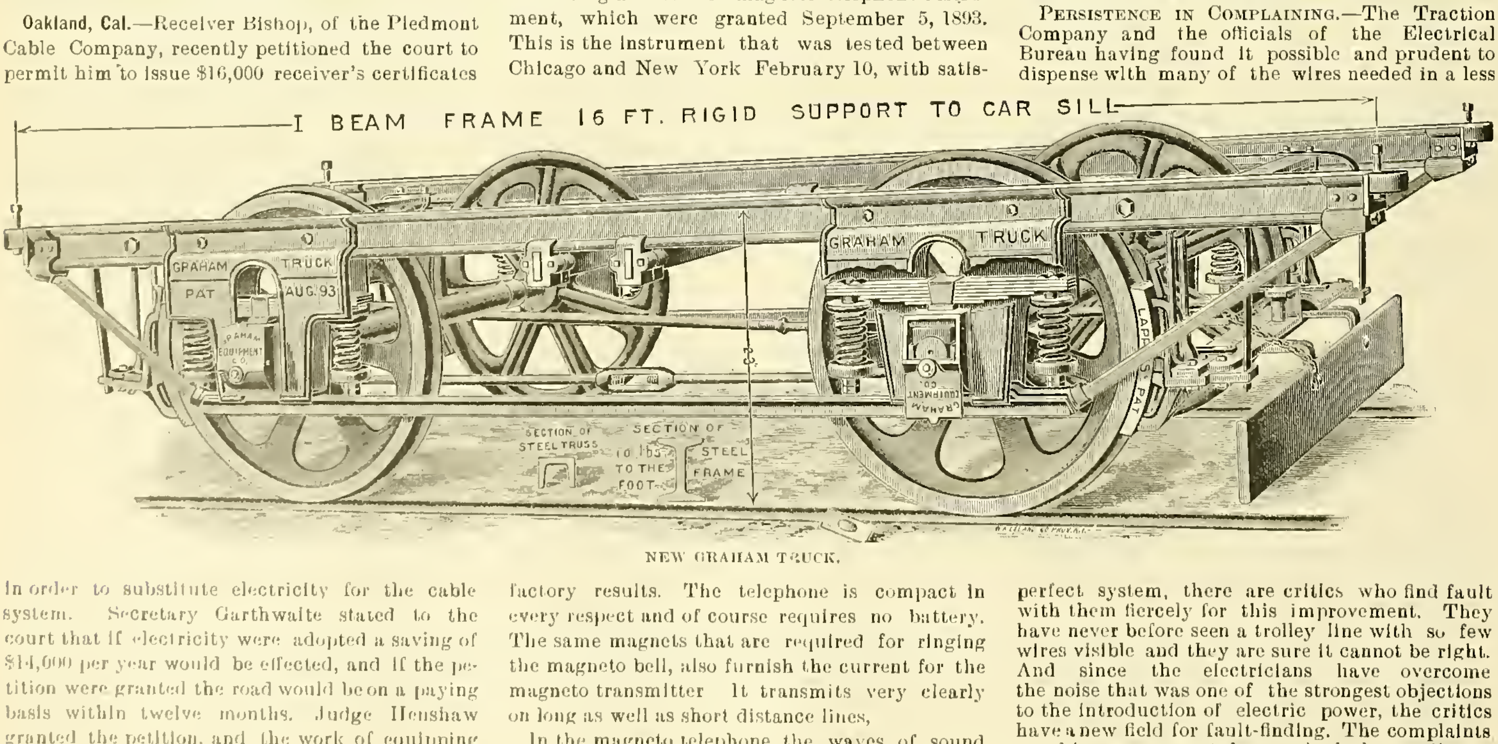


IMPROVED MAGNETO TELEPHONE.

In the magneto telephone the waves of sound created by speaking strike against and vibrate the plate or diaphragm, and the transmitting instrument which moves it to and fro generate the current of electricity, which passes through the conducting line to the receiving instrument, where the sound is produced. On this type of telephone the current is generated by the transmitting instrument itself, and the variations in strength in the currents are produced by the extent of the movement of the plates or diaphragm of the receiving instrument and thus produce the sound waves. The clear transmission of vocal sound, the simplicity of adjustment and the economy of maintenance are the points of merit which are claimed for this instrument by the Western Telephone Construction Company.

NEW GRAHAM TRUCK.

The principle followed in the construction of the new Graham Truck which is illustrated herewith, is that which is embodied in the frame of a locomotive. The jaws or pedestals are bolted to an I beam frame. The springs are arranged between the axle box and the truck frame, giving at once an easy motion and cushioning the hammering on the rail joints and switches. The car body is placed directly on top of the I beam frame. This gives the car an extra sill and keeps the body perfectly rigid, thus increasing its life. This new truck has but 16 bolts and weighs about 3,000 pounds. By slacking four nuts the car body can be removed from the truck. Another important feature is the suspension of one end of the motor on the springs that support the truck. This relieves the delicate parts of the motor from the continuous and tremendous hammering that is constantly felt on rigid trucks. The truck is manufactured by the Graham Equipment Co., of Boston.



NEW GRAHAM TRUCK.

Comments and Views of Contemporaries.

STEAM ENGINES IN SNOW STORMS.—If not contrary to the charter and if both parties interested are agreeable it would be an immense convenience to citizens if the street railway company were to run steam engines during snow storms when the trolleys are unable to run.—*Toronto Star.*

COUNTRY ELECTRIC ROADS.—The matter of building trolley lines through different parts of the state is an alluring subject. The triumph already achieved by electricity gives promise of greater success in the future, and men are confidently looking forward to the time when swift and accommodating trolley railways shall supersede the turnpike and county road, much as the steam railway did the canal and stage route many years ago.—*Baltimore Herald.*

PERSISTENCE IN COMPLAINING.—The Traction Company and the officials of the Electrical Bureau having found it possible and prudent to dispense with many of the wires needed in a less perfect system, there are critics who find fault with them fiercely for this improvement. They have never before seen a trolley line with so few wires visible and they are sure it cannot be right. And since the electricians have overcome the noise that was one of the strongest objections to the introduction of electric power, the critics have a new field for fault-finding. The complaints on this score must be particularly puzzling to those who are trying to satisfy everybody. Some complain that the gong is sounded so loud and long at the crossings as to be a nuisance, while others declare that there is not sufficient warning of the car's approach. Some think that there should be bells on the cars, while those who live along the line declare that the jingling of bells would be intolerable. It all depends upon the point of view. There is certainly no need of disturbing the neighborhood by constant clangor. The gong will answer every purpose when the motormen get more familiar with its use, so that they will sound it when needed and not otherwise. But there is no necessity for gongs so loud and discordant in tone, and in this direction there is room for improvement, just as the noisy indicator has been reformed in the new trolley cars. It is a tribute to the thoroughness with which the new system has been worked out that while it is still but a few weeks old, the only fault to be found with it is in these minute details.—*Philadelphia Times.*

Electric Railway Extension.—It is practically certain that a very few years will find most of the thickly settled portions of the Eastern states covered with a network of electric roads, whose competition will still further complicate the railway problem. And when the trolley system is superseded by something better, as it must be soon, doing away with the necessity of overhead construction and requiring only a track, a battery and a motor, the whole business of transportation between small towns and villages and throughout the country districts will be almost revolutionized.—*St. Paul Pioneer-Press.*

Street Railway Competition.—We face, in short, a situation very similar to that introduced in the early days of steam railroad development, when projects without number were put on foot, when towns were bonding themselves to help them along, and when people were near to losing their heads in the rush to make each locality a commercial and competitive railway center. Massachusetts was among the first of the states to recognize the essentially non-competitive or monopolistic character of the railway transportation business; and in so doing and acting on the idea, and limiting the building of roads to the apparent needs of the state, and appointing a commission to secure the people from the exactions of railway monopoly, we thus avoided the wasteful and disastrous overbuilding which has since come to afflict the west. It is no less plain that this electric railway question should be met at the start in the same wise way. There is no room, for example, for two rival street railways in the same city, any more than there is room for two gas companies engaged in tearing up and piping the street to double the needed extent. One such company can be made, and thus ought to be made, to serve the city. To admit a rival railway company into a place now occupied would be either to impose a needless double burden on the people of the city in the way of rates to support two companies, or to destroy one of the properties and cause a loss as absolute as if a fire had swept through a part of the city.—*Springfield* (Mass.) *Republican.*

Wobbling of Machinery—W. Worby Beaumont recently read before the Society of Arts in London a paper on "The Automatic Balance of Reciprocating Machinery and Prevention of Vibration," in which the following lines sum up the whole principle: "In a general way it may be said that when a piece of mechanism wants to wobble, it is obviously either wrongly constructed, or if it is not and wants to wobble, then let it wobble; but make it wobble something you want wobbled. In most cases it will not wobble so much and never so forcibly if we don't try to stop its wobbling."

FINANCIAL DEPARTMENT.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn street, Chicago, said yesterday: "The market in traction stocks has remained dull except in Philadelphia and we are told that a five point rise in it is likely to come at any time. Metropolitan is neglected around 101 and rather inclined to drop on sales of odd lots, although starting of work on its Lexington avenue lines was expected to stimulate prices. Baltimore has shown no signs of life and there seems stock for sale on any advance. The competition with it is now so sharp that insiders who see the earnings feel grave. As anticipated in our letter of last week there has been a decided improvement not only in the prices of street railway securities but in the demand for the same. West Chicago is now selling on a six per cent. basis and with the great volume of idle money it seems reasonable to look for the demand to continue. Street railways are entering on their best season of the year and we look for increased earnings."

Baltimore Traction Co.—For the year ended December 31, 1893, the gross earnings of the Baltimore Traction Company were $1,062,884.82, while operating expenses amounted to $6-9,317.73, thus leaving net earnings of $373,567.09. Fixed charges, including interest on all bonds, taxes and insurance, were $355,202.10, which showed a net profit for the year of $18,364.99, or about 70 cents a share on the capital stock. The total miles traveled by the various cars of the system aggregated 5,982,646, while the total revenue passengers carried were 21,123,916. There was constructed during the year 22 08 miles of new track, making the total mileage of the system 78.47 miles, of which 15.30 miles are cable, 36.50 electric, 23.59 horse and 3.08 joint electric and horse. It is expected that during the present year 23 miles of horse road will be converted into rapid transit, so that by the end of the year animal power will have been entirely withdrawn from the system.

Waco Railway & Light Company.—It is stated that the assets of the Waco (Tex.) Electric Railway & Light Company are about $300,000, and the liabilities slightly in excess of $200,000. This includes the electric light and street car plants and all property of the company. The earnings at the present time are gratifying and it is believed that with good and conservative management, the company will pull out all right.

Liverpool Overhead Railway.—At the semi-annual meeting of the Liverpool Overhead Railway Company it was stated that the gross earnings of the company for the six months ending December 31, were £18,518, while the operating expenses during the same period were £13,732.

Delaware (O.) Bonds.—The Delaware Electric Street Railway Company has issued ten-year six per cent. coupon bonds, interest payable semi-annually, January and July, in denominations of $100 and $500.

NEWS OF THE WEEK.

Philadelphia, Pa.—All preparations have been made by the People's Traction Company to rapidly complete the construction of the trolley system on all the street railway lines it operates. This means that the trolley will soon be extended so as to take in the entire Fourth and Eighth streets lines, including the Green street and Fairmount avenue, the Callowhill street and the Germantown avenue branches, and the Girard avenue line west of the Schuylkill river. A contract was entered into on last Saturday between the People's Traction Company and Charles A. Porter, the latter representing the firm of Filbert & Porter, by which the firm is to start immediately on the work of extending the trolley tracks and repave the highways enumerated above. The trolley construction has been carried on Fourth and Eighth streets as far north as Girard avenue. Under the contract between Filbert & Porter and the company it is to be extended all the way north on both of these thoroughfares to the end of the road.

Brooklyn, N. Y.—The Long Island Electric Railway Co. was incorporated on March 5 to operate a street surface road by electric power a distance of twenty miles between the intersection of Front street and Greenwich street in the village of Hempstead, and the intersection of Liberty in the township of Jamaica and the boundary line of the city of Brooklyn. The capital is $600,000, divided into $100 shares; directors and their subscriptions to the capital stock are: Alexander R. Hart, Brooklyn, 1,490 shares; Charles H. Mullen, Mt. Holly Springs, Pa., 1,490 shares; Charles M. Cooper, Julius C. Vonarx, William H. English, George W. Miller, of New York, each five shares; Clarence Wolf and Benjamin Wolf, Philadelphia, each 750 shares; Edwin Wolf, of Philadelphia, twenty shares. The other shareholders are Henry Loeb, William F. May, E. Allmeyer, and Charles Miller, of New York, each five shares; Louis Wolf and Albert Wolf, each 740 shares.

Allegheny, Pa.—The Allegheny Corporation Committee last week recommended three ordinances to council for street railways that will likely be built, two of which will run to Watson Park. They are the North End Passenger Railway Company, an electric line from Washington avenue and the New Brighton road, a continuation of the Charles street line. The second grants the Pittsburgh, Allegheny and Manchester line the right to construct an electric line from Wood's run and McClure avenue to the park, and the third grants the Millvale, Etna and Sharpsburg Street Railway Company the right to build a line from East Ohio street to Millvale.

Boston, Mass—The funeral of William M. Bellows took place in Brookline on Sunday last. He was 68 years of age and the oldest horse-car driver in the employment of the West End Street Railway. He drove the first horse-car from Brookline 32 years ago, when the line was under the control of the old Metropolitan Road. His dying wish was that his remains be conveyed in a horse car through Brookline, and acting on his wishes the West End furnished a horse car draped with black crape, and the dead driver was thus borne through the town, followed by the Knights of Honor, of which he had been chaplain, and about 100 drivers in the employment of the West End. The floral offerings were beautiful and many, the employes of the West End sending a horse car composed of violets, pansies and ivy leaves.

Reading, Pa.—An ordinance has been introduced in the city council for the entrance of another electric railway into Reading—the Pottstown, Boyertown and Reading. It is proposed to enter this city at the eastern limits, come down the side of Mount Penn, and, by traversing a number of leading streets, make the terminus at Sixth and Washington streets—in the very heart of the business center of Reading. Leaving this city the road has been surveyed through such flourishing villages as Stonersville, Yellow House, Greshville, Marysville and others to Boyerstown, and, leaving the latter place, through Douglass and Pottsgrove townships, to Pottstown.

Fall River, Mass.—The directors of the Westport & Dartmouth Electric Railway Company have elected the following officers: President, Frank W. Brightman, Fall River; vice-president, Abbott P. Smith, New Bedford; treasurer, J A. Beauvers, New Bedford; clerk, Robert S. Goff, Fall River. A committee was appointed to arrange for grading the highway between Fall River and New Bedford, preparatory to beginning work on the electric railroad between Smith Mills in Dartmouth and the Narrows in Fall River. It is hoped that the road will be in operation by the latter part of July.

New York, N. Y.—Chief Engineer G. W. McNulty, for the Metropolitan Traction Company, has announced that work will commence at once on the Lexington Avenue cable line, which will extend from Twenty-third street north to the end of Lexington Avenue at One Hundred and Thirty-fifth street. The work will be started just north of Forty-third street, and a large force of men will be engaged, as the company are desirous of having the line in operation by next fall.

Brooklyn.—Superintendent Martin, of the Brooklyn Bridge has returned from Florida, where he consulted Mr. Roebling, the architect of the bridge, concerning the proposition to erect two sets of railway tracks, one over each roadway of the structure, for the use of the elevated roads in Brooklyn, and says that Mr. Roebling decidedly opposes it on the ground that the structure could not stand the extra strain.

Victoria, B. C.—March 1st the name of the National Electric Tramway & Lighting Company, of Victoria, B. C., was changed to the Victoria Electric Railway & Lighting Company. The officers of the company are as follows: C. T. Dupont, president and managing director; T. J. Jones, vice-president; T. S. Gore, secretary, and F. W. McCrady, superintendent and purchasing agent.

Dayton, O.—The City Railway Company recently decided to equip its lines for electric motors. It is hoped that the new system will be in operation by July 1. Contracts for three 500-horse power engines have been awarded to the Buckeye Engine Company, of Salem, O., and for three generators which will be coupled to the engine shafts, to the Siemens & Halske Company.

Philadelphia, Pa.—The Philadelphia, Cheltenham & Jenkintown Trolley Company and the Willow Grove Turnpike Company owning the York road, have come to terms and the trolley company expects to have its cars running by July 1. Its line will run on the York road from its junction with Germantown avenue to Willow Grove.

Point Pleasant, Pa.—The borough council has granted a fifty-year franchise to the South Jersey Electric Light and Power Company to operate a trolley road between Bay Head and the Manasquan River Bridge, along the principal streets of the town.

Mohnsville, Pa.—A charter has been granted to the Mohnsville and Adamstown Electric Railway Company, Lancaster county. It will be seven and a half miles long. Capital $50,000.

Homestead, Pa.—The Pittsburgh & Birmingham Street Railway Co. has filed its acceptance of the ordinance granting it a right of way on Ninth Ave. It is stated that the line will be in operation in three months.

Dayton, O.—The City Railway Company has awarded to the Pennsylvania Steel Company a contract for deep girder rails, the amount aggregating $18,000.

Jersey City, N. J.—The Standard Electric Equipment Company has been organized with a capital stock of $25,000 to manufacture electric light, power and railway equipment.

New York City.—The New York Electrical Engineering Company has been organized with a capital stock of $10,000 to construct electrical plants

Philadelphia.—The Delaware Front Passenger Railway Company has been organized with a capital stock of $24,000 to operate an electric railway.

La Salle, Ill.—The motormen employed on the electric railway have struck because of a new order increasing their hours of work.

Des Moines, Ia.—A bill has been introduced in the legislature requiring electric railway companies to vestibule their cars.

PERSONAL.

Prof. E. J. Houston recently resigned his position in the Central High School of Philadelphia to form a partnership with A. E. Kennelly, as already stated in these columns. The faculty of the school at a recent meeting drew up a series of resolutions expressing its regret at the retirement of Prof. Houston. The resolutions state that: "Professor Houston's resignation causes a feeling of deep regret in the minds of all his associates. His connection with this school during the last 27 years has added largely to his reputation and its widening usefulness. In his mind the school and its interest were ever objects of paramount consideration, and his best efforts were earnestly devoted to its welfare and advancement. His own department, so full of natural interest, he made peculiarly attractive to his pupils, among whom he maintained that true dignity of the teacher and the genuine respect of the student."

F. O. Rusling has been appointed superintendent of the Buffalo Railway Company. William A. Reddy will be assistant superintendent.

TRADE NOTES.

The National Water Tube Company, of New Brunswick, N. J., made a bid for 1800 horse power boilers at St. Louis that has caused considerable comment. The publication of the several bids opened by the St. Louis Water Commissioners disclosed the fact that the National Company's bid was 20 per cent. lower than the lowest of its competitors and 40 per cent. below that of the highest. The explanation is apparent, however, when the fact is shown that the specifications of the commissioners provided for a premium of $250 on each of the six boilers for every one per cent. of efficiency actually reached by the boilers above a given per cent., with the same amount of forfeit for each one per cent. below. The condition was introduced for the express purpose of obliging each bidder to guarantee the economy of the proposed boilers with a substantial money return, the commissioners being the gainers, even though the premium should be large, as the higher the premium earned, the greater the saving in the use of the boilers The National Company made a considerable reduction in the contract price with the expectation of making up the reduction by the large premium to be received in consequence of the efficiency of its boilers. The conditions of the specifications of the commissioners were novel and shrewdly contrived, and the result of the tests to determine the amount of premium to be paid will be of unusual interest.

Stern & Silverman of Philadelphia have the contract for rebuilding the line of the Brigantine Transit Company's road at Brigantine, N. J. The road is to be built on trestle, some 5,000 piles being driven for that purpose. Jetties and bulk head largely enter into the construction of the line. It will practically be an elevated railroad when completed. Cars will be in operation June 1.

The Big Four Passenger Department has just issued its Annual Gazette, which will be found of interest to the traveling public. The volume tells in story form some of the sights that may be seen in the localities reached by the Big Four, and incidentally considerable is mentioned of the luxuries that may be expected by the tourist who travels on the Big Four trains. The publication is a handsome one in every respect, and its pages are made attractive by a large collection of interesting half-tone illustrations.

Sioux City Engine Works.—The Sioux City Engine Works, of Sioux City, Ia., were sold at receiver's sale last month for $25,000 to a local syndicate. The business will be conducted by the Sioux City Engine & Iron Works Company. The capital stock of the company is $240,000 of which one-half has been paid in.

The W. T. C Macallen Company, of Boston, has just issued a new catalogue descriptive of its solid sheet mica insulators. The catalogue is thoroughly illustrated and contains much information of value. The goods are sold in Chicago by P. H. Carey, 1137–1138 Monadnock Block.

F. Wayland Brown, Mason and Belden streets, Cleveland, O., is putting on the market the Vogan sanding device and draw bar. These devices are strongly recommended by street railway men who have tested them.

G. P. Nicholls & Bro. have opened an office as electrical engineers at 936 Monadnock Block, Chicago. Both members of the company have heretofore been connected with the General Electric Company.

Okonite Wire Used.—The Pearce cable signal system, described in the last issue of the STREET RAILWAY GAZETTE, is equipped throughout with Okonite wire with lead armor.

W. S. Kinney has secured the contract for a horizontal tubular boiler and connections for the Fort Wayne Electric Company, of Oxford, Ind.

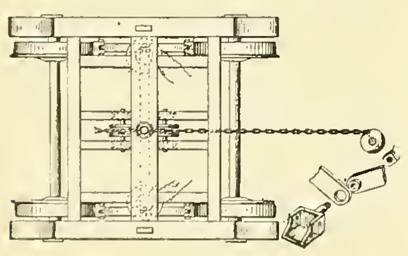
The J. W. Fowler Car Co. has removed its offices from the Havemeyer Building, New York city, to its factory at Elizabethport, N. J.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued February 20, 1894.

514,926. Car Brake. Robert S. Haines, Savannah, Ga., assignor of one-half to Benjamin F. Peet, Springfield, Mass. Filed September 29, 1893.

Claim 1 of this patent reads as follows: "The combination with the truck frame and the car wheels, of the brake shoes and the links pivotally connected to and suspended from the truck frame and supporting the shoes, the pairs of links or toggles connecting the shoes, and the transverse bar or beam which unites the pairs of toggle links at



NO. 514,926.

their middle joints and which is constructed to constitute an armature, and an electro-magnet supported by, and depending from, the top of the truck frame a d in direct working proximity to the electro-magnet." (See illustration.)

514,932. Trolley Wire Support. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Co., of Connecticut. Filed June 30, 1893.

A vertical support is soldered on the under side of the trolley wire and a transverse wire for supporting the trolley wire is connected to the support.

514.972. Electric Railway System. Nikola Tesla, New York, N. Y. Filed January 2, 1892.

This is the combination in an electric railway operated by currents of high potential of a slotted conduit, a supply conductor, a conducting sheath divided into insulated sections surrounding the conductor and a motor car from which depends an arm carrying a conducting plate or bar. (See illustration.)

515,115. Automatic Grip Opener. William P. Courtney, Oakland, Cal., assignor of one-half to Albert Brown, same place. Filed July 3, 1893.

This is the combination with a cable grip provided with the guide and bearing rollers upon the rear edge of a safety bar movable within the guide within the plane of the sides of the grip frame, connections between the safety bar and the detent of the grip and a spring catch by means of which the safety bar and detent are retained in their elevated position when forced upward.

515,122. Railway Switch. Ernest H. Leighton, Boston, Mass. Filed May 19, 1893.

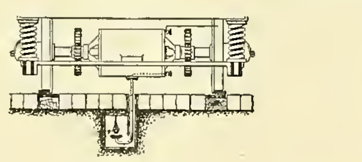
A rack lever pivoted to the car has rollers at its ends which when the lever is actuated by the driver or motorman engages with movable projections in the track. (See illustration).

515,157. Safety Car Fender. William J. Ogden, Baltimore, Md. Filed September 7, 1893.

This invention comprises the combination of a flexible curtain-like guard supported at the front of the car, and a wire rope extending horizontally across the lower edge of the guard, and provided at its center with a joint.

515 179. Electric Railway Conduit Morris S. Towson, Cleveland, O., assignor to Albert G. Wheeler Chicago, Ill. Filed January 6, 1893.

This is the combination with a slot rail and a conductor of a box carrying the conductor and loosely connected to



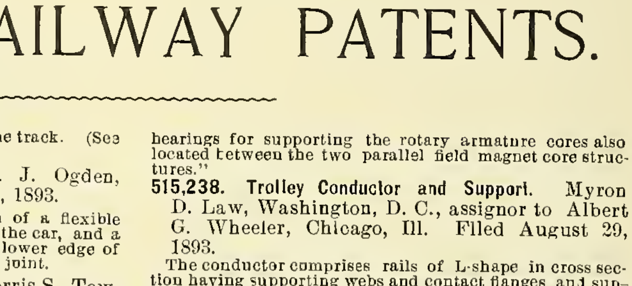
NO. 514,972.

the rail to permit of longitudinal movement. (See illustration.)

515,198. Safety Car Fender. Francis de Fontes, Baltimore, Md. Filed October 24, 1893.

This is the combination of a triangular platform secured to the car truck frame, a car axle having a sprocket wheel, a transverse shaft on the under side of the platform and parallel with a sprocket wheel and two miter gear wheels, two short shafts each having a gear wheel meshing with

NO. 515,122.



NO. 515,179.

the gear wheels of the transverse shaft, and provided with sprocket wheels, two safety rollers in front of the platform forming a V; a cushion, and drive chains between the short shafts and rollers for actuating the latter.

515,216. Dynamo or Electric Motor. Ludwig Gutmann, Pittsburgh, Pa. Filed February 13, 1892.

Claim 1 of this patent reads as follows: "A dynamo electric machine or motor consisting of the combination of field electro magnets in two parallel core structures, armature cores located between said core structures, and bearings for supporting the rotary armature cores also located between the two parallel field magnet core structures."

515,238. Trolley Conductor and Support. Myron D. Law, Washington, D. C., assignor to Albert G. Wheeler, Chicago, Ill. Filed August 29, 1893.

The conductor comprises rails of L-shape in cross section having supporting webs and contact flanges and supports for the conductor having metal shanks which are interposed between the overlapping webs of the adjacent rails.

515,274. Indicator for Electric Cars. Henry C. Beckmann, St. Louis, Mo. Filed August 17, 1893.

A suitable indicator in the car is in electrical contact with a laterally projecting rigid contact rod moving with the car. Combined with this is a fixed conductor having a freely swinging contact rod connected with the trolley wire.

515,289. Wheel Guard for Cars. David R. Howard, Baltimore, Md. Filed June 16, 1893.

This is the combination of brackets projecting from the car body, tilting side bars pivoted to the outer ends of the brackets, side plates united to the rear ends of the side bars by means of links and adapted to move backward and forward relatively to the side bars, and a shoe piece which unites the outer ends of the side plates, whereby, upon the guard striking a body, its forward end will be first depressed, the device then moved backward and the rear end elevated, and then as the body becomes seated on the guard, the said rear end falls to its original plane.

515.308. Electric Railway Trolley. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, of Boston, Mass. Original application filed June 18, 1888. Divided and this application filed November 8, 1890.

The claim of this patent is as follows: "The combination of a car, an overhead conductor, a contact device making underneath contact with the conductor, a standard on the roof of the car, an arm carrying the contact device pivoted on the standard on a transverse axis and free to swing around the standard, a spring connected to the pole or arm for pressing the contact device upward against the conductor, and a line connected with the arm above its pivot for moving the arm."

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CONTENTS.

Mr. Yerkes and Municipal Franchises The principles which should govern municipalities in their grants of franchises have been discussed very freely of late in Chicago since the the mayor by a score of vetoes has demonstrated his belief that privileges should be disposed of at high figures. It might be supposed that Mr. Yerkes, as the head of two great street railway corporations of Chicago, might be inclined to take a radically different view. An article by him presented elsewhere in this issue indicates that such an assumption would be incorrect. The opinions that he entertains are similar to those which have influenced Mayor Hopkins in his vetoes. The following passage, for example, might have appeared in one of the executive messages of disapproval: "The city should receive from the corporation all that the latter can afford to pay for its privileges. Where the corporation is assisting to develop a community in which it is located there should be nothing expected from it, but where it locates in places already built up it should pay the city for its license."

Chicago Trolley Ordinances. Mayor Hopkins has vetoed the ordinances which grant to the Chicago City Railway Company the privilege of equipping for electric traction most of its lines now traversed by horse cars. The reasons assigned for the disapproval of these important measures are found in the mayor's belief that the city can make a better bargain with the company than that contained in the ordinances as they recently passed the city council. Mayor Hopkins has been taking extreme grounds in the matter of municipal franchises. He has held that the city has heretofore been frequently victimized in its transactions with corporations, and he has expressed his intention of exacting the uttermost farthing from companies asking for rights from the municipality. No one will be inclined to find fault with an executive who takes such a stand, unless his zeal becomes so pronounced that projects of merit are killed off. There is a possibility that too much zeal may be manifested in the case of the Chicago City ordinances. If the company is refused its request except upon terms to which it will not agree, its business will not be materially interfered with, for it does not stand in the position of a company asking an original franchise. It can operate its lines for years by animal power and continue to earn dividends for its stockholders. The public would be a far greater sufferer, for it is more than dissatisfied with horse cars and is demanding better transportation, which can only be provided by the adoption of the trolley system. It is certainly to be hoped that the company and the mayor will be able to agree upon terms so that there may be no unnecessary delay in the introduction of improvements which are so urgently demanded.

Attack on Electrical Companies. It is a satisfaction to know that electrical companies are not accused of driving spikes into slots to cause breakdowns on cable lines and thus bring discredit on the cable system of street car propulsion. While he was about it the Massachusetts congressman might have included this charge in his recent wholesale denunciation of companies which are interested in the introduction of the overhead trolley system. Such an accusation would have been wholly as reasonable as certain charges that were made. As will be seen from the abstract of a discussion in the House, which we publish elsewhere in this issue, electrical companies were said by one representative to be so active in their opposition to an underground electric railway, that they did not hesitate to adopt active measures calculated to interfere with its operation. Such a charge is indeed serious, and the imputation of crime is outrageous unless proof can be cited in support of it. It was alleged that criminal attempts to interfere with an underground system had been made both in Chicago and Washington. So far as the former line is concerned we are not aware that such an accusation was ever whispered or gossiped about. To be sure spikes were found driven into the slots, but the mischief was ascribed to boys or to persons influenced by a malicious desire to see an accident. The street railway company no more imputed these acts of interference to electrical companies than it did so when the cable slot was found blocked. Of Washington we have heard nothing, so we are not warranted in speaking; but we certainly hope that the companies who have been so outrageously attacked will demand that proof or a retraction be forthcoming.

Accident Insurance. A brief article printed elsewhere in our columns this week by an Indianapolis attorney recounts the experience of one street railway company in obtaining insurance against liability for the payment of damage claims. The experience of this road is probably not very different from that of other roads that have been carrying similar insurance and have likewise kept pace with the demands of the public for rapid transit improvements. No one disputes the fact that the modern methods of street car transportation, involving as they do the use of larger and heavier cars operated at higher rates of speed, are more dangerous to other occupants of the street than were the slow-going horse cars so universally used a few years ago. This fact admitted, the street railway company that does not reckon in its estimate of the expense of operating by improved methods of transportation a large increase for litigation and damage claims, will find that it has made a very serious error. It cannot be expected that insurance companies will continue to insure against liability for damage claims at the same rate, when the motive power has been changed from the animal system to either the cable or electric, since both of these systems greatly increase the liability of accidents. As might be expected, street railway companies whose insurance rates are based upon results of experience when their roads were operated by animal power, are heartily in favor of this method of disposing of their liability; while companies whose recent experience places their liability at such a high figure as to compel the demand of a correspondingly high rate of insurance are more likely to be in favor of taking care of their own litigation. The question raised by Mr. Fisher as to whether the system of liability insurance does not of itself tend to increase the number of claimants for damages, is well worthy of consideration.

Competition with Steam Railroads. That the steam railroad companies of Pennsylvania are anticipating with no little anxiety the competition of electric railways throughout the state is not surprising. According to the report of the Department of the Interior almost 200 electric railway companies have already begun work on their roads or are merely awaiting franchises before starting construction. Many of these roads will come into direct competition with existing steam lines and a sequence of their operation must be a decrease in the latter's profitable short haul traffic. It is reported that the railroads propose to fight every extension of suburban railways that threaten competition. The fight against the Pennsylvania Traction Company, whose system will eventually extend from Harrisburg to Philadelphia, will probably be one of the first to engage the attention of the courts and the outcome of what promises to be bitterly contested litigation will be watched with no little interest. In the first skirmish the Traction Company was victorious, as the Supreme Court in a recent decision declared that a street railway might be a road connecting contiguous places, that is that such a line is not necessarily confined to one locality. As this important point has been disposed of the railroad company, according to report, hopes to prevent the traction company from making progress by placing legal difficulties in the way of its crossing bridges over railroad tracks. The greatest fight, however, it is said, and the one which will be carried to the Supreme Court of the United States if the railroad company is beaten in Pennsylvania, will be made upon the claim that the charter for a parallel and competing road is a violation of the contract between the state of Pennsylvania and the Pennsylvania railroad. The road to be paralleled is the old state road to Columbia, and the state, when owner, prevented any competition. This right, the railroad claims, was sold it with all the franchises and privileges, and any attempt to grant another privilege now is a violation of the contract. While the progress of the contest will be watched with especial interest in Pennsylvania, as so many roads in that state are reaching out for suburban business, companies throughout the country may well feel concerned in its outcome, for the tendency to compete with railroads is becoming every year more manifest among electric railway companies.

ELECTRIC RAILWAY DISCUSSION IN CONGRESS.

The entire session of the National House of Representatives on Monday last was devoted to consideration of a bill permitting the Metropolitan Railroad Company of Washington to change its motive power. The measure provides that the company shall complete within a year an underground system of propulsion to be put into operation on the Ninth street line, and within two years the entire line shall be thus equipped. The second section authorizes an issue of bonds to pay the cost of this work, while the third section provides that the bill shall in no wise affect the suit pending against the company for the forfeiture of its charter because of its alleged failure to do certain paving. No definite action was taken and the bill will be considered on the next District day.

In the discussion of the bill considerable excitement was caused by a speech of Mr. Walker, of Massachusetts, who offered two amendments. The first provided that the underground system which the bill proposes for propulsion shall be electric. The second amendment provides that the lines relating to forfeiture of charter shall read: "For non-performance of its duty in any respect," instead of "for non-performance of its duty in respect of paving the spaces between its tracks and two feet beyond its exterior rails, and for the non-payment of the cost thereof."

Mr. Walker attacked the electric companies and said that they were responsible for the continuance of the trolley system. They were fighting the underground system with the malignity and ferocity of the infernal regions. He said that in Chicago the dynamo of an underground electric system had been damaged, and rails and bars of iron had been placed in the slots, in order that the road might be a failure.

"Do you charge that the General Electric Company and the Westinghouse Electric Company were responsible for this dastardly work?" asked Mr. Haines, of New York.

"There is a moral certainty that they do these things," replied Mr. Walker, who thereupon argued with much earnestness for the adoption of the underground electric system now in use in Washington. The Buda Pesth system, he claimed, was not regarded as a success by the electrical engineers of Europe. He wanted the people to be protected against the devilish cuttlefish of the electric trust, and the way to do this, he argued, was to make it imperative that the Metropolitan road shall adopt the underground electric system. In the debate it was made very apparent by Mr. Richardson and other members of the committee that under no circumstances would overhead wires be allowed.

Mr. Haines said that being interested in street railroads, he had listened with amazement and surprise to the remarks of Mr. Walker. "Having been concerned in the building of twenty-nine trolley roads," said Mr. Haines, "I want to say that the trolley system is the greatest achievement of the electrical world." Mr. Haines eulogized the great benefit of the trolley system. He admitted that it might not be the greatest development of electrical propulsion, but it was the best that had yet been devised. There was no underground system that was successful or practical. He was afraid that Mr. Walker's attack on the electric companies was due to the fact that the stock which that gentleman might have held had been steadily falling, and he might have been bit. Mr. Walker immediately denied this insinuation, asserting that he did not now hold and never had held any electric stock.

Receiver for the Northeast Railway.—Judge Henry appointed Robert Gillham, on March 12, receiver for the Northeast Electric Street Railway Company of Kansas City. The petition was made by the officers of the road.

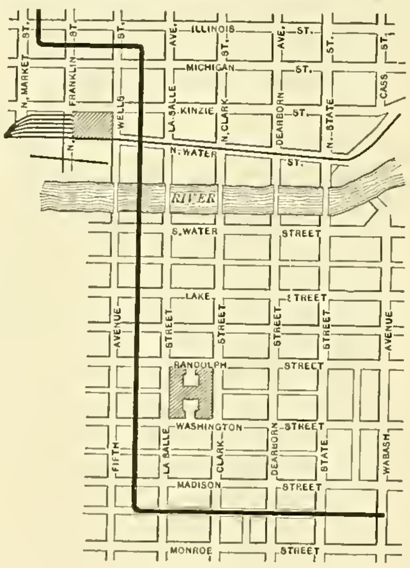
ATLANTA STREET RAILWAY CONVENTION.

President Joel Hurt, of the Atlanta Consolidated Street Railway Co., finds that manufacturers of street railway apparatus are already taking considerable interest in the convention of the American Street Railway Association, which will be held in Atlanta, October 17, 18, and 19. Many letters inquiring about space in the new building which is to be erected in Piedmont Park have already been received. The structure will be completed in the fall so that it may be used for convention purposes. It will contain a large auditorium and a hall suitable for exhibits. In the center of the latter will be installed a large Corliss engine. Outside the building tracks will be laid on which street cars and heavy exhibits will be placed.

NORTHWESTERN ELEVATED RAILWAY, CHICAGO.

The plan of the proposed route of the Northwestern Elevated Railway of Chicago has been filed by the company with the commissioner of public works. If the published plans of the company are executed it will be the first to build an elevated railway on the North Division of the city. The company has back of it a number of the most influential capitalists of the city, and its president is D. H. Louderbach. The company has decided to operate its road by electricity according to all reports.

The line is planned to avoid streets and to follow alleys. It starts at the West line of Wabash



ROUTE OF NORTHWESTERN ELEVATED ROAD, CHICAGO.

Avenue between Monroe and Madison streets, and extends west along the south line of the existing alley to Dearborn street, where the First National Bank Building is encountered. To escape this the line will pass through that block on the north line of the existing alley. Crossing Clark street, it again goes to the south side of the alley until it reaches the alley just east of Fifth avenue. There it turns north, running through the present alley, across the river on a bridge to be constructed by the company, on a straight line to the alley north of Michigan street. Thence it continues west, running on the south side of the alley found there to a point 125 feet east of Market street. Thence it runs northeast in the existing alley in a straight line until Hill street is reached. A detour to the east is there made necessary on account of a church, but after crossing Elm street the road gets back to the old line and continues until the first alley south of North avenue is reached. It then turns west again, running on the south side of the existing alley to Town court. Then it runs north for half a block until the south line of North avenue, the terminus, is reached.

In the accompanying map the proposed route in the business section is indicated.

DECISION IN A TELEPHONE-ELECTRIC RAILWAY SUIT.

The supreme court of Tennessee on March 10 handed down a decision affirming the judgment of the lower court in the case of the Cumberland Telegraph & Telephone Co., against the United Electric Railway Co., of Nashville. The judgment from which the latter company appealed awarded $4,000 to the plaintiff corporation as damages caused to its telephone system by reason of the operation of the electric railway.

IMPROVEMENT OF THE HESTONVILLE LINE, PHILADELPHIA.

The Hestonville, Mantua & Fairmount Passenger Railway Company, of Philadelphia, which operates the road familiarly known as the Hestonville line has decided to adopt an electric system. The present management which has been in control over a year has instituted many improvements in the property, but has become convinced that the road will prove profitable only when it is electrically equipped. A plan for obtaining the money necessary for the improvement has just been approved by the stockholders.

The Hestonville line includes 17 miles of track and the system will soon be extended to Overbrook. The facilities have not been of the best; the cars are old and there are several heavy grades on the line which make fast time with horses out of the question. For these reasons the company has carried, as its directors admit, only those persons who could not be accommodated by any other line. When the electrical system is installed its equipment will be as fine as any in the city, and as the company will be in a position to compete with any other line, a large increase in traffic is expected.

At the stockholders' meeting it was voted to increase the capital stock by the issue of $533,900 of preferred stock on which 6 per cent. dividends will be paid. The stock will also be entitled to share in any dividends over and above 6 per cent. after 6 per cent. is paid on the common stock.

The total issue of new bonds will be $1,250,000. They will be payable in gold and will bear 5 per cent. interest. Their term will be 30 years. Of the new bonds about $500,000 will be held in reserve, and will be used to retire the present outstanding 6 and 7 per cent. bonds, some of which will mature next year. The remainder of the issue has been placed by Edward B. Smith & Co., and the leading financial institutions of the city are among the subscribers.

With the money available from the issue of new stocks and bonds the trolley system is to be installed on all the lines, which include the Arch street, Race and Vine streets and the extension out Lancaster avenue to Overbrook, which is to be built at once.

Bids for much of the work have already been received, and the contracts will be awarded in a few days. The company hopes to have trolley cars running over the entire system by October 1.

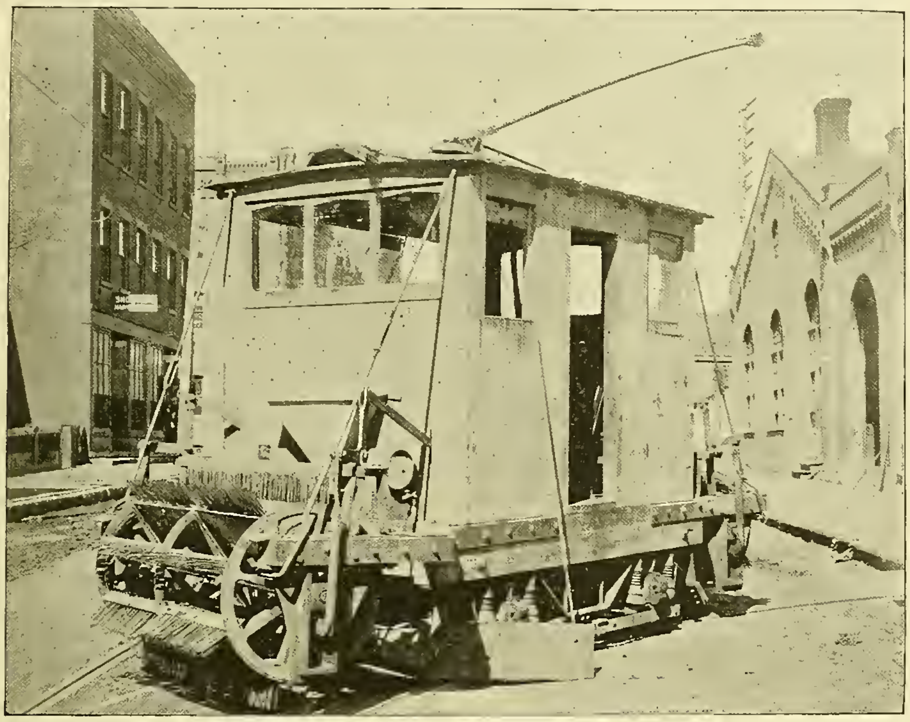
The power station will be erected at Twenty-sixth and Callowhill streets, on the Schuylkill river, occupying part of the property used by the Race and Vine streets line for a depot and stable. It will have the advantage of easy delivery of coal from boats. The station will be of stone and Pompeiian brick, one story in height, and of attractive appearance.

It will have a capacity of 2,000 horse power, and, if more is needed in the future, the capacity can be doubled by extending the station on the company's property. The equipment will consist of four cross-compounded engines of 500 horse power each, belted to the same number of 400 kilowatt generators. Eight boilers, each of 250 horse power, will furnish the steam.

Portland, Ore.—It is said that the $70,000 subsidy for the Portland-Beaverton electric motor line is so nearly made up that the enterprise is assured.

SUCCESSFUL ROTARY SNOW PLOW

The economical and successful removal of snow from electric street railway tracks is a matter that has been a constant source of expense and trouble to street railway companies, large and small alike. On the smaller roads particularly there are numerous schemes and devices in use such as horse snow plows and scrapers, which accomplish the work only in part. The railway companies in the smaller cities keenly feel the effects of severe snow storms, as they have not the benefit of the heavy street traffic and the rapid service of the larger cities, to assist them in keeping the tracks open, nor can the majority of them afford to expend the same amount in clearing their tracks, as the traffic will not warrant it. They must therefore turn to an economical way of keeping their tracks clear throughout the winter, which is particularly difficult on all roads that extend toward the suburbs.



ROTARY SNOW PLOW IN USE IN DUBUQUE, IA.

The cuts show a snow plow both economical and successful which was used by the Dubuque Light & Traction Company of Dubuque, Iowa, this winter. This is the first winter in many years that Dubuque has enjoyed uninterrupted street car service and its immunity from prolonged blockades was due to the very successful work of this rotary plow. Because of the extremely heavy grades encountered on the lines of the Dubuque Light & Traction Company it has been difficult to find a snow plow that would operate in severe storms. One grade in particular is 8 per cent. on the average throughout its length of 1,500 feet and it has two sharp curves, and another is on the average 6½ per cent. for a distance of 2,200 feet.

The truck of the Dubuque plow was taken from under an open summer car and strengthened so as to withstand the strain and load put upon it. The cab is built of unusual strength for the purpose of taking by hog chains the weight of the brushes which are placed far out on both ends, thus leaving little or no strain on the angle supports, as both brushes are of the same weight; it also provides a ready means of handling the motors while the plow is in operation. The cab protects the wiring and all the electrical equipment of the plow and forms a support for the trolley stand and pole. Another advantage of the cab is that it provides a warm and comfortable house for the men who are fighting the snow.

The plow has on either end revolving brushes or flyers. The frame of the machine is built out at the ends at an angle of about forty-five degrees and is wide enough so that the brushes will sweep six inches on each side of the track; on each of the angle beams are bolted two cast iron bearing guides, constructed in such a manner that the brush bearings can be raised or lowered at will by levers controlled within the cab, Nos. 2, 2, 2, 2.

The brushes on the forward end of the plow are the only ones used as the plow sweeps in the direction it is moving, the rear brush being in the meantime stationary and raised several inches above the track by means of the levers, No. 2.

The rotary brush is constructed in the following manner: Three steel spider castings, each with eight radial arms and a thirty-six inch sprocket wheel are keyed to a three inch shaft and to these radial arms are bolted flat steel plates one-eighth of an inch thick, to which are bolted the brush holders. The brushes are constructed of hard, well seasoned maple, very similar to the ordinary track brush, with removable tops, so that in case the brush wires wear down or break, they can be easily replaced.

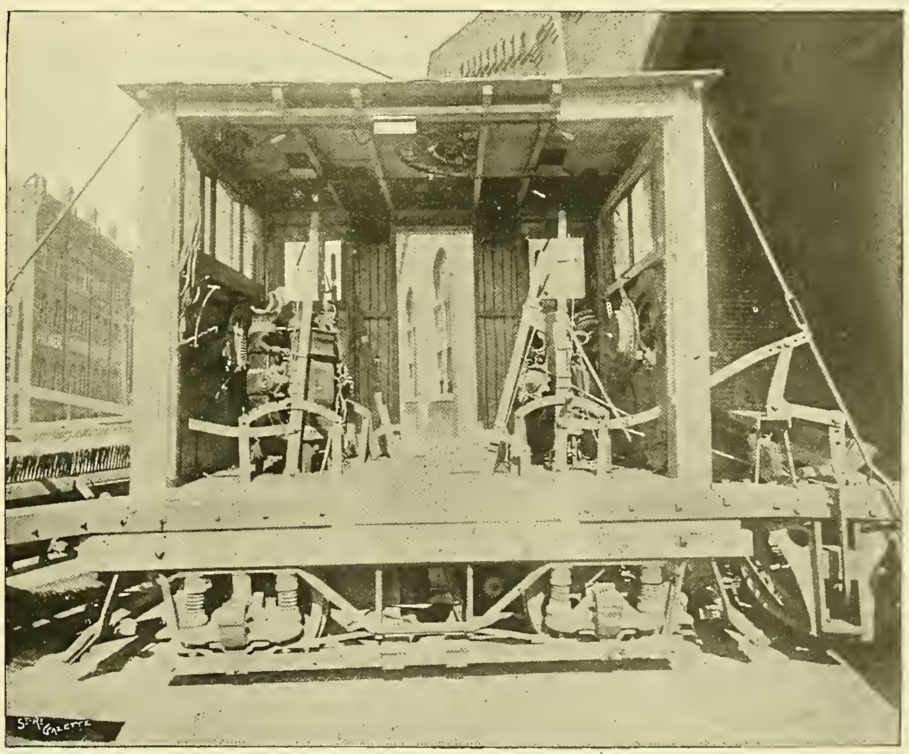
Flat, tempered steel wire is used, five pieces being placed in each hole and allowed to project six inches beyond the holder; but it is suggested that rattan be used in preference to flat, tempered steel wire; as it has been the experience in Dubuque that contact with salt will cause wires to rust quickly and besides the extreme cold has a tendency to make them break very easily. If wire is used, it is advisable to immerse the entire brush in hot asphaltum before it is put into service as this will prevent rusting to a considerable extent.

Each of the brushes and bearing guides has a combined weight of about thirteen hundred pounds. This weight is centered on the main supports of the truck by means of the hog chains, which extend from each end of the brush supports, presenting the advantage that the weight is directly over the axles, which is one of the features of the plow as it gives increased traction to the wheels.

Special mention should be made of the simple and effective construction of the brake, which consists of a powerful toggle joint and is operated by a hand lever four feet long, extending through the floor of the cab and constructed in such a manner that when the lever is thrown back into its normal position, the brake is released in a positive manner without the aid of springs.

On alternate ends of the plow is a scraper two feet long, consisting of an oak board two and a half inches thick faced with sheet steel of the same width and one-eighth of an inch thick, curved at the lower edge in such a manner that it will fit the track and clear away snow which is deposited by the brushes from near the track; these scrapers are raised and lowered from within the cab by means of a cable. They are attached to the truck by two iron eyes on the scraper and are held in place by an iron pin which passes through them and the ordinary track brush holder which is on the spreader of all trucks.

The power for propelling the plow is furnished by two 15 horse power S. R. G. Thomson-Houston motors, thoroughly protected. They are equipped with two type 51 Thomson-Houston rheostats, one at each end of the plow placed within the cab, thus avoiding the usual difficulties experienced from operating cables. It will be seen that the motors are placed in such a position as to be



INTERIOR OF SNOW PLOW CAB.

readily operated by the motorman. The electrical equipment for running the brushes is perhaps a little unique as well as interesting. It consists of two fifteen horse power G-30 Thomson-Houston motors, one for each end, separately operated by a specially designed series multiple switch (No. 4), which gives a number of combinations for regulating the speed that are needed for the varying work the brushes have to accomplish. This is quite necessary in using a motor of this high speed type, for this purpose. It will be noticed that the motors have been placed upon end in an iron frame; this was necessary to economize space as well as to bring the armature shaft to which the small sprocket wheel is attached in proper position to be connected with the large sprocket wheel on the brush by means of a No. 75 link chain.

A small idler where the link chain enters the cab is also used to prevent it from running off, which might happen as the work which the brush accomplishes is not steady and the chain is more or less slack at times.

The speed of the brushes is about two hundred revolutions per minute and as there are eight brushes, a brush will strike the ground about sixteen hundred times a minute, which speed has been found sufficient to meet all requirements.

The plow was operated successfully the entire winter and in the outlying districts went through and cleared drifts of snow two and a half and three feet deep with little difficulty. On each end of the plow, outside the cab, is placed a large combination sand and salt box operated from the inside of the car. This sand box was especially designed and on account of its simplicity and reliability has proven most successful, not only on the plow but on all of the cars where it is in use. Two men operate the plow entirely, one the brush and brake levers from the center of the cab; the other, the motorman, who also controls the brush motors and scraper cable, from his position in the corner of the cab where he has full view of every thing in front of him.

While this plow met all requirements during the present winter, it was designed and constructed in a hurry and on a purely economical basis. There are many improvements which, a little careful study would suggest. The entire outlay necessary was two hundred and twelve dollars. The plow, which was constructed in the company's shops, was designed by A. W. Mc Limont, general manager, and H. A. Douglas, assistant manager.

Disposition by Cities of Corporate Privileges.*

BY CHARLES T. YERKES,

President of the North and West Chicago Street Railroad Companies.

Selfishness has much to do with the management of affairs, be they either private or public, and consequently to suggest a correct manner of regulating the latter would be simply impossible; therefore it is best, instead of attempting to control the acts of our public servants, to adopt such laws for their government as will, when obeyed, accomplish the proper end.

We find an answer to the question in the fact that privileges are disposed of as natural laws dictate at the time of the organization of a community. In a country enjoying a free government it is natural they should band together, not wholly for protection, but the improvement of their condition both socially and financially. Towns have sprung up and in time grown into cities. Why? Mainly for the reason that certain rights have been given large and active corporations, which have been attracted by the promise of the land and the prospect of success. The grantee accepted these rights in the hope that the future would deal kindly, and the risks taken would inure to its benefit. This city has thrived greatly, and the corporations are in a great measure responsible for that thrift. It may be said that they, too, have thrived. Why should they not? And still their increase in value is not commensurate with that of things, principally real estate, bordering on the territory through which they run. This applies more particularly to old street railroads. Compare the amount of increase in the value of these companies with the increase in the value of the real estate through which they pass, and the former, while it is large, is infinitesimal as compared with the latter. It will not be claimed that the street railroads produced all of this result, but it will hardly be denied that such a condition of things would not have been experienced if street railroads had not been built. The progress of the city and the increase in values would have been much smaller as compared with what we witness at the present time.

The laws empowering citizens to form corporations for the purpose of establishing and maintaining large business enterprises are among the most solid foundation stones of our free government. Most of the railroad and telegraph lines in Europe are owned and operated by the government, and the proceeds go to the support of the country. Who is better off for this condition? Not the travelers and shippers, for the rates are higher than in this country; not the people, for we know that they are much more heavily taxed than the people of this country. It is the persons who govern the properties who receive the profit. In this country it is the millions of stockholders who reap the benefits, while there it is the government and the officeholders.

Suppose the railroad and telegraph properties were subject to the President as the postal and internal revenue departments are. Emperors and czars and the great rulers of the earth would pale before him in power. No man living would have the amount of patronage at his command, to say nothing of the amount of moneyed investments under his control.

It is argued that the cities should own and operate such properties as water works and gas works. In such towns where the former is under municipal control the reason can be found in the early settlement of the community, when no corporation of a private character could be found to take the risk. As water was an imperative necessity the municipality was compelled to supply the need; with gas works it is different. This comes after the municipality has grown and the people desire luxuries. It is a fact that does not admit of contradiction that a well-managed corporation can handle a business better than a municipality. The extravagance and bad management in the Water Department are well known. It is used by every political party which has control to forward the ends of that party. It has been reduced to a party machine. Every change in administration makes a change in the heads of its department and its employes. Consider for a moment your own business run in that manner. It would be almost a miracle if you were successful.

In Philadelphia, for many years no man could be elected to the city council unless he was under the control of the gas trustees. Contracts were made about as the members of the board saw fit, and at election times thousands of men were placed on the pay-rolls so that the bosses could elect their men. It was not until the people compelled the legislature to change the charter of the city that the power of the gas trustees could be gotten rid of. Before going out of office the trustees reduced the price of gas to $1.50 a thousand feet, at which rate the commissioner found himself unable to manufacture and to extend the supply. In consequence of which the city is now purchasing large quantities of its gas from a corporation which is making a profit. It is not only demonstrated that the city can purchase gas from outside parties, but sell it to people at a less price than the municipality can manufacture it.

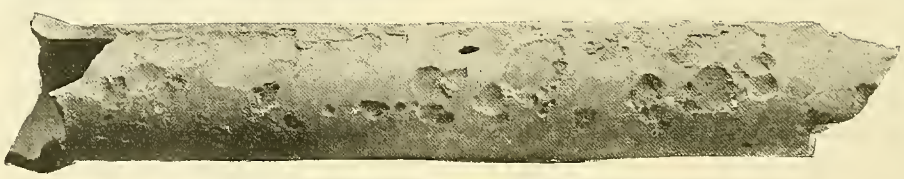
To the question how and to whom should these rights be given, I answer it is impossible to say. In some cases it would be well to give them to the highest bidder, and in others this plan would be unnecessary, for the reason that there would be no one to bid owing to the uncertainty of profits in the future. To have the city develop the plants would be to build up such a political ring that the community would surely suffer, besides having the poorest of management to maintain the property. I believe it is the best plan to give these franchises to any corporation which can develop and push the work to its fullest capacity.

The city should receive from the corporation all that the latter can afford to pay for its privileges. Where the corporation is assisting to develop a community in which it is located there should be nothing expected from it, but where it locates in places already built up it should pay the city for its license. Whether better terms could be secured for the privileges if given in the hands of a few persons rather than with the city council it is difficult to say. It is a fact, however, that where there are so many to determine what is proper it is impossible to get intelligent and sound judgment. It would therefore seem that if the disposition of privileges was in the hands of a few honest and experienced business men much better results would be obtained. We want no demagogues or political aspirants for such positions, but men with sound business principles. We do not want the work naturally belonging to a corporation performed by the municipality, for this fosters political rings and bossism. It would be better to-day if there were no such appointments depending on the gift of the officers of our government, be it Federal or municipal.

*Read before the Sunset Club, Chicago, March 15, 1894.

ELECTROLYTIC ACTION IN ZANESVILLE, O.

The accompanying illustration represents a portion of a four inch waterpipe taken from the ground in Zanesville, Ohio. The metal has been subjected to electrolytic action until the pipe was



FOUR-INCH WATER PIPE CORRODED BY ELECTROLYSIS.

perforated. The pipe was laid new about four years ago in an alley in the rear of the electric light plant which was built about two years ago. The street railway return was laid in the alley about 12 inches below the surface. All the pipes that were laid in the alley were affected and some of them lasted only six months. The wrought iron pipe in the ground is said to have been badly corroded, looking like "a badly cut piston rod." The photograph, for which we are indebted to Mr. R. M. Saup, of Zanesville, shows the appearance of the cast iron pipe.

The Curtis Motor Manufacturing Company's fifty motors in service on the system of the Brooklyn City Railroad Company have proved so satisfactory that 120 new equipments have just been ordered. The company has several large contracts pending in the West.

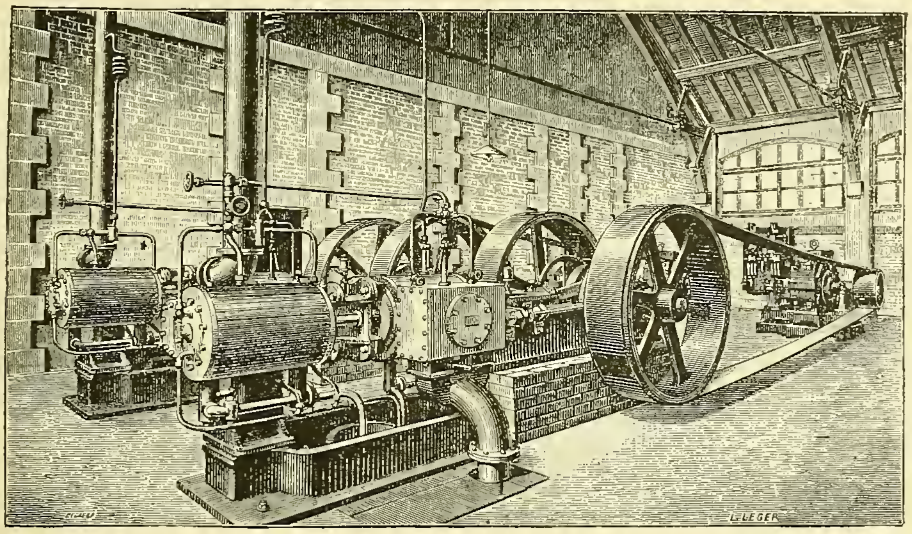
ELECTRIC RAILWAY AT BORDEAUX, FRANCE.

Since December last an electric railway has been in operation in Bordeaux, France. The franchise was granted last May and for several months the choice of a system was discussed. It was finally decided to adopt the Thomson-Houston system and the contract was awarded to the Compagnie Francaise pour l'Exploitation des Procedes Thomson-Houston.

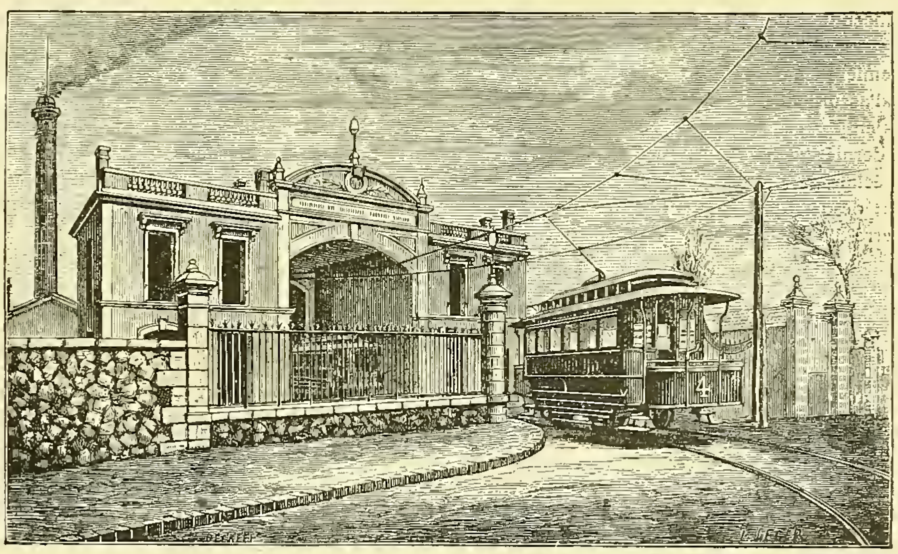
The line which has been equipped leads from Bordeaux to Vigean and is about three miles in length. The line is single track throughout with seven turnouts.

The power station is situated at a point about midway between the termini. At the same place the car barns are located the entrance to which is shown in Fig. 1. The apparatus in the power station is equipped entirely with American types of machinery. Steam is generated in two Babcock & Wilcox boilers, and the feed pumps are of the Worthington make. The engine room, of which a view is shown in Fig. 2, contains two McIntosh & Seymour 150 H. P. engines, each of which is belted directly to a 100 kilowatt Thomson-Houston generator.

The six motor cars operated are equipped with Thomson-Houston waterproof motors. The illustrations are reproduced from *L'Electricite.*



POWER PLANT OF BORDEAUX (FRANCE) ELECTRIC RAILWAY.



CAR HOUSE OF BORDEAUX (FRANCE) ELECTRIC RAILWAY.

ADVISABILITY OF INSURANCE OF STREET RAILWAY COMPANIES AGAINST LIABILITY FOR WRONG-DOING.

BY R. D. FISHER.

The modern street railway is peculiar in both its commercial character and its legal status. It has been and is a conspicuous factor in municipal growth and convenience. During the recent decade a new impetus has been given to the business of rapid transit, and the field of operation has been widely extended. The carrying capacity of the modern street railway has also been marvelously increased. No other business in existence to-day touches at so many places the legal rights of its patrons and employes, or owes a greater responsibility or is held to a more radical performance for prompt and safe transportation. The recent development of the modern system of local transportation has not only invited an increased patronage but has been met with an extraordinarily crop of litigation. It is the duty and business of a shrewd manager to keep the company out of litigation and lessen the legal expenses as much as possible. Accidents, from whatever cause, are at times unavoidable; negligent management and inexperienced service must at times be endured—all of which are approximate, causes resulting in personal injury or death to patrons or employes, or damages to private property. To meet these demands and effect an equitable settlement requires consummate skill and no small sum of money. The court house should be the last resort. I say this advisedly and largely on account of the average prejudice of the American jury. But to avoid litigation or damage suits is impossible; in the light of past experience, then, is it advisable for a street railway company to assume the risk of judgment or compromise claims rather than pay the current rate for insurance or indemnity against damages recoverable?

To indemnify a company in respect to such liability the rate or premium charged is usually based upon the gross receipts of such company, the number of miles operated; the number of employes in service; the character of the machinery and the experience of the company concerning legal expenses of the past three or five years. There are no statistics that will afford a reliable basis for computation. Neither will the experience of the past five years suffice. This is absolutely true because of the marvelous changes made from year to year in motive power and in other respects which render the business more hazardous and thereby increase the liability. There are not more than three or four reliable indemnity or casualty insurance companies writing street railway business in this country at the present time. One or two have become insolvent within the past year. The American Casualty Company, of Baltimore, was the first to engage in securing street railway companies against loss by reason of damages to person or property. This company's first experience in Indiana was with the Citizens' Street Railway Company of Indianapolis, and this continued for two years. The first year that the security company stood between the street railway company as a wrong-doer and the claimants, the system was for the most part operated by animal power. The insurer at the end of the first year was in possession of no discouraging experience and readily renewed the contract for a second year. With this year came the rapid improvement and change from animal to electric power. Inexperienced men were largely placed in charge and a flood of damage suits, the result of a series of accidents, followed. During this period thirty-nine causes of action were defended, thirty-four settled or compromised, five dismissed and a number left pending future action, or on appeal to a higher court. The amount required to effect settlements and pay judgments and costs increased fifty per cent. The insurer refused to renew the contract for a third year notwithstanding the fact that the street railway company agreed to pay a largely increased rate. Pending these conferences and settlement between the insured and insurer the latter became insolvent. The experience of this company in this particular case elicited some hitherto unknown facts, viz: that the use of electricity as a motive power has increased the risk to damages recoverable at least fifty per cent.; that it requires an increased sum to pay counsel to defend the numerous causes in which the company is made defendant; that the average jury is not only prejudiced against a corporation, but that such prejudice as already exists is intensified where it is made known that a street railway company is indemnified against loss for damages in consequence of its wrong doing. Further, it is thoroughly believed, that the system of indemnity on account of its desire and custom to compromise claims out of court, has invited and encouraged a large number of claimants to proceed against the carrier hopeful of obtaining something for trifling or imaginary injuries. Unscrupulous attorneys have also encouraged claimants upon contingent contracts to share in the amount recovered and subsequently labored with those in charge of the defense for a compromise, and rarely have they failed because of the incentive of the carrier as well as the indemnifier to prevent, if possible, the burden of innumerable suits. It is doubtless a very great relief to the officers and managers of a street railway company to be relieved of all responsibility concerning damage suits, and if statistics were of sufficient value and reliance on which to base a premium it would, in the light of present experience, certainly be advisable for a street railway company to obtain reliable indemnity.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Tenth Article.)

With the coil in the position shown the maximum electromotive force is being generated for the reasons already explained, and the direction of the resulting current will be as indicated by the arrows. When the coil has arrived at the position shown in Fig. 23, it is cutting no lines of force and generating no electromotive force, but immediately after passing this position it commences to cut the lines again, the two sides cutting the lines in opposite directions, however, viz: *A B* has exchanged places with *A D*, the former cutting them from west to east, if in looking towards the north pole we be supposed to be looking north, and the latter now cutting them from east to west,

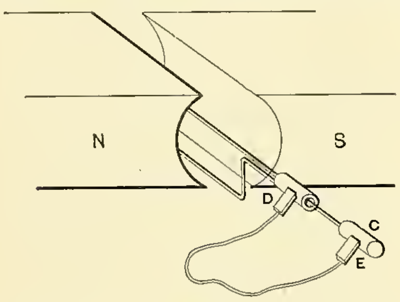


FIG. 23.

using the same points of the compass. The current will, therefore, be reversed and will reach its maximum strength when in the position shown in Fig. 24. It will again become zero and reverse its direction when the coil has reached a position at right angles to this; and so the changes will follow each other as the coil revolves, repeating the changes with each revolution, becoming zero and reversing its direction each time the coil takes up a position at right angles to the lines of force and reaching a maximum each time it becomes parallel with them.

We have here what may be termed a typical machine generating alternating currents, viz: those which are periodically reversing their direction. What is wanted, however, is to generate a current that shall flow always in the same direction in the outer circuit. It is evident that if at the moment the coil arrived in its neutral position, Fig. 23, when for a moment it is generating no current and the next commences to generate one in the opposite direction, we should exchange the places of the two brushes *D* and *E*—placing *E* upon the cylinder which terminates the end of the wire *B* and *D* upon the cylinder *C* and replace them again in their original positions when the coil arrives at its next neutral position, the current in the external circuit would no longer be reversed, but would continue to flow in the same direction throughout the complete revolution of the coil. A simpler way of accomplishing the same thing, however, is at hand.

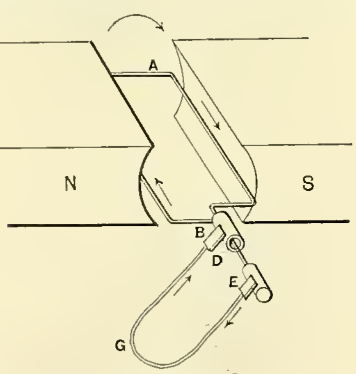


FIG. 24.

Suppose the hollow cylinder *D*, in Figs. 20, 22, 23, 24, be slit longitudinally into two equal parts, and let one part be connected to each of the two ends of the turn of the wire, as shown in perspective in Figs. 25 and 26 and in section to a larger scale in Figs. 27 and 28.

Calling these two halves *m* and *n*, if we place the slits at right angles to the coil, as shown in the figures, and place the brushes *D*, *E* in the

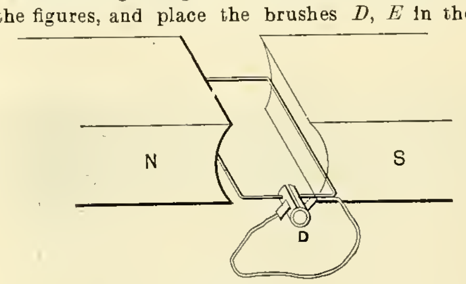


FIG. 25.

positions shown, the direction of the current in the outer circuit will be automatically changed at the proper time. In Fig. 28 the coil is in one of its neutral positions. Just before this *D* has been in contact with *m* and *E* with *n*; the current at that time was flowing from *n* through *E G D* to *m*. When the coil has arrived at the vertical position shown in Fig. 28, there is no electromotive force generated, but just after it has passed this position the section *n* passes from under brush *E* and section *m* passes from under brush *D*. Therefore brush *E* rests upon section *m* and brush *D* upon section *n*, Fig. 29, just as the direction of the electromotive force in the coil changes, so that the current will continue to flow in the same direction in the circuit *E G D* as before.

This arrangement, by which the alternating current is changed to one always flowing in the

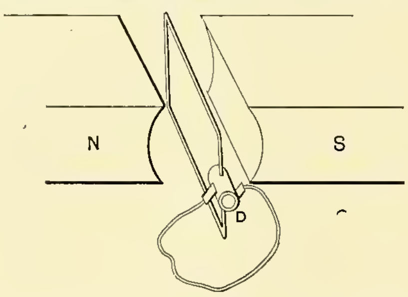


FIG. 26.

same direction, is termed a *commutator*, and the line joining the positions of the brushes where the change of direction or commutation takes place is called the "axis of commutation."

We have already accomplished part of our purpose, but not all, for while the current now always flows in the same direction it is an exceedingly unsteady one, having at one time no electromotive force at all and at others a maximum. We must have a more uniform current, and to this end let us add another coil at right angles to the first. Fig. 30.

If this second coil is added and the commutator split into four sections the currents in both coils will be rectified and as the coil *b* is in its neutral position while coil *c* is generating its maximum electromotive force and *vice versa*, there will be no time when the circuit is without current, for while coil *b* is contributing nothing, the other coil *c* is doing its best. Referring to the cut it will be seen that each coil will come into action when it comes within 45 degrees of its position of

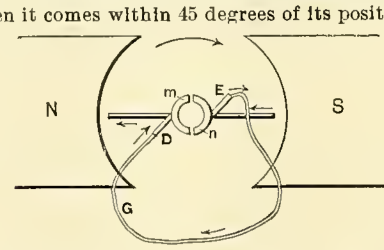


FIG. 27.

maximum effect and will go out of action when it has passed 45 degrees beyond that point.

While in the position shown, the coil *c* is in a maximum position and section *o* is positive and *p* negative. The current will therefore flow from brush *E* through *G* to *D*. The potential will diminish until the coil has passed through 45 degrees. Then the sections *o* and *p* of the commutator and the coil will no longer be in connection with the brushes and the outer circuit and may be neglected for the next quarter of a revolution. When the segments *o* and *p* pass from under the brushes, segments *m* and *n* immediately succeed them and coil *b* is connected to circuit. This coil is approaching its position of maximum effect and therefore its potential difference is increasing and will continue to increase as it passes through an angle of 45 degrees when it reaches its maximum and will then decrease as did coil *c* for 45 degrees more until like the other coil it is cut out of circuit by its commutator segments passing from beneath the brushes. Thus a decreasing electromotive force of a strength due to a position of one coil 45 degrees beyond its position of maximum effect is succeeded by an increasing electromotive force from another coil due to its position of 45 degrees in front of its position of maxi-

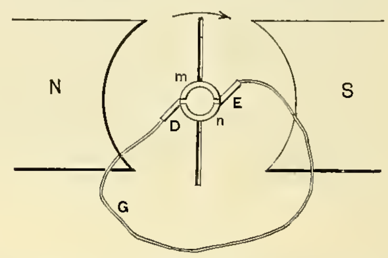


FIG. 28.

mum effect, and we have a current still varying in strength, but only between that which would result from a position of the coils of maximum effect and that which would result from a position 45 degrees removed from it instead of one varying between a maximum and zero.

If we double the number of coils again and divide each of our commutator segments into two, the fluctuations will become still less, and so, by multiplication of coils each terminating at both ends in commutator segments which come under the brushes and leave them at a less angle from the position of maximum effect, the resulting current will vary between narrower and narrower limits and gradually approach uniformity of strength.

INCREASE OF ELECTROMOTIVE FORCE.

We observed from our experiments with the solenoids that two turns affected the needle more than one turn did and it has been stated that the magnetizing effect of a coil or the magneto-motive force of an electro-magnet was proportional to the product of the current flowing into the

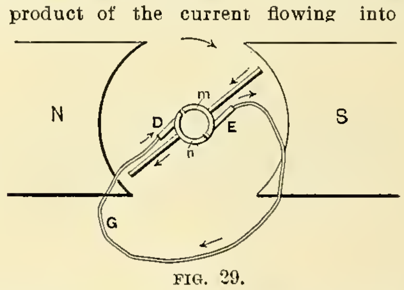


FIG. 29.

number of turns in the coil or the ampere turns, as we have called this product. The converse of this is also true. If a coil of one turn of wire such as has been discussed heretofore, revolving in a given magnetic field at a certain speed generates an electromotive force of say 1 volt, a coil of two turns or a coil of three turns revolving at the same speed in the same field will generate an electromotive force of double or treble as much. That is to say that since a given current passing two and three times around a bar of iron or space will generate two and three times as many lines of force as it will if it passes around but once, so if a coil of one turn cutting the lines of force at a given rate generates a certain electromotive force, the same wire bent into a coil of two and three turns will under like conditions generate two and three times as many volts. Thus if a coil, such as is represented in Fig. 31, be substituted for the coils of a single turn represented in the previous illustrations it will at the same speed of revolution generate twice as much electromotive force, because in doubling the wire it is equivalent to doubling the rate at which that wire cuts the lines of force—which alone determines the electromotive force that will result. This being the law, many other means of increasing the electromotive force at once suggest themselves. If we revolve our coil faster, its rate of cutting will be greater or if we increase the number of the lines, the rate of cutting will still be faster even though the speed of revolution be not increased. This latter statement suggests two other means of increasing the electromotive force, for we can increase the number of lines of force in our field in two ways—either by increasing the magnetomotive force of our magnet by increasing the number of ampere turns, or by decreasing the magnetic resistance of the air space in which our coils revolve. Since our coils are of a certain size we cannot bring the poles of the magnet closer

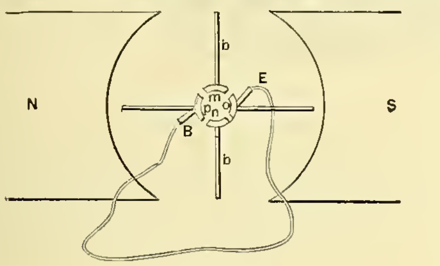


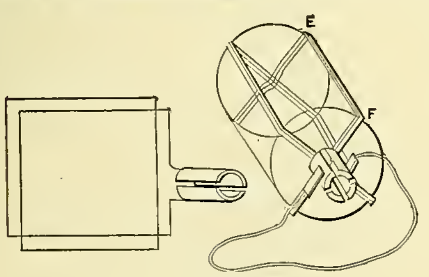
FIG. 30.

together as we did in Fig. 12 and still leave room for our coils to revolve, but we can wind our coils on a cylinder of iron which is the best conductor of the magnetic lines that is known and thus by greatly reducing the resistance in this gap greatly increase the number of lines that our coils will cut at a given speed, and thus increase enormously our electromotive force. And this method is always employed in dynamo construction because it results in an enormous saving in copper, since with one turn of the wire on an iron core a greater number of volts will be generated than with very many turns of wire without the iron revolved at the same speed. Nor is any expense spared to have this core of the softest and best iron for the purpose, for the saving in other directions where the best iron is employed in the armature core more than counter-balances the additional cost of the extra quality.

EDDY CURRENTS IN ARMATURE.

Those who have seen generator or motor armatures in process of construction will have noticed also that they are not made of one solid piece but are built up of a great number of disks of thin sheet iron, each of these disks being insulated from its neighbors usually by thin sheets of paper.

This lamination, as it is called, is not for the purpose of increasing the capacity of the iron to



FIGS. 31 AND 32.

carry lines of force, but is for the purpose of permitting the core to rapidly change the direction of its magnetization. As will be seen later on the armature becomes a magnet whose poles always have a constant position with regard to the field magnet poles—that is, they are stationary with regard to the latter, but since the armature is revolving they are constantly changing with regard to a fixed point on the armature. This lamination greatly facilitates this rapid shifting of these poles, which if retarded as would be the case even with the best iron if it were solid, would give rise to eddy, or Foucault currents as they are called, in the iron itself which would be at the expense of the engine which drives the armature, would contribute nothing in return to the output of the dynamo, would cause the armature to heat up to an abnormal degree so as to perhaps destroy the insulation on the armature wires, and cause ir-

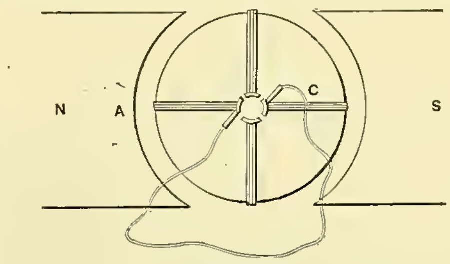


FIG. 33.

regularities of working too enormous to mention at this point.

Figs. 32 and 33 represent an armature consisting of two coils of two turns each wound on an iron core at right angles to each other. It will be seen that in Fig. 33 when the armature is inserted between the pole pieces *N S* that the distance which the lines of force have to pass through air is reduced to the two narrow spaces which need only be wide enough to permit the armature to revolve rapidly without allowing the coils to strike against the faces of the field magnets. Of course as the armature revolves the wires on its surface tend to fly outward and sufficient room must be allowed to provide for this. Other precautions are taken to prevent these wires, *E F*, Fig. 32, from flying outward or from moving in any way from their position. In small motors and dynamos the most common way to prevent this is to bind them down tightly to the core with a number of windings of iron or steel wire.

In larger machines it is now becoming very common practice instead of winding the wires on

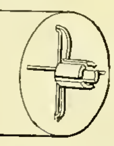


FIG. 34.

the outside of the cylindrical surface of the core, to carry them through slots cut in the iron itself, each coil, whatever the number of turns occupying a slot by itself.

Fig. 34 represents an armature thus wound. This method where the size of the machine permits has several advantages, some of which are mechanical while others are purely electrical. One of the chief advantages is that it is impossible for the wires to move and another is that the air space between the armature and the pole pieces of the field magnet may be made considerably smaller, for it is evident that the space taken up by the windings of the wire on the outside of the armature offers quite as high resistance to the magnetic flow as does that additional space which must necessarily be left for clearance.

YOUNGSTOWN STRIKE SETTLED.

The Youngstown strike was virtually settled on Monday last. The pay of the engineer at the power station, whose reduction in wages from \$2.75 to \$2.50 per day precipitated the strike, will remain at the latter figure, but he will no longer be called upon to act as chief engineer. The strikers return to work as a union, and the adjustment of wages is postponed temporarily. At a conference soon to be held it will be determined whether a reduction will be accepted. The men considered the outcome of the controversy as a victory for them.

COST OF PRODUCING ELECTRICITY.

The National Electric Light Association maintains a committee on data, who have made an effort during the past year to collect information relative to the cost of running electric stations in terms of coal consumed per watt-hour. The committee was requested to furnish the convention with the facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in amperes, volts, and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, etc. The aggregate electrical output for twenty-four hours was then calculated and compared with the total amount of fuel used, giving the watt-hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement submitted in the committee's report comprises intelligent replies from a large number of the electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly evident from the report which shows 208 watt-hours per pound of hard screenings where about 8,000,000 watts were generated, running full twenty-four hours, as against the report which claims only 30 watt-hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best reports do not compare favorably with the results secured in generating power for manufacturing purposes.

In order to facilitate this comparison, the committee prepared a table based on 90 per cent. mechanical efficiency in the engine and the same efficiency in the dynamo. Then

$$\frac{746 \times .90 \times .90}{\text{coal per hour}} =$$

watt-hours per pound of coal. And

Coal per hour per I. H. P.	Watt-hours per lb. of coal.
1.5 lbs. should produce	402.84
2 " " "	302.13
3 " " "	201.42
4 " " "	151.06
5 " " "	120.85
6 " " "	100.71
7 " " "	86.32
8 " " "	75.53
9 " " "	67.14
10 " " "	60.43
11 " " "	54.93
12 " " "	50 35
15 " " "	40.28
18 " " "	33.57
20 " " "	30.22

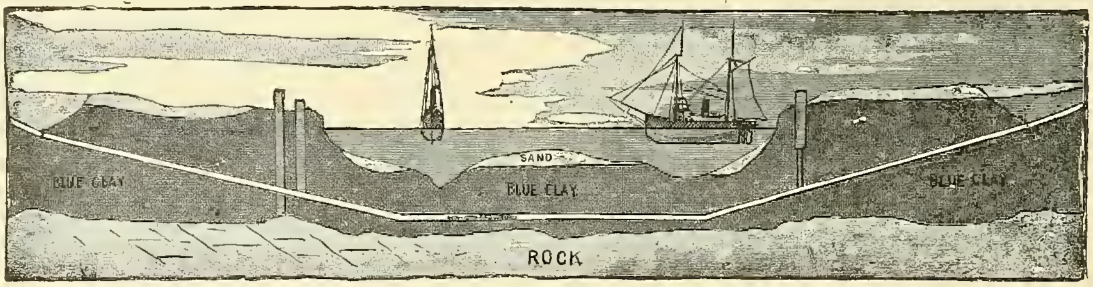
From this estimate of engine and dynamo loss, 1½ pounds of coal should produce 402.24 watt hours. The committee had a report from the Chelsea Jute Mills, of Brooklyn, N. Y., covering a period of six days, where an average of 653.3 indicated horse power was developed from a coal consumption of 1.482 pounds per indicated horse power per hour, the load varying from 495.21 to 764.96 horse power. This equipment consists of Corliss compound condensing engines and vertical tubular boilers. The plant was in operation 10 hours each day. The figures given cover the whole amount of fuel used, including banking, etc. The fuel used was George's Creek bituminous coal.

If the committee's percentage of efficiency is correct, and if a fairly uniform electrical output could be obtained, this plant ought to produce over 400 watt-hours, or double that of the most favorable report given in the committee's tabulated statement, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report. The reports show an average of 91.7 watt hours per pound of coal, a very low average indeed, thus requiring the consumption of nearly 7 pounds of coal per indicated horse power.

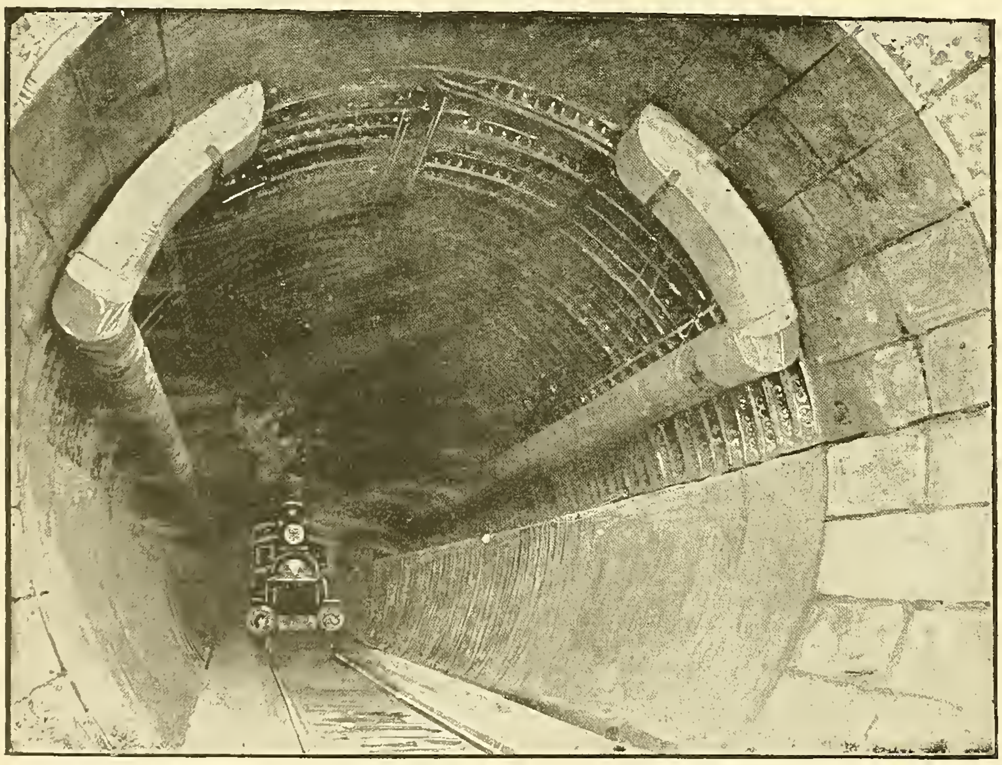
Sioux City, Ia.—The directors of the Sioux City Railway Company have decided to extend the road to Crystal Lake at the south and across the pontoon at the north end of the line.

CONSTRUCTION AND EQUIPMENT OF THE ST. CLAIR TUNNEL.

In order to establish communication between Sarnia and Port Huron, the Grand Trunk Railway Company constructed an immense tunnel under the St. Clair River, which is one of the finest examples of engineering work in this country. The length of the tunnel proper is 6,025 feet and of the portals that form the approaches 5,605 feet additional, or more than two miles in all, being the longest submarine tunnel in the world. It is a continuous iron tube 19 feet 10 inches in diameter, put together in sections as the work of boring proceeded and firmly bolted together, the total weight of iron aggregating 56,000 tons. The tunnel commenced in September, 1888, was opened for freight traffic in October 1891, and passenger trains began running December 7, 1891. Work was commenced at both ends, the two sections meeting in mid river with perfect accuracy. The tunnel passes through blue clay, except an occasional pocket of quicksand and water and a few boulders. Borings were made by cylindrical steel shells, with cutting edges driven forward by hydraulic rams. One of the accompanying illustrations gives some idea of the course of the tunnel and the steep grades on either end.



DIAGRAMMATIC SECTION OF ST. CLAIR TUNNEL.


INTERIOR OF ST. CLAIR TUNNEL.

The rails of the track rest on a bed of brick and concrete, filling the bottom of the tubing. The engines, built by the Baldwin Locomotive Works, used to pull trains through the tunnel and up the steep grade, are the largest in the world, having ten driving wheels and weighing nearly 200,000 pounds, with cylinders 22 inches in diameter, with a 28-inch stroke.

The cost of the tunnel was $2,700,000. Four thousand cars can be daily moved through it, which shows its immense superiority over the old ferry. Electric lights were employed for illumination during the construction, the plant being furnished by the Edison Company on the American side and the Ball Electric Light Company on the Canadian side.

The Great Northwestern Telegraph Company, of Canada, was obliged to carry its lines through this tunnel, and this large contract for cables was secured by the enterprising American house of W. R. Brixey, New York city. Six thousand feet of 18-conductor aerial Kerite cable was required for this purpose, and it is stated by the Great Northwestern Company that in spite of the severe test to which it has been subjected during the past two years it has given perfect satisfaction.

THE PHILADELPHIA-WASHINGTON RAILWAY.

The daily papers have had considerable to say of late about a colossal electric railway scheme which contemplated the control of the Washington lines for the purpose of making them trolley roads as part of a complete system of electric roads from Philadelphia to Washington. It was stated that the syndicate which proposed to secure the Washington lines was composed of Messrs. Widener, Elkins and other Philadephia capitalists whose names have been associated with so many alleged electric railway enterprises. It has been said further that another similar line is in contemplation west from Philadelphia as far as Pittsburg; also that the trolley road from Jersey City to Newark, and the road just begun between Washington and Baltimore, are links of the system. The story, if true, would suggest, not a consolidation of the several interests mentioned, but simply several connections bound together by either traffic agreements or trackage rights, says the *Philadelphia Stockholder*. In the first place, the road from Jersey City to Newark is owned by the Consolidated Traction Compsny of New Jersey, in which Messrs. Widener, Elkins and Dolan are interested. The next link in this alleged grand chain of electric railway, from Trenton to Philadelphia, has for its head Colonel Morrell, and in this line the Traction people have no interest; at least, they say they have none. The proposed line from Philadelphia to Baltimore exists only on paper. The line from Philadelphia to Harrisburg—part of which is already constructed—is owned by another set of capitalists, headed by ex-Senator Patterson, while the line beyond Harrisburg is similar to that between Philadelphia and Baltimore. It will be seen, therefore, that there are at least two big gaps in the alleged grand system—that between Philadelphia and Baltimore, and one from Harrisburg to Pittsburg, while a third may be also said to exist from Baltimore to Washington, although there is but little doubt that this latter line will be built. If such a system as referred to is ever constructed it will, in all probability, be simply by connecting the various lines, not by consolidating them, although in years to come there is a probability that a company, with an enormous capital, may be organized to absorb them all. For the present and immediate future, however, the "grand system" will exist only in the minds of sensational paragraphers.

CONTINUOUS USE OF CONDENSING WATER.

Walter C. Kerr, of Westinghouse, Church, Kerr & Co., writes to his firm regarding an instance of the continuous use of condensing water as follows:

The question is sometimes asked whether the water from a pond having no outlet can be used for condensing by circulating the water over and over again. Naturally the success of such a system depends upon the size of the pond, both volume and surface being factors in the determination of its efficiency. Evidently the pond must have such a volume that a given quantity of water shall remain in it the length of time necessary for the cooling effect of the total surface to abstract the amount of heat which the quantity of water received in the operation of condensing the steam. With a surface condenser the waste by evaporation would need to be supplied, while with a jet condenser the extra hot water would need to be cooled. The exact dimensions of such a pond or reservoir would need to be determined in each instance by a very careful calculation and due regard to local conditions such as temperature, climate, etc.; but it is the purpose of this bulletin merely to record a case of satisfactory operation of such a system under rather adverse circumstances.

At the Victor Cotton Mills, Charlotte, N. C., a compound condensing Corliss engine of 400 horse power is operated under a very constant load indicating 385 to 400 horse power, water for the condenser being taken from a pond about 130 feet by 180 feet and about 5 or 6 feet deep. A Knowles independent jet condenser is used, discharging the water at 120 degrees to the pond, where it cools in the hottest summer weather to 110 degrees, at which temperature it returns to the condenser. About 20 inches of vacuum is thus formed, while in cold or cool weather the temperature naturally falls, and 24 or 26 inches of vacuum is obtained. This plant is doubtless working to the limit of possibility in such practice. It was designed by D. A. Tompkins Company of Charlotte, N. C., and has been in operation several years.

Comments and Views of Contemporaries.

New York Rapid Transit.—Three years ago, as the result of a long agitation and strenuous efforts, a commission was created to give this city the means of rapid transit, which were already sorely needed. So far as practical results are concerned, the city stands now where it stood then, but with the need still more sorely felt. Yet those three years of weary waiting may still be made fruitful if we will profit by experience and if the people can get those who must act for them in this matter to do their duty.—*New York Times.*

Trolley Speed.—The highest rate of speed at which a trolley car can be safely run anywhere in the built up parts of this city is nine miles an hour. Any speed is excess of this is sure to be dangerous to human life, and nearly all the people who have been knocked down, run over or killed by the four trolley lines now in operation in this city have been the victims of higher rates of speed than the law permits.—*Philadelphia Times.*

Passengers on Platforms.—A good many people would like to understand why passengers are permitted to ride on the front platforms with the motormen. These faithful and hard working employes have about all they can conveniently attend to, without having to answer hundreds of useless and foolish questions and having their minds distracted from their important duties, often at times when their work needs their closest care. The work of the conductor is also sufficiently arduous, without requiring him to crowd through to the front platform to collect a fare. But this is not all. The nuisance is a serious inconvenience to the passengers inside the car, who often desire to glance through one or the other front windows to determine their location, so as to give the conductor warning when they wish the car stopped. If their view is obstructed, by two or three persons standing on each side of the motorman, guying that official, the passengers feel that they have a sort of a personal grievance against the company.—*Toledo Commercial.*

STREET RAILWAY AFFAIRS IN ENGLAND.

(*From Our Special Correspondent.*)

Bristol.—Probably the English provincial towns will show London the way to deal with street railway traffic upon modern and sensible plans. For instance, speaking last week at the half-yearly meeting of the Bristol Tramways Company, the president stated that the directors could safely recommend the immediate introduction of the overhead system of electric traction, otherwise the trolley wire, upon portions of their lines. The accumulator system appeared to have been tried at Birmingham where a thorough test under the best possible conditions had shown he said, that it was not only excessive in cost, but unreliable also, and not practically suited to the requirements of street railway work. The authorities at Bristol, representing the local governing bodies along nearly all the proposed lines, had expressed unanimous approval of the company's project; and this after an inspection of such lines as are at present equipped on that plan in England.

Too Tall.—Street railways are as prominent in the English law courts as anywhere, not for the purpose of allowing the proverbial carriage and four to be driven through an act of parliament, but in the humbler guise of plaintiff or defendant. The London Street Tramway Company occupied lately the latter unfortunate position, being sued by a passenger for damages incurred while mounting a car. It appears that the unlucky passenger jumped on and ascended to the roof (the car being of the usual double-deck type) just as the car was passing under a low railway bridge. Being a tall man—6 feet 2 inches high—he did not quite fit the space available, which was only 5 feet 11 inches, between roof of car and bridge girder. Result—a broken head and a solatium to the extent of $750 from the tramway company in a court of law.

Continental Lines.—Apparently the continental countries afford even greater scope for profitable street railway work than the richer districts of England and Scotland. The Leipzig Tramway Company declares a dividend for the second six months of 1893 at the rate of six per cent. per annum upon the preference shares and 5 pêr cent. per annum upon the ordinary stock. So also the Tramways Union Company pays a dividend of 7½ per cent. per annum, operating lines in Spain, Germany and Roumania. Perhaps one reason may be that employes are willing to work longer hours for less wages than they will do in England.

All Aboard.—It seems more than curious to English cars marked with the number of passengers they are allowed to carry, that is, the number they can seat. Cases are constantly being brought before the police magistrates in which the conductors of street cars are fined for permitting overcrowding; for instance, at Preston a car designed to seat 18 passengers was found to contain 21 besides 4 children. The majority of the magistrates on the bench desired to treat the conductor leniently, although one or two held out for penal servitude, the stocks, boiling in oil, or some other such dreadful fate; eventually he was let off on payment of costs. As these would come out of the company's treasury, the only punishment the man got would be of a moral nature. Fancy putting such a system to work on a route to any favorite base ball ground!

Municipal Working of Tramways.—Probably the topic of greatest interest at the present moment in the English street railway world is the question of local authorities or municipalities taking over and operating the various lines in their respective districts. The mass of opinion is clearly divided—one party claiming that municipal working is the best method of securing the most public conveniences as regards cheaper fares, quicker transit, etc., while the other side avers that private companies and responsible boards of directors will always prove more capable in every way. Both parties appear to admit the advisability of local authorities owning the street railways; the argument turns upon their operation. Of course the question is far too intricate and important to discuss in a paragraph, but so far the results of municipal working of street railways (e. g., Blackpool, Huddersfield, Glasgow and Plymouth) appear by no means favorable, however much they may improve as time goes on. The Leeds Corporation has just decided by 41 to 13 that the street railways of that town—just taken over by the corporation (including a short piece of electric line on the trolley system)—shall be hired out for operation by lease; but plenty of the rate payers are kicking against the decision.

Going Concern or Scrap-iron.—Another highly important question concerning street railways in England has already occupied the law courts for some time and is not yet done with. Doubtless it will eventually be decided by the House of Lords—the final court of appeal on legal questions, not be it understood to the general body of lords, but to those known as the "law" lords. It all turns upon the construction to be placed upon the words "the then value" which occur in the Tramways Act of 1870 or thereabouts, as to the price which is to be paid to the tramway company by the local authority if the latter should choose to exercise its right of purchase after a lapse of 14 years. Is the price to be that of a going concern, or merely the scrap value at an auction sale of the whole affair? It looks as though the men who drafted that Act of Parliament had a wish to benefit the lawyers. No one envies the lords their right to serve as a final court of appeal; their decision is bound to upset somebody. If given in favor of the tramway companies, it will probably keep back the development of electric traction for some time, except in favorable places. Most of the English tramway companies are desperately poor, with no capital for converting their lines into electric roads and unable to get credit for it, either, whereas the municipalities can borrow money at 3 per cent. any day. But they will not do it if the purchase of tramways implies paying ten or twenty years' profits as "the then value."

NEW ENGLAND NOTES.

(*From Our Special Correspondent.*)

To Carry Express Packages.—There is at the present time a bill before the Massachusetts state legislature having for its object the granting to street railway companies the right to carry express packages and merchandise on their lines. It is expected when the bill becomes a law that quite a number of companies will avail themselves of the privilege.

Improving its System.—R. S. Brown, the enterprising selling agent in the Boston office of the Westinghouse Electric & Manufacturing Company, has just closed contracts with the Springfield (Mass.) Electric Street Railway Company for a large, new switchboard, two railway generators and four complete car equipments.

Regulation of Fares.—The regulation of the rate of fare to be charged by the West End Street Railway Company and other companies operating lines wholly or partly within the city of Boston, and requiring all street railway companies to issue transfers good on all connecting cars, is the purport of two bills now before the Massachusetts State Legislature.

Rapid Transit in Boston.—The Commission on Rapid Transit in Boston, has, as is well known, reported in favor of a subway, as the best solution of a problem that is of increasing interest to the people of Boston. The estimated cost is about $5,000,000, although some authorities claim it cannot be built and equipped for less than $15,000,000, or even $20,000,000. Naturally the subject is engaging much attention and is being discussed in all its phases. There are many opponents to the scheme as well as many supporters, and each class is going to no end of trouble to prove that its views are the only correct ones. The costliness of the plan has appealed to some and they have employed financial and engineering experts to show up the fallacious statements of the commissioners. Others have undertaken to show that a subway would mean certain death from pneumonia to multitudes who would risk themselves in the cold damp air of the subway in summer time. To prove that this opposition was groundless, medical men were employed to give their professional opinion in contradiction of it; while those who desire an overhead railway have had a legislative committee visit Brooklyn, N. Y., for the purpose of inspecting the Boynton unicycle railway that is in operation there. As a result of all this discussion and difference of opinion not much progress has thus far been made, although it is a foregone conclusion that whether an overhead or an underground system be ultimately adopted electricity will certainly be the motive power.

From Brockton to Boston.—The entire electric street railway system of Brockton, Mass., and the surrounding shoe towns will soon be in the control of a wealthy syndicate which proposes, when the deal is consummated, to extend the system, and so make a connection with Boston. The two cities are twenty-two miles apart, the intervening territory being fairly well populated.

LEGAL NOTES.

Sale of Franchise.—The New York Supreme Court lays it down, that under laws 1890, c. 565, providing that the board of aldermen may consent to the sale of a street railroad franchise, where application in writing and certain publications have been made, the consent is not vitiated by the fact that the entire board was not present at the hearing on the application, but only the committee of the board to which the application had been referred. The court also holds, that (a) The consent of the board of aldermen to a sale of a street railroad franchise is not an alienation of appropriation of property of the city, within the consolidation act, (Laws 1882, c. 410.) § 80, providing that no resolution or ordinance shall be adopted, respecting the alienation or appropriation of property of the city, until an abstract thereof has been published. (b) It is a reasonable condition, on consenting to the sale of the franchise of a street railroad, for the board of aldermen to require the purchaser to deposit half of the amount necessary to complete the road, and that, if it is not completed in two years, the unexpended portion of the deposit shall be forfeited. (*Abraham vs. Meyers*—23 New York Supplement 225).

Liability for Collision.—A passenger on a street car which has been stopped at a railroad crossing to permit a locomotive to pass is not bound to be on the lookout, when the car starts, for other approaching engines; and his failure to do so is not contributory negligence which will prevent his recovery from the steam railroad company for injuries sustained in a collision between the car and another locomotive, though, if he had looked, he might have seen the approaching engine in time to jump from the car. (*O'Toole v. Pittsburg & L. R. R. Co.*, Supreme Court of Pennsylvania, 27 At. Rep. 737.)

Liability for Personal Injuries.—Where a boy, by invitation of the motorman of an electric car, was permitted to ride on the platform and steps of the car, to a certain switch, for the purpose of inducing such boy to turn said switch, and the conductor forcibly ejected him while the car was in motion, and he was injured; as the boy got upon the car by invitation, he was not a trespasser, and the company was charged with the exercise of ordinary care toward him while he remained upon the car, and the company is liable for any injury sustained. (*Hart v. West Side R. Co.*, Supreme Court of Wisconsin, 57 N. W. Rep. 91.)

Liability for Injury to Passenger.—Where horses attached to a street car on which one was a passenger became frightened, and threw the car off the track, and he, while alighting from the front platform, was injured, there was evidence that the injury was from a kick from one of the horses, and that the horses were unsafe, to the knowledge of the driver. It was the duty of the company to exercise reasonable care in selecting horses and in ascertaining whether they were safe for such use, and that any knowledge which the driver had of their disposition in the course of his employment is presumed to have been known by the company. In an action for such injuries one who drove the horses after the accident may give his opinion as to whether the horses were safe. Though the passenger was standing on the front platform of the car prior to the time he attempted to alight, this fact will not defeat his right to recover for injuries caused by a kick from one of the horses, where it appears that such standing was not the proximate cause of the injury. (*Noble v. St. Joseph & B. H. St. Ry. Co.*, Supreme Court of Michigan, 57 N. W. Rep. 126.)

Rate of Speed Allowed on Street Railways.—Street cars propelled by electricity, and running along land burdened only with the easement of a public highway, cannot be run at a rate of speed incompatible with the lawful and customary use of the highway by others with reasonable safety. (*Newark Passenger Ry. Co. vs. Block.* Court of Errors and Appeals of New Jersey. 27 At. Rep. 1067.)

Liability of Street Railway for Collision.—Where one driving in his wagon, in a broad street, with his nigh wheels in the street-car track, was met and run into by a car, the court properly charged that the car driver had a right to assume that he would turn out in time, but that, if he failed to do so, and the car driver saw it, he must do what he could to stop his car and warn him off. (*Glazebrook vs. West End St. Ry. Co.*, Supreme Judicial Court of Mass., 35 N. E. Rep. 553.)

When Negligence of Carriers is a Question for the Jury.—In an action against a street railroad company for personal injuries, the case should go to the jury where the passenger proved and the company denied that he was received as a passenger on a car which was so filled that he had to stand on the rear platform, that the platform became so crowded that he had to stand on the side step, and that the car increased its speed so that he was jolted off and injured. (*Saltzman vs. Brooklyn City Ry. Co.*, Supreme Court, General Term, Second Department, 26 N. Y. Supp. 511.)

Liability of Carriers for Injuries to Passengers.—In an action against a street car company for injuries by a passenger in alighting by a sudden starting of the car, it is competent for the company to show that, by an ordinance under which its cars were operated, no car was allowed to stop for passengers at the intersection of streets, until it had reached the further side of the street crossed, and that, when the passenger undertook to alight, the car had only slackened its speed to await a signal from the flagman. Where a street railway company adopts and publishes reasonable regulations as to where its cars shall stop for leaving and taking on passengers, the passengers are bound to take notice of such regulations. (*Jackson v. Grand Ave. Ry. Co.*, Supreme Court of Missouri, Division No. 2, 24 S. W. Rep. 192.)

Liability for Negligence.—The Supreme Court of Maryland holds, that in an action for injuries sustained by being run over by a street car, evidence that plaintiff, a cripple, stopped to look and listen for a car before crossing the street, that she saw no car approaching, and that the one which struck her came around a curve, and passed over the intervening space to the place of the accident within a minute, warrants the jury in finding that plaintiff was not guilty of contributory negligence, since one minute may not be a sufficient time to enable a cripple, who had started to cross the street, to get out of the way of an approaching car. The Court also rules, that; (a) Though plaintiff in an action for injuries sustained by being run over by a street car is guilty of contributory negligence in attempting to cross the track, the street car company is liable for her injuries, if its servants could have avoided the accident by ordinary care after seeing her on the track, or after being able, by the exercise of care, to discover her there, or approaching it under circumstances of peril. (b) Where the evidence in an action for injuries sustained by being run over by a street car shows that, when plaintiff started to cross the street, the car was around the corner and not in sight, an instruction that plaintiff was guilty of contributory negligence if a reasonably prudent person could have seen the car approaching for a distance of one block from the place where plaintiff left the sidewalk is properly refused as irrelevant. (*Baltimore Traction Co. v. Wallace*, 26 Atlantic Reporter—518).

Franchise.—The Supreme Court of Kansas holds, that where a company builds a street railway under an ordinance requiring a stated car service, an assignee, under a deed conveying all the company's rights, franchises, powers, privileges, and immunities, assumes the performance of the duties towards the public which before rested on its assignor. (*City of Potwin v. Topeka Ry. Co.* 33 Pacific Reporter—309.)

Obstructing Passage of Cars.—It is held by the Supreme Court of Wisconsin, that contractors, under a contract with a city to pave a certain street, have no power to obstruct the passage of street cars over such street during the paving of the same, where the contract gives no such power, and it is shown that such work has been, and can be done without such interference. (*Milwaukee St. Ry. Co. v. Adlam*, 55 Northwestern Reporter—181.)

Leasing Road and Franchise.—In Pennsylvania the Supreme Court decides, that an application for a preliminary injunction to restrain a city passenger railroad company from leasing its roads and franchises to a traction company, involving the question of *ultra vires*, should not be granted; such question being one of great difficulty, and of much practical importance, and it being better to pass on such question when the case is reached on final hearing.—(*Smith v. Reading City Pass. Ry. Co.*, 26 Atlantic Reporter—779.

FINANCIAL DEPARTMENT.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, of Chicago, said yesterday: The feature during the week in Philadelphia has been the demand for Philadelphia traction which has advanced 5 points with quiet buying. With the close of winter, work on its east and west lines is actively progressing and insiders say the results already shown by the north and south lines mean increased handsome earnings as the results to come. The decline in Baltimore seems over and there is evidently short stock out there that must be covered. Metropolitan has been neglected but firm. The market in Chicago cable securities has been quiet but with a firm undertone. The bonds are held so strong and at such high figures that they are no longer very tempting to investors and we look to see the public turning to the stock which will surely mean higher prices. There are evidences on all sides of returning industrial activity and the outlook for better prices is very bright.

Transfer of the Lehigh Traction.—The final act in the deal by which the Lehigh Valley Traction Company, of Allentown, Pa., buys out the Allentown and Bethlehem Rapid Transit Company, took place in New York last week, when the Transit people turned over to the Traction Company 7,000 shares of stock and $400,000 floating indebtedness and received in return a check for nearly $1,000,000 that has been lying in bank in the metropolis for two weeks. The two companies will be run independently of each other, the same as heretofore, until the connections between the two lines can be made. The same rates of fare will be as at present probably until the systems are combined, when a five cent rate to Bethlehem and the transfer system will be established.

Richmond (Ind.) Street Railway.—The Richmond Street Railway Company, already in the hands of a receiver, is in imminent danger of going under. Some time ago the Union Trust Company of St. Louis foreclosed on its mortgage, amounting to $212,000, and the court has now admitted the General Electric Company on a claim of $32,000 and the Cambria Iron Company of Johnstown, Pa., on a claim of $5,000 as parties in the suit. Besides these, the City of Richmond will endeavor to collect an indebtedness of $15,000. The road, of which John F. Miller, superintendent of the western system of the Pennsylvania, is president, it is estimated, will not sell for half the indebtedness.

Fort Worth Receivership Continued.—Judge W. D. Harris has decided not to authorize a termination of the North Side Street Railway receivership for the present. The property is admirably managed and is beginning to make money, and for this reason he feels that the interests of all parties concerned would be best served by continuing the receivership until next May at least.

General Electric Annual Meeting.—The annual meeting of the General Electric Company will be held at Schenectady, N. Y., Tuesday, April 10, at 12 m. Transfer books close to-day and reopen April 11.

Kansas City (Mo.) Cable Earnings.—The Kansas City Cable Ry. Co. reports for February gross earnings of $28,443; operating expenses $22,875; net $5,568.

Boston, Mass.—The Street Railway & Illuminating Properties last week invested $200,000 in preferred shares of the company at an average price of $84.94.

New York, N. Y.—Manhattan has declared its regular quarterly dividend of $1\frac{1}{2}$ per cent., payable April 2.

New Incorporations.

Chicago, Ill.—The Chicago Central Sub-Railroad Company has been incorporated. The incorporators are: Marcus Pollasky, Morris Messinger, William N. Northrup, Chicago; William H. Llewellyn, of Seattle, Wash., and A. M. Low, of Detroit Mich. The object of the company is the building of a four-track underground railroad beneath the streets in the business district as a loop for the elevated roads. The territory to be pierced by the tunnels is given in the papers and authority to issue $15,000,000 of capital stock is asked.

Pinckneyville, Ill.—The Pinckneyville Street Car Railroad Company has been organized; capital stock, $4,000; incorporators, Herman C. Henke, Philip Groner, Henry Driemeyer, H. P. Huntsinger and W. K. Murphy.

NEWS OF THE WEEK.

Providence, R. I.—Previous to the first of August the Union Railroad Company had in operation but 12 or 15 miles of electric railway. It now has an extensive system of nearly 100 miles in operation, covering not only the entire city of Providence but much of the available territory round about it. The work of construction under the contract with the Woodbridge & Turner Engineering Company, of the Times Building, New York, was begun about the first of July, and during the summer and autumn over 75 miles of overhead line work was completed ready for operation. About one-half of the line is constructed with iron poles, being mainly of the lattice type, though a considerable number of Walworth poles have also been used. On the remainder of the line there is both span and bracket construction. Georgia pine poles are used throughout. The line construction embodies all the latest and best features in this class of work, the line equipment being furnished in part by A. & J. M. Anderson and in part by the General Electric Company, by whom the entire motor and generating equipment was supplied. The feeder lines are run on the poles, there being over 80 miles of feeder wire on the whole system, mostly 500,000 C. M. wire. The lines radiate in all directions from the central business sections of the city, reaching to the towns of Riverside, Rumford, Pawtucket, Centerdale, Auburn, Cranston, Olneyville and Lakewood. The work of construction was entirely in the hands of Superintendent Elmer Bell, of Woodbridge & Turner, and was pushed vigorously through to completion, so that the whole system was practically ready for operation by the middle of November.

Site of the New Johnson Steel Works.—Hon. Tom L. Johnson and representatives of the Johnson Company have been hunting for a site on which the new works will be erected. Mr. Johnson was quoted by a Cleveland paper as saying: "No decision will be made until the entire territory in this region has been inspected. The Chamber of Commerce committee has laid before Mr. Moxham and myself plans of a number of pieces of land within a short distance of Cleveland and we are looking them over as we get opportunity. I should prefer that we locate in Cleveland or near enough so that our main office would be in Cleveland, but circumstances will decide the question. If we are within twenty or twenty-five miles of the city, we are practically a part of it and the city will be benefited by the business about as much as though the works were within the city limits."

Detroit.—In the much litigated case of the city against the Citizens' Railway Company Justice David J. Brewer, of the United States Supreme Court, has issued an order superseding Judge Taft's decree, and he has furthermore stayed the injunction ordered in the decree, and an order will be entered protecting the railway company in the occupancy of the streets pending the appeal. This means that the city's hands will be tied for two or three years. Judge Taft has issued a similar order, but the Supreme Court's order supersedes the circuit judge's, so that even if a decision is given on the case in the Court of Appeals during this year, the city will be unable to take advantage of it.

St. Louis, Mo.—Councilman Clark has introduced an ordinance making it a misdemeanor for minors under the age of 18 years to jump on or off a street car while in motion. The bill is very brief and makes the offender subject to a fine of not exceeding $10 for each and every offense. This is aimed primarily at newsboys and gamins who make it a practice of hanging on the platform of the cars and jumping off while they are in motion. It would also exempt the railroads from a great many damage suits, as minor persons injured while getting on or off a car in motion would be debarred from suing, as they were committing an unlawful act at the time.

New York, N. Y.—The employes of the Steinway Street Railway Company, whose road runs to Steinway, L. I., struck on Thursday because their wages had been reduced. The men made every effort to interfere with the operation of the line. They cut the trolley wires and tore up the track in some places; in others blockading the road with wagons, paving stones, and other obstructions. Assistant Superintendent Cosgrove received a severe scalp wound from a pistol shot fired into the office of the company. The directors called upon Mayor Sanford and asked him to act as an arbitrator in the dispute between the company and its employes. He agreed to do so and thereupon the men returned to work.

Washington, D. C.—By invitation of the district commissioners the presidents and managers of the street railway lines in this city, which use mechanical motive power, met with them last week to talk over the matter of using fenders on the cars of their lines. They seemed to agree that the best device it is possible to obtain to save life and limb should be used on all cars propelled by mechanical motive power. The result of the conference was that the Eckington and Soldiers' Home line will equip one of its cars with the Pittsburg fender and the Rock Creek line is to use one to be recommended by Engineer Commissioner Powell. These fenders will remain in use several days, so as to give a practical demonstration of their worth.

Chicago, Ill.—Mayor Hopkins has vetoed the ordinances giving to the Chicago City Railway Company the right to adopt an electric system for most of its roads on the south side now operated by horse power. He held that the ordinances do not contain such provisions as "are absolutely necessary to guard the interests of the people." The city council reconsidered the measures and temporarily postponed action on them. Mayor Hopkins also vetoed the ordinance authorizing the North Chicago Electric Railroad Company to construct a street railway on the North side.

Philadelphia, Pa.—A bill in equity was filed last week in the United States Circuit Court by Wm. M. Schlesinger for himself, and as trustee for Susan E. McDuffee and Alfred H. Williams, against the Philadelphia Traction Company and the Westinghouse Electric & Manufacturing Company, alleging infringement on patents. The court was asked to restrain the defendants from using patented improvements in electric railways, the exclusive rights to which are claimed by the plaintiffs.

Kansas City, Mo.—President A. A. Pearson of the Merriam Park, Rosedale & Kansas City Electric Railway Company has filed a petition with the board of county commissioners of Wyandotte county, asking a franchise for the operation of the company's proposed electric street railway line. The company asks a right of way along the Southwest boulevard from the state line through Rosedale and to the Johnson county line. The board will take action on the petition at the April meeting.

Gettysburg, Pa.—The Gettysburg Electric Railway Company which was forced to abandon work on the battlefield last June for want of money, and which was almost in a receiver's hands two weeks ago, this week put a gang of men to work in the "Valley of Death" to blast out the rocks just where work was left off last year. The company claims the road will now be finished.

Penny-in-the-Slot Ticket Machines.—The "penny-in-the-slot" apparatus has been arranged to deliver tickets on the Berlin Elevated Railroad. There are tickets for two classes and of different rates for different distances on the road, but the apparatus supplies only second-class 15-pfennig tickets. Two 10-pfennig pieces are put into the slot, and a ticket and a 5-pfennig piece supplied in exchange.

Chicago, Ill.—Mayor Hopkins has received a communication from the Chicago General Street Railway Company offering to coöperate in any action looking to the establishment of a 4-cent fare rate in the city. The company also offers to co-operate in any action of the council in amending the street car ordinance making the license fee equal to 1 per cent.

Boston, Mass.—Mr. Henry M. Whitney says the report that he may again assume the presidency of the West End Street Railway is absolutely without foundation. Mr. Whitney has no desire for the office, and on the other hand the present directory is perfectly satisfied with the management as it now stands.

LaSalle, Ill.—The electric street cars in this city and Peru started running on schedule time last Monday morning, the strike having been declared off. A compromise was effected, by which the motormen will work two hours a day longer, the company agreeing to an advance in wages of $5 per month.

Chicago, Ill.—It seems to be settled that the first extension of the line of the South Side Rapid Transit Co. will lead to the stock locks. The company is ready to build when the right of way is secured and presented to it by property owners who are clamoring for the construction of the extension.

San Antonio, Tex.—Leonarda Garza and S. P. Maury and wife have filed a petition asking for the appointment of a receiver for the Crosstown Street Railroad Company, alleging that the affairs of the corporation have been mismanaged. The track is only one mile long and only one car has been run to hold the franchise.

Baltimore, Md.—The storage shed of the Baltimore City Passenger Railway Company, on Hartford road, west side, near the stables of the company, was destroyed by fire March 10. The building was a two-story frame one, 16 by 80 feet. The loss nets about $500, which is covered by insurance.

Chicago, Ill.—The Lake Street Elevated railroad has been accepted by the company from the construction company. At the present time trains are run as far west as West 48th street.

Chicago, Ill.—Judge Gibbons has vacated the injunction which prevented the Lake Street Elevated Railroad Co. from building its line between West 48th St. and West 52nd street.

Dayton, O.—The Dayton City Railway Company has purchased for $15,000 a site for its power house situated on the west side of the Miami river near the C. H. & D. tracks.

Elizabeth, N. J.—The Consolidated Street Railway Company has been granted a franchise for overhead construction and will commence work at once.

Chicago, Ill.—The Chicago General Street Railway Company has purchased for $15,000 two acres of land in Lawndale as a site for its car barns.

Holyoke, Mass.—The city council has granted a franchise to the People's Street Railway Company. The proposed line is to be 9¾ miles in length.

Chicago, Ill.—The Illinois Steel Company will start the South Chicago plant next week, giving employment to 2,000 men.

Springfield, Mass.—The Springfield Street Railway Company will extend its Liberty street line to Chicopee Falls.

PERSONAL.

E. B. Kittle formerly with Northwest General Electric Co., has been engaged to look after the motor business of the Interior Conduit & Insulation Co., in New England, and will make his headquarters in Boston with Messrs. Pettingell, Andrews & Co. The Lundell motor is already well known and Mr. Kittle will devote his entire time to increasing its popularity.

Col. J. H. Shay, representing the Charles Munson Belting Co., of Chicago was in New York last week and returned to Chicago with several nice orders.

J. H. Carson, of the Sterling Supply & Manufacturing Company of New York, was a Chicago visitor this week.

Francis B. Badt has opened an office as electrical engineer and manufacturers' agent at 1215 Monadnock Building,

E. I. Robinson of the Laclede Car Co., St. Louis, was in New York this week and reports business good.

Charles Wilson, Minneapolis representative of the Babcock & Wilcox Company visited Chicago this week.

J. A. Hannah traveling representative of the McGuire Manufacturing Company was in Chicago this week.

Thomas Lowry, president of the Twin City Rapid Transit Company of Minneapolis, was in Chicago this week.

W. J. Cooke of the McGuire Manufacturing Co., Chicago, visited New York last week.

TRADE NOTES.

Berlin Iron Bridge Company's Orders.—The iron work for the extension of the E. W. Bliss & Co.'s foundry building, at Brooklyn, N. Y., will be furnished by The Berlin Iron Bridge Company, of East Berlin, Conn. The Calumet & Hecla Mining Company has placed the order for a new iron building with the same company. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The New Jersey Zinc & Iron Company, at Newark, N. J., has placed the order for the iron roofs on its new buildings with the same company. The furnace room will be 50 feet wide and 400 feet long, made entirely of brick and iron. The engine room, fan room and boiler room will be 60 feet wide and 187 feet long, the engine room covered with slate, and the fan room and boiler room covered with corrugated iron. The Philadelphia Gas Improvement Company, of Philadelphia, Pa., has placed the order for the iron roof over its new coal shed with the Berlin Company.

The Beardsley Manufacturing Company, of 234 Lake Street, Chicago, is making what is claimed to be a high grade oil paper and cloth for use as an insulating material in winding and repairing armatures, fields, converters, or electric coils of any kind. The manufacturer claims that it is water, acid and gas proof and that it will resist the highest voltages used. It is made in sheets 21 by 30 inches and will not tear or crack by being folded or formed to the wire or work. All who have tried it speak well of it as a handy, cheap and efficient insulating material for the purposes intended.

Ford & Bacon is the title of a new firm of consulting and constructing electrical engineers whose headquarters are in the Philadelphia Bank Building, Philadelphia, Pa. Frank R. Ford is well known throughout the west through his connection with the interests of the Brush and Short companies, and more recently he has acquired an eastern acquaintance through his association with the La Roche Electric Works of Philadelphia. Geo. W. Bacon, the junior member of the firm, formerly had charge of the Wightman shops of Scranton, Pa. The new firm will make a specialty of street railway work.

The McLean Armature Works, of Chicago, report that business is decidedly good. The company rewinds and repairs armatures, transformers, etc., of any make, and its customers are street railway companies, lighting and power stations and isolated plants throughout the whole country. Being especially equipped for this work and employing a regular corps of expert winders, they guarantee prompt service and first-class work.

Messrs. Cushing & Morse, of Chicago, western agents for Day's Kerite wires and cables, say that business is improving rapidly with them. During the past few days they have received several first-class orders for wire and cables from various western points. They predict an unusually large business this season.

T. McCoubray, of New York, has invented a system of telephone inter-communication designed for use in warehouses, stores, mills and large plants of every description. It may well be adapted for the use of street railway companies in certain departments. Mr. McCoubray, who was formerly secretary of the National Electric Light Association, may be addressed at P. O. Box 34, New York City.

The Laclede Car Company, of St. Louis, Mo., has issued a new catalogue for 1894. No effort has been made to present unusual styles or designs but only such as have come to be looked upon as standard types in the larger cities. Full page illustrations are presented of more than 50 cars in use in large cities. Dimensions are given in each case. The Laclede truck is also described and illustrated.

The Davis Car Shade Company, of Portland, Me., has issued a new 16-page catalogue giving more than 20 illustrations of its automatic rolling shades for street railway cars and similar purposes. The company is represented in the West by J. M. Denniston whose office is in the Monadnock Block, Chicago.

Walter S. McKinney, 225 Dearborn St., this city, reports that among the recent orders received is one of six horizontal tubular boilers, 60" diameter by 20 feet long, with breeching, and an iron stack 70" diameter by 70 feet high from the Marinette Iron Works Co., West Duluth, Minn., to be erected at New Orleans, La.

New Catalogue.—The Berlin Iron Bridge Company, of East Berlin, Conn., has issued a new catalogue of over 300 pages illustrating and describing iron buildings for machine shops, foundries, rolling mills, casting shops, electric light and power plants—in fact all classes and kinds of manufacturing buildings.

Wallace & Sons, proprietors of the brass and copper rolling mill at Ansonia, Conn., with warehouses at 5 Reade street and 29 Chambers street, New York, have made a settlement with their creditors, and the receivership has been discontinued.

The Demand for Dermaglutine Pinions is reported by the manufacturers, A. Groetzinger & Sons, of Allegheny, Pa., as increasing upon all sides. Their shop is working full time to satisfy the wants of the trade

Westinghouse, Church, Kerr & Co. have removed their New York offices from 15 Cortlandt street to the Havemeyer Building.

RECORD OF STREET RAILWAY PATENTS.

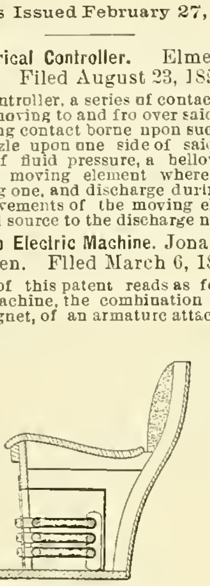
Patents Issued February 27, 1894.

515,374. Electrical Controller. Elmer A. Sperry, Cleveland, O. Filed August 23, 1893.

In an electric controller, a series of contacts, an element of the controller moving to and fro over said series of contacts, a co-operating contact borne upon such element, an air-discharge nozzle upon one side of said co-operating contact, a source of fluid pressure, a bellows, means connected with said moving element whereby said source shall inhale during one, and discharge during the other of the to and fro movements of the moving element, and a duct from the said source to the discharge nozzle.

515,386. Dynamo Electric Machine. Jonas Wenstrom, Orebro, Sweden. Filed March 6, 1893.

The first claim of this patent reads as follows: "In a dynamo electric machine, the combination with the two poles of a field magnet, of an armature attached to one of



NO. 515,401.

said poles and having a continuous uninterrupted surface adjacent to the air gap, and a keeper of solid magnetic material revolving in the air gap between the said armature and the other pole."

515.396. Tramway Switch. Simeon L. Cole, Brooklyn, N. Y. Filed April 26, 1893.

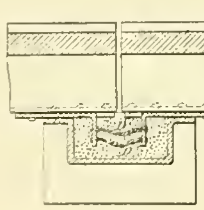
This is a tramway switch having its switch-tongue pivoted between its ends as a lever of the first class, in combination with a car having a switch-shifter dependent from its front end, movable downward at will to engage the tongue, and constructed to bear against the after-arm of the tongue to throw the switch.

515,401. Electric Heater. Austin S Hatch, Windsor, Canada, assignor of one-half to Stephen J. Martin, Detroit, Mich. Filed March 27, 1893.

In an electric heater, the combination with a casing of a face plate thereon having an open base and an apertured upper portion, a series of open, rectangular insulated frames arranged one above the other and out of contact, and each connected to the face plate at a point between the open base and apertured upper section, and a heat developing conductor wound spirally around the frames, the respective spirals being out of contact with each other. (See illustration.)

515,431. Railroad Track. Moses G. Hubbard, Chicago, Ill. Filed October 11, 1892.

This invention covers the hollow sheet-steel tie, the lower portion of which is constructed approximately in



NO. 515,478.

the form of a half circle and the upper portion of which is flat, or nearly so, and continuous and connected to the lower portion by small curves, adapted to afford vertical elasticity.

515,448. Fixing Electric Conducting Wires to Insulators Supporting Same. Rudolph Schomburg, Berlin, Germany. Filed March 29, 1893.

One of the claims of the patent reads as follows: "In combination with the insulator adapted to receive and support the line wire, the clamp device also carried by the insulator and movable toward and from the same and the operating means carried by the insulator and connected to the clamping device, said operating means consisting of the bolt passing through the insulator and having eccentric disks at its ends."

515,467. Armature for Electric Machines. Waldemar Fritsche, Berlin, Germany. Filed July 1, 1893.

This is an armature for machines of the class described comprising a hub, a core built up of a series of interspaced elements arranged radially on said hub, and conductors contained in the spaces between the elements, and arranged parallel with the longitudinal axis of the core.

515,478 Bond for Electric Railways. Julius Meyer, New York, N. Y. Filed October 21, 1893.

This is the combination of the rail-ends, a supporting shoe provided with a central trough closed at the ends, metallic plates interposed between the base of the rails and the shoe, said plates being provided with downwardly bent lugs, bonds connecting the lugs of the plates, bolts connecting the rail-ends with the bond-plates and shoe, and a filling of plastic insulating material run into the trough of the base-plate, so as to inclose the lugs and the bonds. (See illustration.)

515,555. Car Brake. Henry H. Sessions, Chicago, Ill., assignor to the Pullman Palace Car Company, same place. Filed December 18, 1891.

The fourth claim of this patent reads as follows: "In means for operating car brakes, the combination with the brake shoes and their actuating lever, of friction gearing mounted upon the car axles and adapted to be locked therewith, a flexible connection between the friction gearing and the brake actuating lever, a link or rod for actuating the friction gearing, and a brake rod operatively connected to said link and said brake rod being divided at the car roof and having its members geared together."

515,563. Bushing for Drums or Pulleys. John Walker, Cleveland, Ohio. Filed November 11, 1892.

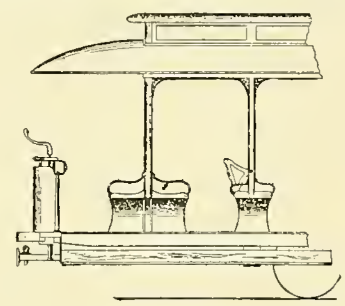
This invention covers a combination with the hub of a drum having a key seat therein of uniform width, a bush in halves or sections having at the point where two sections come together, a tapering key seat and a key adapted to fit both seats.

515,567. Street-Car. Thomas H. Wickes, Chicago, Ill., assignor to the Pullman Palace Car Company, same place. Filed September 27, 1893.

This is a car having its end walls provided with removable and interchangeable bulk heads, one of which is constructed to receive doors to adapt it for a closed car and the other of which is adapted to contain sashes or panels to provide a closed end wall for an open car. (See illustration).

515,572. Conduit Electric Railway. Joseph A. Cassidy and William A. Butler, New York, N. Y. Filed August 24, 1892.

This covers in combination with a car, an electric contact bar adapted to operate contact levers arranged within a conduit and to thereby electrically communicate with an



NO. 515,567.

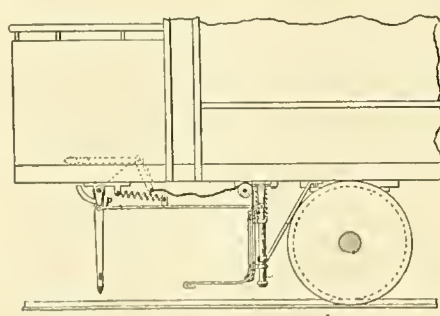
electric conductor, toggle mechanism connecting said bar to the car, and means for operating the toggle mechanism.

515,581. Safety Car Fender. William S. Fowler, Baltimore, Md. Filed September 27, 1893.

This is a safety fender for street cars comprising rigid pendent rod; a fender attached loosely to and vertically movable on said rods and provided with a projecting lip; springs on the pendent rods serving to force the fender downward; a pivoted latch having a liphook to engage the lip on the fender, a pendent swinging-frame forward of the fender; and a rod attached to the pivoted latch and operated by the swinging frame to release it. (See illustration.)

515,588. Safety Attachment for Street Cars. Henry A. Howe, Albion, assignor to himself and Joseph Norwood, Brooklyn, N. Y. Filed August 26, 1893.

This invention covers the combination with supporting brackets upon the car platform, of a safety guard having a back bar, another bar connected therewith and extending



NO. 515,581.

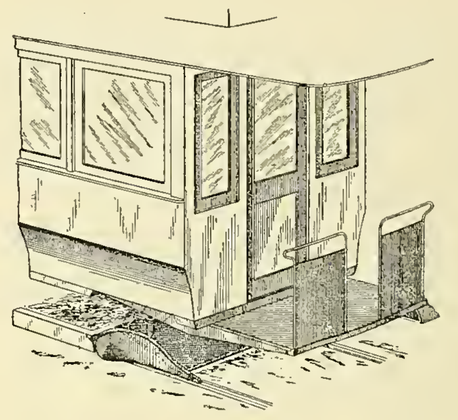
down and across and forming the sides and front, a rubber rim or cushion upon the outer faces of the bar and connected therewith, and a lattice or filling between the bars and pivots for connecting the safety guard to the brackets.

515,609. Street Car Fender. Walter W. Peay, Toronto, Canada, assignor to John Henry Banes, same place. Filed May 6, 1893.

This is a mold board shaped foot attached to the end of a vertical spring actuated spindle below the car in front of the wheel, in combination with a spring actuated brush on the rail behind the mold board, said brush being actuated independent of the foot. (See illustration.)

515,616. Air Brake Apparatus. Moses L. Rothschild, Chicago, Ill., assignor to the Genett Air Brake Co., of Illinois. Filed August 4, 1892.

One of the claims of this patent reads as follows: "In an air brake mechanism, the combination with an air compressor of the type whose operation is controlled by air pressure, of a regulating reservoir connected with the discharge port of said compressor, a car reservoir for com



NO. 515,609.

pressed air, an air brake cylinder, and means, substantially such as described, whereby said compressed air reservoir may be connected either with said regulating reservoir or said air brake cylinder."

515,617. Air Brake System. Moses L. Rothschild, Chicago, Ill., assignor to the Genett Air Brake Co. of Illinois. Filed December 6, 1892.

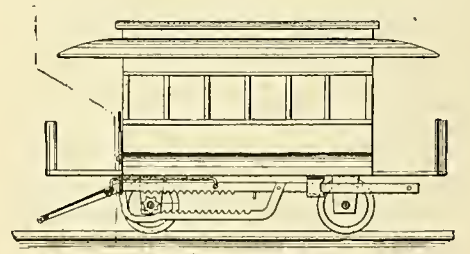
The claims made are as follows: "The combination with an air compressor, a regulating reservoir, a car reservoir for compressed air, connections between said reservoirs, and an air brake cylinder, of a valve consisting of a shell having four ports formed in its bottom, the first connected with the air compressor and regulating reservoir, the second connected with the car reservoir, the third connected with the brake cylinder, and the fourth opening into the air, and a rotary disk or plate having the bottom surface provided with a series of grooves adapted to connect the second named port with either the first or third, and to connect the third port with the fourth, or to isolate all of said ports from each other."

515,654. Electric Railway. Benjamin F. Comstock, Decatur, Ill. Filed April 13, 1893.

In a trolley railway, the combination, with a double track and the electric cars adapted to run thereon, of a single trolley wire, and trolleys provided with rollers and pointed plates carried by the cars and adapted to run upon and pass each other on the single trolley wire.

515,692. Car Brake. George W. McKenzie, Thomas C. Sloane and Moses B. Sloane, Beaver, Pa. Filed November 15, 1892.

This invention comprises in a brake, a winding shaft, two toggle links pivoted thereto and carrying brake shoes,



NO. 515,728.

two toggle links pivoted to the first-named links, a winding chain connected to the second pair of links, and a spring interposed in said chain.

515,728. Fender for Street Car. William H. Brock, Brooklyn, N. Y. Filed September 26, 1893.

This is the combination of a car, a fender movable longitudinally of the car, actuating devices for such fender, operative by the car axle, the fender in its normal inner position being out of engagement with the actuating devices and being movable inward beyond such normal position, and trip devices serving automatically to shift the fender into engagement with its actuating devices, when the fender is moved inward beyond the said normal position. (See illustration.)

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CONTENTS.

Reduction of Car Speeds. A bill to limit the speed of electric cars to six miles an hour in large cities has been introduced in the New York legislature, but street railway managers throughout the State seem to have little fear that the measure will become a law. They believe that the protest of property owners, and, in fact, of the public generally, will be so vigorous that the lawmakers will hesitate to pass the bill. There is a great deal of fault found with present trolley speeds in certain newspapers, especially in New York and Brooklyn, but few people condemn the rapid service that trolley cars furnish; in fact managers everywhere report that their passengers not only do not complain of the rapid rate at which cars travel but are even insisting that schedule time be reduced. A proposition to reduce the speed to that of horse cars would be laughed at as preposterous by 99 out of every 100 patrons of electric railways.

Some Large Orders. That capital is still ready to back both new and existing street railway enterprises, whenever an improvement in the general business situation will warrant the investment of money in any important undertaking, is quite evident from the recent placing of a number of large contracts, principally in the East. One company reports an order of 75 trucks for Cincinnati, another an order of 80 motor equipments for Brooklyn, another of 150 motor equipments for Boston, and in addition to these and others of nearly as much importance, a contract has just been placed amounting to $12,-000,000 for the complete construction and equipment of 100 miles of new railway in and around Brooklyn. The placing of $2,000.000 in bonds on a western plant is also reported, and a Pennsylvania system has just changed hands for a consideration of $3,000,000. Appearances certainly indicate that the small returns in prospect for money invested in steam roads is influencing capitalists to prefer investment in street railway stocks and bonds.

Drawing Room Cars. If reports are true the new electric railway project in Brooklyn is to be carried out along enterprising lines. One of the features to be introduced by the Nassau Electric Railroad Company, the new corporation that has just let the contract for building 100 miles of new electric railway line in Brooklyn, is the use of drawing room cars, the interiors of which will be finished in a much more luxurious style than has been customary in street car service. They are to be fitted with easy upholstered chairs in winter, and cane chairs in summer. Double fare will be charged for transportation in these cars and no more passengers will be admitted than can be accommodated with seats. It is not proposed to run these cars except in connection with one or more cars of the ordinary type of construction, so that it will always be possible for a passenger to take his choice of the ordinary car for a five-cent fare or the drawing room car at double that amount. In other words the company proposes to run first and second class cars, very largely as an experiment to see if the public cares enough for a better service to pay what it is actually worth. As some of the new lines of the company run out into suburban and seashore towns these long runs will afford special facilities for a trial of cars of this kind. It is worth mentioning in this connection that the company also proposes to introduce another innovation in its construction by using electrically welded joints for its entire system.

Telephone and Railway Wires. During the last two years comparatively little has been heard of controversies between telephone and electric railway companies, but a decision which is presented elsewhere in this issue indicates that litigation of this kind has by no means died out. The suit in question was instituted against a Nashville railway company whose wires were alleged to interfere with the circuits of the local telephone company. The allegations were all of a character familiar to those who have followed the progress of suits of this kind, but the decision is not of the ordinary character. The lower court decided against the railway company, and the supreme court has just affirmed the finding. The position which it assumes is of great interest to all companies whose circuits may be complained of by telephone companies. The court holds that while by reason of the operation of the railway system the complainant was forced to make changes in its wires at a considerable expense, it was not its legal duty to protect itself, but it devolved upon the railway company to refrain from causing injury. If the latter company forced the complainant to expend money in self protection it was bound to compensate the company for its expenditure. Judgment is therefore given the telephone company for an amount to cover the cost of its purchase of new poles and wire for a common return. Such a decision as the court apprehends may be productive of a considerable number of suits, but the inconvenience and expense of the litigation are held to constitute no defense.

A Profitable Investment. In view of the large amount of street railway construction that has been done in the past few years in a more or less hap-hazard way, it is well worth careful consideration that the economy of a plant depends as much, if not more, upon the character of its original design and construction as upon the care exercised in its subsequent operation. It is a fact to be regretted, of course, but a fact nevertheless, that many plants have been constructed and are now in operation that can never be made economical in the highest sense, simply because of their bad design and faulty construction. A good round sum spent in securing the services of a competent engineer cannot fail to save many times that amount, both in the cost of construction and in the subsequent expense of operation of even a small street railway plant. The refusal to spend money for engineering advice is most emphatically one of the cases where economy, so-called, does not pay. The street railway companies' experience in this respect is not essentially different from that of the steam roads, many of which have failed to pay any return upon their investment. When this state of affairs becomes apparent, the engineer is called in, and upon brief examination, readily points out that a sufficient percentage of the operating expenses might have been saved to pay a good dividend if the line had been built under good engineering advice. A reference to our directory of consulting engineers will show that there is no difficulty in obtaining the services of competent men to direct the design and construction of street railway plants.

Underground Feeders. The question of placing all feeder lines underground is just now receiving a great deal of attention in Boston, where an effort is being made to force the West End Street Railway Company to transfer all of its overhead wires except the trolley lines to underground conduits. In that city the bulk of the telephone and telegraph wires are now buried and some interested parties are endeavoring to make the electric light and street railway circuits go into the same or similar conduits. This proposed change from aerial to underground feeders means a very heavy expense—much more than would be supposed—in the case of a road operating such a system as that of the West End company. According to its last annual report, that company has 377 miles of feeder lines for its 182 miles of electrically equipped track, or an average of a little over two miles of feeders per mile of track. Its financial statement shows that more than $157,000 was expended during the year 1893 in the erection of new feeders for new lines and the reinforcement of existing circuits. It is thus seen that the question is of considerable importance from a financial point of view, and it is worth considering whether after all it pays to invest money in a kind of construction, that, at the whim of the public, the company may be compelled to abandon almost immediately, because of dangers, that, whether they exist or not, are supposed by the public to be necessary accompaniment of the construction to which they object. Street railway managers in large cities are watching with interest the contest between the street railway company in Boston and the perennial advocates of buried wires.

WALKER COMPANY SUED BY JOHN WALKER.

John Walker, who recently retired from the position of general manager of the Walker Manufacturing Company, has brought suit against the company for $38,981.01. Mr. Walker asserts that he is the owner of patents on improvements on differential drums, struts and other appliances for cable railroads. He says that he regularly obtained letters patent on the improvements in question, which are now on record. He claims that the Walker Manufacturing Company has made and sold the appliances and that the amount named is due him by way of royalties The material upon which the suit is based was obtained, so it is claimed, from the company's own books. A long list of alleged sales is attached to the petition. A list of 428 interrogatories, which the company's treasurer is called upon to answer, is also attached. The questions have to do with the making of the appliances and their sale, as well as other matters relating to the same.

SUIT AGAINST THE INDIANAPOLIS CITIZENS' RAILWAY

The city of Indianapolis has brought suit against the Citizens' Street Railroad Company of that city, for an injunction restraining the latter from further use of the streets. The proceeding is based on the allegation that the franchise once granted to the company expired on January 19. It is held that inasmuch as the city has exclusive power by statute over all streets and highways, that when it grants a franchise for a fixed term it practically makes a lease of the use of the streets for that time, and that upon the expiration of such a franchise the city has the same remedy against a street car company, under certain limitations, necessary for the protection of the interests of the public, that a landlord has against a former tenant who holds over after the expiration of a lease.

In this suit the original thirty years' franchise is cited, together with the attempted transfer of the remainder of the unexpired term of franchise to a new company. It is alleged that the city, upon the expiration of the thirty years' franchise, or lease, on January 19, 1894, demanded possession of the streets upon which the company was operating, but that the company refused to deliver possession and now holds over wrongfully. The complaint avers that the charter granted by the State conferred no right upon the company to the use and occupancy of the streets of the city, but by the act of June 4, 1861, the exclusive control of the streets was vested in the municipality, and its sanction was necessary to the occupancy of the streets.

It is alleged that the company recognized this, and very soon after securing the charter secured a franchise from the city for a fixed term and period of thirty years. After setting out in full the ordinance granting the franchise the complaint charges that the sale of the company in 1888 was ultra vires and therefore illegal and void. Then the ordinance ratifying the sale is set forth, with the ordinance of 1889 granting the company permission to use electric power. A last paragraph avers that the company, recognizing that its charter expired at a definite period, at various times after April 23, 1888, and prior to January 18 of the present year attempted to have its franchise extended. The city asks that its title to the streets be quieted against the company, and that the latter be enjoined from further operating its street car system. Further, that it be required to surrender full possession of the streets of the city and that a judgment for damages, by way of rental from January 19, 1894, be rendered in favor of the city. The complaint asks that the rental be rated at $250 a day.

MARCH MEETING OF THE MASSACHUSETTS STREET RAILWAY ASSOCIATION.

At the regular monthly meeting of the Massachusetts Street Railway Association 21 members were present. Mr. G. E. Cutler, of New York City, read an interesting paper on Insurance Risks and Accident Insurance in general. The paper was well prepared and the members present were much pleased with it. The subject was referred to the executive committee for further investigation. The same topic was also assigned for further discussion at the next meeting of the association on April 5. The latter part of the evening was devoted to a discussion on car wheels and brake shoes, in which W. W. Sargent, of Fitchburg, B. F. Weeks, of Quincy, R. F. Goff, of Fall River and E. C. Foster, of Lynn, took part. Overhead construction will be the subject for discussion at the next meeting in addition to the question of insurance.

SALE OF THE NASHVILLE UNITED ELECTRIC ORDERED.

Judge Lurton, of the United States Circuit Court, has issued a decree ordering the sale at auction of the United Electric Railway of Nashville, Tenn. The decree provides that as the company has defaulted in its interest on the first mortgage bonds which are a valid mortgage on all properties covered by it and on the income bonds, which are a valid mortgage on the extensions covered by the second mortgage, unless within ten days it pay to Master Commissioner H. M. Doak, money enough to defray costs of the cause, compensation and expenses of the receivers, enough to pay the taxes due, enough to pay past due interest, and and principal and past due interest of all bonds, then the road shall be sold to the highest bidder.

The terms of the sale are as follows: First, the rights, franchises and assets covered by the first mortgage bonds; second, that covered by the income bonds; third, the property not covered by any of these mortgages. The day of the sale is to be named by Master Commissioner Doak, and advertised for four weeks. Every bidder must deposit $25,000 as evidence of good faith, to be returned to all except the successful bidder, who shall have it credited on the purchase. Except the costs of the receivership the purchase money is to be paid in six, twelve, eighteen and twenty-four months. The purchasers are to take possession on confirmation of the sale. The funds realized from the sale are to be kept separate and applied pro rata to the expenses of the receivership, past due interest, debts for supplies and materials, then to the payment of the bonded debts of the respective companies.

EARNINGS OF THE LIVERPOOL OVERHEAD RAILWAY.

A shareholders' meeting of this company was held February 13. and the half year's report of working was submitted. This line is the only elevated city passenger railroad in England. It is electrically equipped and is operated by an automatic electric signaling system. The total length authorized is 7 miles and 5 chains, of which 5 miles and 68 chains is built, and 5 miles and 12 chains were operated during the half year reported on, ending December 31, 1893. The passenger train mileage was 243,539, and the total passengers carried were two and a half millions; being, first-class, 260,000; second class, 1,294,000, and workingmen on special return tickets, 922,000. The average load (computed) was about 50 per train, the total capacity of each train being 114 passengers seated. The report states that 95 per cent. of the trains were punctual on a five minutes headway.

The gross revenue for the half year was £18,514, and working expenses £13,773, or 74 per cent. After paying interest there was available for dividends sufficient to pay five per cent. on the preference shares and one per cent. on the ordinary. This result for the first full half year seems very satisfactory. The cost of locomotive power was undertaken by the electrical contractors, who equipped the line, at four pence per train mile; but the directors took over the whole equipment from the first of January, 1894, and expect to save money.

A very careful account of the equipment and operation, with financial results will be found in the papers by Messrs. Greathead, Fox and Parker, which are published in abstract elsewhere in this issue.

AN EXTENSIVE NEW RAILROAD SYSTEM IN BROOKLYN.

The Nassau Electric Railroad Company of Brooklyn, N. Y., of which Mr. P. H. Flynn is the president, made a contract last week for the building of its 100 miles of street railroad in Brooklyn and the country towns, for which it has held the franchise for some time. It is usual enough in these days of electric railroads to find street railroads with a trackage of more than one hundred miles, but such a condition has always been the result of slow growth and gradual extension to keep pace with the growth of the city. It is, however, a most unusual thing to find a railroad company of that great extent built and equipped all within one year, and a large part of it within four months. Such, however, will be the case with the Nassau railroad if the plans of its managers are carried out as expected. This enormous contract for building the road and equipping it, which will involve the expenditure of nearly $12,000,000, has been given to Mr. W. A. Boland of Boston, Mass., who in turn has made a contract with the Johnson Company of Johnstown, Pa., to build the railroad and turn it over to the company completed. Mr. Boland takes $6,000,000 common stock and $6,000,000 five per cent. 50-year bonds for equipping the road. There has never before been a contract as large as this one and similar in character given out in the United States. When this contract is carried out the railway company will occupy a prominent position in the financial matters of Brooklyn and will also be a factor which cannot be overlooked in the building up of the suburbs of the city and the extension of its boundaries. The plans of the company, as outlined by the Brooklyn *Eagle*, are here given with considerable fullness of detail.

Since the trouble with the board of aldermen about the franchises, which were finally awarded to the Nassau Company, there has not been much heard of this railroad; and, as a factor in the railroad business of the future and as a feature which should be carefully considered by investors in its relation to the local railroad security list, it has been somewhat overlooked. During the time which has elapsed since the franchises were granted the company has proceeded with the securing of the consents of the owners of the abutting property along the streets where it was intended to build and operate the railroad. Much more than the desired amount of consents has been secured on all of the routes, with the exception of South Fifth street and on Union street, so that there is practically nothing in the way to prevent the building of the railroad and making it ready to carry passengers. The men who have been interested in the railroad company from the start are P. H. Flynn, S. B. Dutcher, J. J. Allen, W. A. Boland, of Boston, and A. L. Johnson, of Cleveland, O. Each of these men has interested with him some of his financial friends. At a more recent date R. T. Wilson of 33 Wall street, New York, the well-known banker who has been at the head of the underground railroad syndicate in that city, has become interested in the company through the financiering of Mr. W. A. Boland. There will be none of the $6,000,000 of stocks or $6,000,000 of bonds of the company put directly on the market, as the men named and their friends have subscribed for them all, and are not in this venture for the speculative value there may be in the railroad stock, but have placed their money there as an investment.

The contract which has been signed calls for the completion of thirty miles of single track before the middle of July. The routes to be finished are the Marcy Avenue line, the Hamburg Avenue line and the Thirty-ninth Street Ferry line. The contract provides for the using of the regular Johnson girder rail, ninety-three pounds weight. That is the heaviest rail which has ever been used for surface railroad purposes in Brooklyn. The new electric welding process, which has been very much improved within the last year by Mr. J. A. Moxham, who, with the Johnsons, is interested in this company, is to be tried.

Sites have not yet been secured for the power houses, but there will be two of them, one within the city, on the water front or near it, and the other somewhere within the county towns, as near as possible to the water front, so that supplies can be easily taken to both of them. The house in Brooklyn will be provided with five Corliss engines of 1,000 horse power each, and the one in the county town will have ten Corliss engines having a combined horse power of 7,500. There will be supplies used from both the Thomson-Houston and the Westinghouse electric companies, and each of them will supply motors for the cars.

Cars will be used of the regular size and the standard style of manufacture. In appearance they will be similar, to some extent, to those used on the Atlantic avenue railroad in Brooklyn. The St. Louis Car Company has been given the contract for building them. The Nassau company will try one thing that Brooklynites have never had the chance to test and that is drawing room cars. They will be built in every detail as handsomely as possible, and the interiors will be finished off in luxurious style for a street car. They will be fitted up with roomy cane chairs in summer and with easy upholstered chairs in winter The floors will be carpeted, the windows will be given a bowed appearance and hung with curtains. In these cars there will be no more passengers admitted than there are seats to accommodate them. A fare of 10 cents will be charged for passengers who take advantage of the drawing-room cars. They will always, however, be run in connection with the ordinary car, in which a five cent fare will be charged. For women who have to go shopping and for people who desire to take a long ride it is likely that the more comfortable cars will prove a very acceptable innovation. A special feature of them will be made on those lines of the company which are run to Coney Island and Fort Hamilton, where long distances through the country will be operated.

The lines which are to be completed and in operation by July 15 will be those of the Marcy avenue branch. These cars will start from Broadway Ferry and pass through the following streets: South Eighth street, Marcy avenue, New York avenue, Atlantic avenue, Rogers avenue, Avenue F in Flatbush and Ocean avenue to Sheepshead Bay and Manhattan Beach. It will take 35 minutes for the cars of that line to go from the ferry to the Beach and they pass through a district which at present has no satisfactory direct means of reaching the island. The Hamburg avenue line is from Broadway ferry to South Eighth street, to Marcy avenue, South Fifth street, Union avenue, Johnson avenue, Morgan avenue, Hamburg avenue, Cooper avenue, Rockaway avenue to the Canarsie landing. This line passes through the German district of the city, and as it affords a quick means of reaching Canarsie it will, it is anticipated, turn that little fishing resort on Jamaica bay into one of the most popular places for excursionists to visit that there is to be found in the suburbs of Brooklyn. The Thirty-ninth street route is from the ferry to Church avenue, east Ninety-eighth street, Hageman avenue, New Lotts road, Berriman street, Sutter avenue to city line. The remainder of the railroad will be completed, it is expected, before the first of next year. These lines are those from Hamilton ferry through Union street and other streets to the line between the city and Queens county in the Twenty-sixth ward, and from Thirty-ninth street ferry to Fort Hamilton and to Coney Island. This last route is expected to prove a very profitable one from excursionists.

There will soon be an election of a board of directors of the Nassau Railroad Company, and at that time there will be elected as trustees, Messrs Flynn, Dutcher, Allen, A. L. Johnson, W. A. Boland, R. T. Wilson or some one to represent him, and three others who have not yet been decided upon. The Hamilton Trust Company has been selected as the trustee for the stock and bonds of the Nassau railroad. Offices have been secured in the Real Estate exchange on Montague street.

The Johnsons who are interested in this railroad are A. L. Johnson and his brother, Tom L. Johnson, of Cleveland, O The latter is the congressman who has occupied so prominent a place before the public during the last few months, by means of his famous free-trade doctrine. He is one of the owners of the Johnstown steel works, while his brother is the active man in the railroad business. Between them, however, they own many miles of street railroads in Cleveland, Allentown and other cities in the central and middle Atlantic states. R. T. Wilson is a banker of very high reputation and with very wealthy connections. He is best known in New York by his offer to put $15,000,000 into the scheme to construct an underground railroad if New York city would agree to bond itself for a large number of millions more to assist in doing the work. Mr. Boland, although a Boston man and largely interested in railroads in New England, is well-known in Brooklyn because of the interest which he has taken in its growth from a real estate point of view. He is one of the largest owners in the Bay Ridge Park Improvement Company and is elsewhere interested in real estate. During the last two weeks it is said that he was engaged in a deal for the Johnsons and succeeded in securing for them the entire railroad system of Allentown, Pa., for about $3 000,000.

To Settle the Detroit Railway Controversy.

Mayor Pingree of Detroit has sent to the common council of that city an ordinance framed for the purpose of ending the bitter controversy between the city and the Citizens' Railway Company that has given rise to so much discussion within the last year. Compared with the existing charter the mayor's proposed ordinance makes the following proffers:

1. A 30-year franchise in exchange for one that, at the best, has only 14 years to run.

2. A 5-cent fare on general transfers, where such transfers as are now made to depots. Belle Isle and across town are made on tickets for which the company formally received only 4 1-6 cents.

3. The wiping out of the "workingman's ticket" as a special class of fares, upon which transfers were secured in a large percentage of cases for 3½ cents, where the company will hereafter get 5 cents.

4. Relief from the cost of paving, of maintenance of paving, of street cleaning, and of specific taxes.

5. Relief from the cost of constructing the substructure of tracks up to the iron rail, on the theory that the city should own its own streets and as much of the construction therein as it may.

6. The simplifications of the fare system, whereby the greater percentage of travelers will use tickets, thus lessening the number of cash fares and limiting the opportunities of dishonest employes.

7. A monopoly of the business.

8. The entire wiping out of passes.

TELEPHONE-ELECTRIC RAILWAY DECISION.

The decision of the Supreme Court of Tennessee in favor of the complainant in the case of the Cumberland Telegraph & Telephone Co. against the United Electric Railway Co., of Nashville, was briefly noted in the last issue of the Street Railway Gazette. This was a suit brought to recover about $4,500 to compensate the telephone company for money expended in overcoming the difficulties incident to interference with the telephone circuits by the railway wires. The plaintiff had introduced the McCluer system which involves the use of a common return wire at an expense of $3,660 and had purchased poles higher than those used by the railway company at a cost of $856. The lower court gave judgment for both amounts and the appellate court gave a judgment of affirmance. In the course of the opinion the court says:

Both companies are quasi-public corporations with powers derived from the same source, the city authorities. No purpose to sacrifice one for the other is apparent in the Legislature or the city authorities, and their rights to use the streets are co-ordinate. It is not accurate to say that the right of the defendant is dominant and the right of the plaintiff subservient. The defendant has the right to use the streets for the erection and operation of a street railway, a strictly legitimate and ordinary use; the plaintiff's right is to use the street incidentally in the erection and operation of a telephone plant, with the proviso that the ordinary use of the streets be not thereby obstructed. No conflict can occur if these companies remain within their proper sphere and exercise power with that careful and prudent regard for the rights of others, which the law enjoins. Each must use care not to obstruct the other in this ordinary use of the streets.

The court then discusses the question whether the operation of an electric railway is an ordinary use of the streets. Decisions are quoted to show that courts here held that this is an ordinary use of the streets. Streets were designed to furnish facilities for the inter-communication of the multitudes of people assembled in cities and towns. New and improved methods of travel, devised to meet the growing demands of increased population and suburban life, are within the general purposes for which streets are constructed. Electric railways are but modern and improved use of the streets, a legitimate and therefore an ordinary use. Judge Wilkes and Bright, however, do not concur in the conclusion that the electric street railway is an ordinary use of the streets.

No intention on the part of the Legislature to abridge the rights of one corporation by grants to another will be recognized by the courts unless such intention plainly appears in the law. Plaintiff's rights and franchise have not been abridged or revoked by the subsequent legislation in favor of street railway companies. There is no necessary conflict between these two companies. Each can be operated properly without trenching on the rights of the other. The defendant insisted that plaintiff could not recover the damages caused by conduction unless on the theory that it has an exclusive right to the whole earth for electrical purposes. The plaintiff repudiates this and says that all it wants is exclusive use of electricity on its own premises. The plaintiff's request is to be let alone on its own premises; the defendant's command is "Get out of my way" to all feeble electrical enterprises that come in its way. To concede defendant's claim is to give it an injurious use of plaintiff's property, and at the same time deny the plaintiff the harmless use of its own.

The doctrine that reason sanctions and justice approves, as it appears to us, is that the lawful, harmless and accustomed use upon one's land, alike of water, air or electricity cannot be lawfully obstructed or impaired by injurious act of another, attended with such disturbance of natural and existing conditions and consequent loss as that caused by conduction in this case, especially when the party performing the injurious act had the power to obviate and remedy the injury or loss without greater sacrifice comparatively than is required of defendant in this case to remedy conduction. It is not material that the act is done on the premises of another than the injured party. Many cases are quoted to sustain this view.

It has been suggested that electric railways may be subjected to multiplicity of suits under this decision. This may be inconvenient and expensive for them but constitutes no defense to their liability. It was not plaintiff's legal duty to protect itself, upon the institution of defendant's electric system, against the injurious consequences by making at its own ultimate cost such changes in its pre-existing plant as would obviate the effects of conduction. Plaintiff was in enjoyment of its own property and under no obligation to take notice of defendant's approach to get out of its path. The fact that the plaintiff could apply the cheaper remedy could not affect defendant's liability.

Judgment is given in favor of the plaintiff for $3,660.58 for loss by conduction and for $816.00 for loss by conflict of poles and wires.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

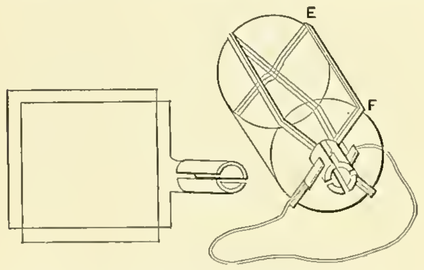
BY NELSON W. PERRY.

(Eleventh Article.)

SHIFTING OF THE ARMATURE WIRES.

We have laid some stress upon the injunction that the windings of the armature must not be allowed to move. It is evident that if they are free to move ever so little, it will be almost sure to result in the breaking of the insulation with which they are protected and this being destroyed even over spaces the size of a pin head, the current will pass from wire to wire of the coils or from wire to armature core, instead of passing out through the commutator and outer circuit, and this new path being short and of low resistance the flow will be large, or if not large at first rapidly becomes larger and the armature burns out. In fact this slight movement of the coils is one of the most fruitful causes of burning out of armatures.

There are three agencies constantly at work when either the dynamo or motor is in operation which tend to cause movement of the coils and



FIGS. 31 AND 32.

hence their ultimate destruction. One has already been referred to—the tendency of the wires to fly off from the core when the latter is revolving rapidly, which is counteracted by binding them down tightly to the core by bands or other coils of fine wire. Another is that when a dynamo is doing work and the coils are passing rapidly through the lines of force, the latter act like material obstructions to their motion with the core and tend to push them off sideways. It is very much as though we were revolving the armature rapidly in a tank of water; considerable friction would result between the water and the wires on the surface of the cylinder which would tend to strip the former from the latter, and this tendency would increase with the speed. One can form an estimate of how great this stripping force is when he realizes that practically all of the force exerted by the engine in driving the armature is required to overcome it. That is to say, that when an engine is exerting say 100 H. P. in driving an armature, there is practically 100 H. P. being exerted upon the windings of that armature tending to push them off sideways or to strip them from their position. This stripping force is divided equally among all the coils and increases for each coil with the number of turns in the coil. In the case of the dynamo this friction acts as a drag upon the coils tending to prevent them from passing from under the pole pieces of the magnets. In the case of a motor, the action is reversed and it manifests itself as a pull upon the wires as they approach the pole pieces.

It is bad enough when this tendency to strip is always in one direction, for as the force exerted is constantly varying with the load on the machine, there is a tendency for the coils to move accordingly, which if allowed to occur must inevitably result in friction between the wires themselves, or between the wires and the core, which will wear away the insulation in places and cause a short circuit and a burnout, but it is still worse where the strain comes first in one direction and then in the opposite as is the case with motors which are constantly reversed as are street car motors. One of the trials to which street car motors are peculiarly subject is tugging in one direction at the wires on the armature on starting up, and the tugging at them again in the opposite direction whenever the car is reversed, and it is much ag-

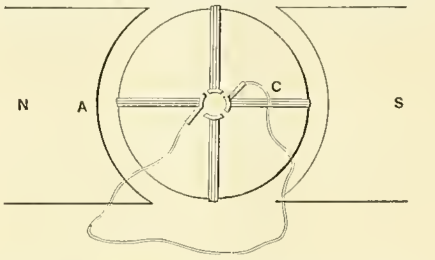
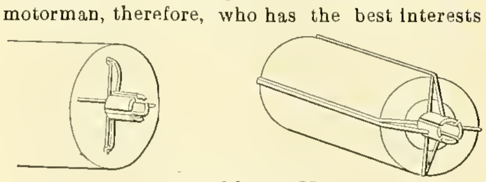


FIG. 33.

gravated if these operations are performed too suddenly. This is one of the reasons why motormen are always instructed not to turn on the current too rapidly in either direction and why provision is made in the controlling switch so that the current cannot be turned on or off, or reversed at full strength. The deterioration of reversing motors (street car motors) due to this cause, even with the best of care on the part of the motorman is slow but *sure*.

There are several methods of obviating this tendency of the wires to shift, with which, however, the motorman has nothing to do. One is that which is resorted to to prevent the wires from flying off tangentially previously described of tightly binding the coils to the armature by metal bands or wrappings of wire, and the other is by imbedding the coils in channels or slots in the armature core as shown in Fig. 34. This latter method, however, is seldom practicable in small motors such as are used on street cars, because of lack of room for the required number of coils, but in large generators and motors of many hundred horse power it is becoming to be a favorite method, not only on account of its efficiency for the purpose, but because this method of building the armature has other advantages to recommend it.

In street car motors, however, where of all cases there should be the best possible provision against these strains, we have to rely upon the least efficient method, viz., of holding the wires in place by the binding wires referred to. The motorman, therefore, who has the best interests



FIGS. 34 AND 35.

of his employers at heart will therefore refrain from jerking his car, for he will remember that these jerks all come upon the armature wires and will hasten the destruction of his machine.

The third agency which tends to cause the wires to move from their position upon the armature is heat. As everyone knows, metal expands with increase of temperature. Now the coils of an armature are wound as tightly as possible, but if the temperature of the wire be raised far above that at which it was wound, the wire will become appreciably longer and the coils which were tight when cool, become loose when hot. Upon cooling again they contract, but this very expansion and contraction has caused a motion of the various convolutions of the wire relative to each other and to the core which may be more or less harmful by causing abrasion; but the heating is still more harmful for the reason that it aggravates the other tendencies toward movement of the coils already mentioned, for if these strains are brought to bear upon a coil that is already loose, it will be readily seen how much more harmful they may become. The only remedy for this is to avoid overworking your machine. Over this remedy the motorman has almost complete control. Starting up or reversing too suddenly, or taking a heavy load too rapidly up a grade, are all examples of practices that should be prohibited, because in all of them the wires are overworked and likely to heat even to burning out. Running at a high speed on a level track is *not* overworking the motor, however, and may be indulged in with impunity, almost, so far as the heating of the motor is concerned, so that it is much better to lose time on grades and make it up on the level stretches than to save time at the expense of the motor where the hardest work is being done, viz., in starting and in ascending grades and going round curves.

OPEN AND CLOSED COIL ARMATURES.

In all of the preceding cuts where the armature is represented as having two coils and four commutator segments, it will be observed that after the coil has passed 45° from its position of maximum activity, its commutator segments pass from under the brushes and the outside circuit remains disconnected from the coil until the latter has revolved through 90° and again approaches within 45° of its next position of maximum activity. This occurs twice during each revolution of every coil. That is to say, twice during every revolution of the coil it is open and contributes nothing to the outside circuit. An armature wound in this way is called an open coil armature. Such construction is now never found upon street railway apparatus of any kind, either motors or generators, but is thought to have some advantages for arc lighting dynamos and is the method employed on both the Brush and Thomson-Houston arc dynamos.

If, instead of having connected the coil so that it was out of circuit except when generating a certain potential, we had connected it so that it would be always in circuit (except when generating no potential at all, the moment of reversal, when it would be short circuited by the brush) we would have taken advantage of the small electromotive forces which we threw away in the other arrangement by cutting out the coils before they had reached and after they had passed 45° of their positions of maximum activity.

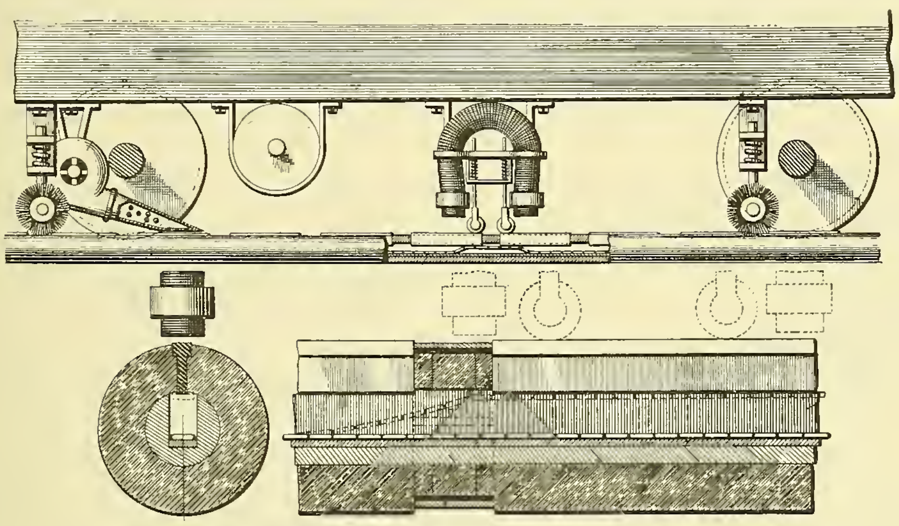
Fig. 35 shows an armature wound in this way. By comparing it with Figs. 32 and 33 it will be seen that the only difference between the two is that the two coils are really the one a continuation of the other, but each has separate connections with its own commutator segment. Each coil is therefore always connected with the outside circuit—directly through its commutator segments when the latter are under the brushes, and indirectly through the other coil and its commutator blocks when its own have passed from beneath the brushes. Armatures thus wound are called *closed* coil armatures and are the kind now universally employed both for generators and motors in street railway equipments and for generators in incandescent lighting stations.

New Rochelle, N. Y.—Work has begun this week on the trolley road which is to connect the lines in New Rochelle and Mount Vernon with the Union Railroad Company's lines at West Farms. Men are employed at both the Mount Vernon and West Farms ends of the route, and it is expected that the lines will be in operation some time in June.

Bristol, Pa.—The Trenton & Bristol Trolley Company has purchased three acres of ground in the center of the town. The purchase includes the old Doran mill property, which will be converted into a depot and power house. The price paid for the property is said to be $30,000.

THE TIBBALS-PURVIS RAILWAY SYSTEM.

A model system of closed conduit electric railway under the above name has been on exhibition for some time in Philadelphia at the shops of the Novelty Electric Works. As the system possesses some peculiar characteristics a brief description of its proposed features will be of interest. It is proposed to have a glass tube or conduit about six inches in diameter (the glass being about 1½ inches in thickness) containing on the upper side an intermittent shouldered slot. Within the conduit is placed a tightly fitting wooden bar containing on the upper side and immediately beneath the slot above referred to, a slot one inch wide and 2½ inches in depth. At the bottom of this is placed a copper plate one inch wide and about one-fourth of an inch in thickness upon which rests a light flat coppered iron chain. The shouldered slots in the conduit above referred to are about two feet in length and separated by a space of six inches. This slot is one-inch wide at, and about one-third of an inch wide below, the shoulder, and filled with a copper plate which extends beneath the thickness of the glass into the wooden conduit about one-quarter of an inch and



TIBBALS-PURVIS CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM.

projects but slightly. if any, above the surface of the glass conduit. This feature has been exaggerated in the drawing. It is also hermetically sealed. This conduit is buried in asphaltum or Portland cement midway between the railway tracks, leaving the copper sections exposed.

The cars proposed are in all respects similar to those used in the overhead trolley sytem, with the exception that instead of conveying the electricity by means of the overhead trolley, an inverted horseshoe electromagnet is placed underneath the car, and in its center line about midway between the front and rear trucks. This magnet is separated at the toe about 12 inches in the clear and between the bars of the magnet are placed two trolley wheels, one immediately preceding the other. These are insulated from the magnet except that the magnet coils are connected in shunt with the trolley wheels. The trolley wheels are connected with the motor by wires not shown in the figure. As the car passes over the track the trolley wheels being regulated by means of steel springs rest lightly upon the sections of the conduit and the force of the magnet raises the chain and brings it into contact with these sections. The copper plate at the bottom of the wooden slot being charged, the current passes through the chain and copper sections and by means of the trolley wheels is conveyed to the motor of the car. It is thus seen that there is exposed only small sections of copper plates and as these trolley wheels are more widely separated than the intervening spaces between the copper plates, the current is continuous and the motion of the car smooth and regular. It is estimated that the first cost of construction of this system is approximately 40 per cent. less than the first cost of the overhead trolley system. But two sections in the conduit can be charged at one time, and these sections are immediately beneath the center of the car. As the car moves on the chain drops by gravity and another portion of the chain is brought into contact with other sections through the influence of the magnet and these in turn become charged.

Electrolysis of Water Mains.

The following reference to the electrolysis of pipes by currents leaking from street railway circuits is contained in a paper recently read by Geo. P. Low before the Pacific Coast Association of Fire Chiefs at San Francisco: "A new feature of concern that will, sooner or later, force itself upon those in your calling is the possible destruction of water mains and all underground metal work from the use of electric railway circuits having a ground return. This destruction, which is due to the action technically known as electrolysis, consists in the corrosion of water mains which have, perforce, become conductors of the electric railway current. A remedy of the evil may be had in converting the circuit from a 'grounded' one into a metallic one, or, to be more plain, to run return wires to the power house instead of allowing the current to return through the rails, the earth and underground metal work or piping."

BROOKLYN, QUEENS COUNTY AND SUBURBAN NOT YET LEASED.

The boards of directors of the Brooklyn Heights railroad and of the Long Island Traction Company were to have met on Monday of last week for the purpose of executing the lease of the Brooklyn, Queens County and Suburban railroad to the Brooklyn Heights. This was not done, however, and a committee was appointed to consider the advisability of assuming the operation of the eastern district company by lease or whether a contract would not be better. Mr. Lewis explained the reason for thus deferring action as follows:

"There was discussion as to whether it was desirable, in any event at present, to have a lease. It was suggested that the Brooklyn, Queens County and Suburban Company be operated by contract. In the statement which I made I said that there was no obligations upon the Brooklyn Heights or the Brooklyn City railroad or the Long Island Traction Company under the arrangement of the consolidation and the capitalization of those properties. We want to keep it so and we do not like to give the appearance of an obligation by having a lease, provided a contract will answer the purpose. Whether a lease or a contract is made none of the companies mentioned, that is, the Brooklyn City Railroad, the Brooklyn Heights Railroad or the Long Island Traction Company, will take upon itself any obligations."

New York Rapid Transit Bill.

The rapid transit bill prepared by the Chamber of Commerce of New York has been introduced in the Senate at Albany. It is entitled an act to provide for rapid transit railways.

The bill provides for a new board of rapid transit commissioners, consisting of the mayor, the comptroller, the president of the Chamber of Commere, ex-officio, and four others named in the bill. The board may fill vacancies. The four named in the bill are Samuel D. Babcock, Seth Low, John Claflin and Alexander E. Orr.

The scheme of the bill is to extend the powers of the board of rapid transit commissioners under the act of 1891 so as to confer upon the board the right, if its judgment it is found desirable to do so, of providing for the construction and operation of rapid transit roads for and on account of the city.

When the plans are finally adopted and consented to, the board is authorized to advertise for proposals for the construction and operation of the road. Power is given to the commissioners, if they see fit to do so, to make one or several contracts for the construction of an entire system or parts of a system of rapid transit.

The commissioners are authorized to reject all the bids and readvertise, or they may accept any bid that in their judgment will best promote the public interest. The successful bidder is then required to enter into a contract for the construction of the road, and also to equip, maintain and operate the same for a term of years, to be specified in the contract, not less than thirty-five nor more than fifty years.

The annual rental to be paid by the contractor to the city must be an amount, to be fixed by the commissioners, not less than the interest on the bonds issued by the city to pay for the construction of the road, and an additional sum, not less than 1 per cent, upon the amount of said bonds.

In order to secure the city the contractor is required to enter into a bond with sureties which shall be satisfactory to the commissioners. He is also required to make a deposit of $1,000,000 with the Comptroller of the city, which sum is to be repaid to him, with interest at the same rate as that by the city upon the bonds issued under the act, as soon as the road has been constructed, equipped and the operation of the same commenced to the satisfaction of the board.

For the purpose of paying the cost of construction the city is authorized to issue its bonds, principal and interest payable in cold coin, to an amount not exceeding $50,000,000. The road, upon being constructed, immediately becomes the property of the city; the rolling stock and other equipment of the road to be the property of the contractor, provided at his own expense.

As a substitute for the security of $1,000,000, when repaid, the city is to have a first lien upon the rolling stock and equipment. Power is also given to the board to enter into any agreement that may be considered wise in reverence to renewals of the lease or the purchase by the city of the rolling stock and equipment at a valuation if the lease is not renewed.

The bill also contains a provision that where in the existing law a vote of four members of the board is required the number shall be increased to six. This is in effect giving the same veto power to one member of the board which the existing law now provides for; the present board consisting of five persons and the board provided for in the act consisting of seven persons.

The bill also terminates the offices of the present Commissioners of Rapid Transit, and requires them to transfer and to deliver to the new board all records, maps, plans and other property relating to their work.

Provision is also made for the payment of the expenses of the new Board of Rapid Transit Commissioners and also of a reasonable compensation to the members thereof other than the Mayor and Comptroller.

THE HILLSIDE LOOPS OF THE NORTH HUDSON COUNTY RAILWAY.

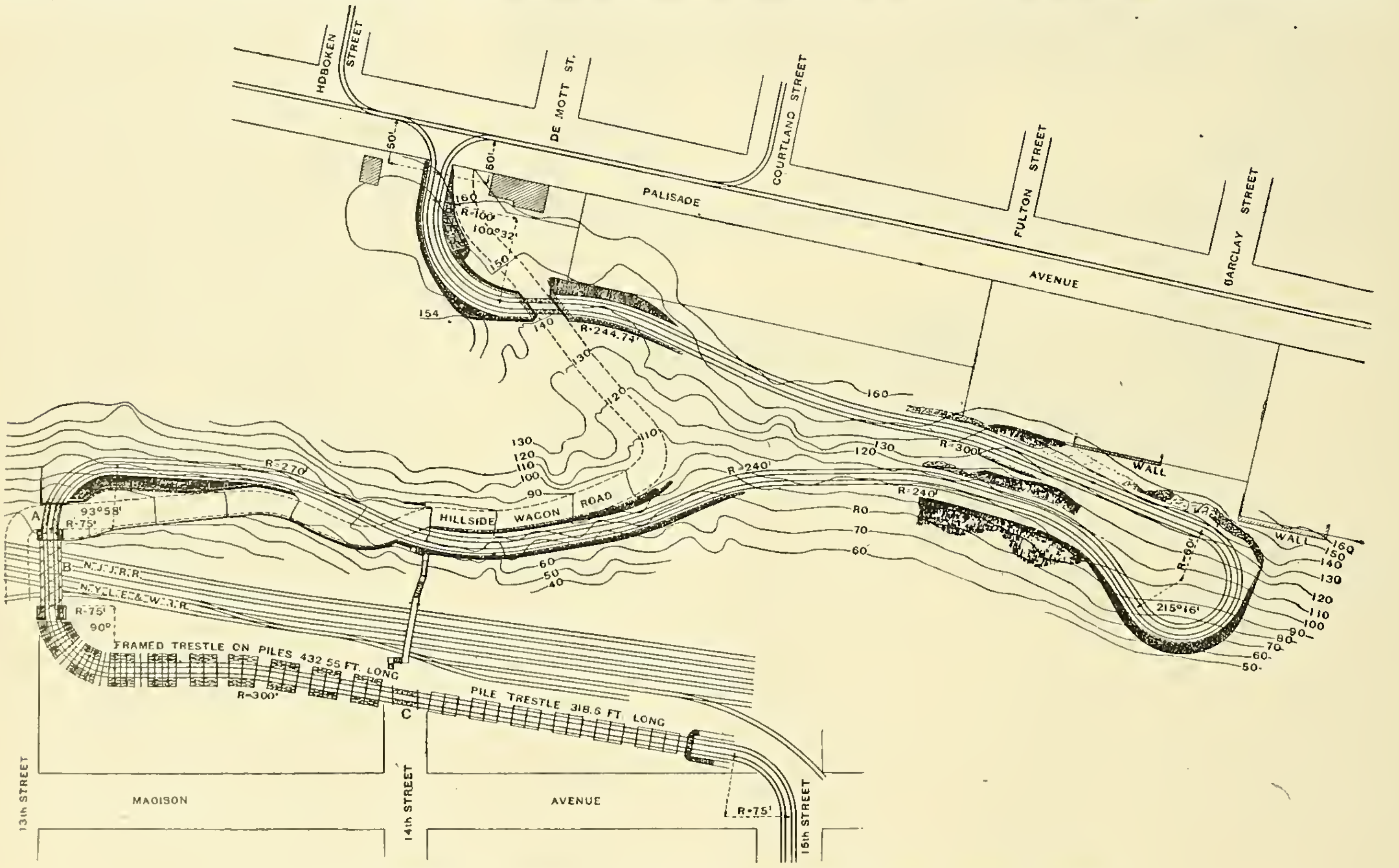
The primary object of this article is to describe a very interesting piece of construction work recently completed by the North Hudson County Railway in Hoboken, N. J. The problem was to overcome a vertical ascent of 160 feet in about 700 feet of horizontal distance; that is, to carry an electric railroad from the corner of Madison avenue and Fifteenth street, as shown on the plan herewith, to the plateau at the summit of the steep hill back of the flat on which the main part of the city of Hoboken stands. This was done by developing a line of 3,688 feet in going the horizontal distance of 700 feet. The alignment of this work is shown on the plan herewith, for which, together with the accompanying data, we are indebted to the *Railroad Gazette.*

Beginning at Fifteenth street and Madison avenue there is a curve of 75 feet radius, including about 90 degrees; then there is a pile trestle followed by a framed trestle on piles, a second curve of 75 feet radius, a plate girder viaduct over the Erie tracks, another curve of about 75 feet radius, including 94 degrees of curvature, and then comes the heavy side-hill work. The contour lines on the plan show the slope of the hill, which is of trap rock. The slopes formed by wasting from the side-hill cut are indicated by hatchings and the retaining walls by stippled work. The location was made somewhat more difficult by the necessity of avoiding the Hillside wagon road, which is also shown on the plan. At the extreme right it will be seen is a curve of 60 feet radius and over 215 degrees of curvature. The maximum grade is 5½ per cent. The railroad is double track, as shown on the plan, and the whole construction is very substantial. The retaining wall at the extreme right is 70 feet high.

The structures other than the trestles mentioned are a 40 feet plate-girder, double-track bridge at *A*, a 92 feet lattice girder at *B*, and a 30 feet plate girder at *C*, and the bridge at the crossing of the Hillside wagon road. The track is laid with 56 pound rails from the Pennsylvania Steel Company, and guard rails of 32 pound section are laid inside for the whole length of the road on the heavy grade. The track is ballasted with stone. Great care has been taken to secure perfect drainage, there being two 24 inch cast-iron pipes the entire length of the road. The cost of this piece of work from Madison avenue to Palisade avenue was $120,000, exclusive of the right of way. It was executed under Mr. Myles Tierney, contractor, now president of the North Hudson County Railway Company, and Mr. C. B. Brush, chief engineer.

The North Hudson County railway consists of 50 miles of track, of which about 24 miles is operated by horses, 19 is trolley road, and 7 miles is operated by steam. The Hillside section which we have just described is a trolley road. The nearest ferry to this portion of the road is from West Fourteenth street in New York to Fourteenth street in Hoboken. The system also reaches the ferry from Barclay and Christopher streets, New York City, to the D., L. & W. station in Hoboken. From this ferry it has an elevated line going straight up to the plateau on the top of the hill, which was built some years ago to be operated by cable, but within 12 months the cable machinery was replaced by electrical machinery, and this is now a trolley line. Aside from these two elevated steep-grade lines, the company operates about 13 miles of trolley road on the surface, interchanging at various points with the horse car lines. The company, by means of the lines which it owns, or those it controls, operates lines as far south as the Pennsylvania ferry in Jersey City, touching the Pavonia Ferry of the Erie also, and as far north as the North Hudson Driving Park track. It carries about 17,500,000 passengers a year.

The electric power equipment for the Hillside line consists of a 1 400 H. P. Corliss cross-compound engine in the power station of the Hudson Electric Company at Fifteenth street, with the necessary generators. At Palisade avenue and Ferry street, about a mile further south, the company has its own power station, where there are two Watts-Campbell Corliss engines of 500 H. P. each and three Ball, single expansion engines of 250 H. P. each, driving the necessary Thomson-Houston generators. The Corliss engines at this station were designed for the cable plant.



MAP OF THE "HILLSIDE" ELECTRIC ROAD OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

ELECTRIC AND STEAM RAILROAD CROSSINGS.

This is a subject that is forcing itself to the front and demanding adequate consideration. We quote the following extract from the *Railroad Gazette* as showing the attitude of the steam railroad people:

It is a good thing that the directors of the Pennsylvania railroad have adverted, in their annual report, to the increasing danger which the public is imposing upon itself by permitting the establishment of electric street railroads across standard railroads on which heavy trains are run at high speed. The Pennsylvania directors are very moderate in their complaint, and an impartial critic might reasonably put the case much stronger. The directors say:

> It must be borne in mind that the entire movement on these electric railways is in the transportation of passengers, and that therefore the risk to life and limb from such crossings, owing to the frequent service, is proportionately much greater than on the steam railways where the trains are not nearly so frequent, and where the movement is made up largely of freight traffic. It would hardly seem reasonable that the electric railways should be permitted to indefinitely increase the number of these crossings, while at the same time your company and the city of Philadelphia are expending over $400,000 to remove the grade crossing of your road by the North Pennsylvania railroad in the northern portion of the city. [The city pays a part because streets are involved.]

In other words, if we eliminate the freight trains we find that the vast numbers of people who travel on the steam railroads are carried in a small number of trains. If the same number went by street cars, they would be distributed among perhaps five or ten times as many trains. This increase in the frequency of trains is, indeed, a principal element in the value of the street line. But with the frequency of the street service—the division of the total number of passengers into a large number of small loads—the freight trains become a serious element of danger, for the more trips an electric car makes across a steam railroad at grade the more chances does it take of being run into by a freight train. And whichever kind of steam road train the street car encounters at a crossing, much the larger risk of injury is borne by the street car. The general disposition all over the country to encourage electric roads may be looked upon as a movement of the public to get cheaper rides at more convenient intervals, at the expense of comfort and safety. The lack of suitable warmth, of ample seats and smooth riding, does not concern us just now, but the high speed, endangering persons both inside and outside the cars, which has been very common, and the willingness of the companies to cross railroads at grades rather than make a larger investment, call for a general protest. It is true that individuals take these risks with their eyes open, but, as in the case of steam railroads, the law will probably require the carrier, finally, to protect people from the consequences of their own carelessness, whether the people desire it or not.

RAPID TRANSIT.*

BY ALBERT L. CLOUGH.

As a community increases in size and begins to evolve from a coun ry town to a city, as its business area extends and its suburbs push far out into hitherto unoccupied territory, the distances between its various points become too long to walk with comfort, especially under the increased value placed upon time by the more and more busy people of the growing city. It is then that the rapid transit problem forces itself inevitably upon the attention of the people, and upon the promptness and effectiveness of the solution of this problem depends in a remarkable degree the future growth and prosperity of the community and much of the future comfort and well-being of its inhabitants. The statement of the rapid transit problem is briefly this: Required means to transport each inhabitant to and from every point within the city area in the least time with, the least expense, and with the utmost safety; rapidity and comfort, and, moreover, it is required that these means interfere as little as possible with the other activities of the people.

The advantages of rapid urban transit are so obvious that it is hardly necessary to dwell upon them, but a few words may not be out of place. In the first place rapid transit secures the very plain advantage of a greater degree of rapidity in doing business, the different sections of the town being brought more closely into touch and less valuable time being abstracted from the already crowded business day by the necessary going from place to place which falls to the lot of every-one.

Not quite so plain an advantage, but perhaps even a more important one is secured by rapid transit, in the improvement which it is bound to effect in the social, sanitary and moral condition of a city, by the prevention of excessive crowding of the population about the business center. This effect is clear when we remember that it is not the number of miles from a man's home to his business which determines his isolation, but rather his distance in minutes. As the speed of the means of transportation increases the distance out of town which one may live with the same time economy also increases in like proportion. Thus the city having speedy transportation facilities can afford to be much more scattered, and may almost entirely avoid the frightful evils of crowded tenement house life, and yet be practically as compact and easy to do business in as its crowded rival with its slow and inadequate street railway service. The advantages secured to a city having no crowded residential area are great from moral, social and sanitary considerations, and the large number of people who may be able to own their own homes on account of the large area of comparatively cheap land which is made available tends strongly to preserve the family relation, increase the stability of the population and foster public spirit among the citizens.

But if these effects of the introduction of rapid transit seem to be a little visionary and far fetched, let us turn to the financial side of the question. The effect of improved transit facilities upon real estate values is in general so markedly beneficial as to form a strong argument for their introduction. In the resulting expansion of area which the city sustains there is rapidly created a demand for land which previously was too far without the city limits to be of any value for residential purposes. This land meets with an immense increase in value and rises to a figure mutually advantageous to both buyer and seller, but without any corresponding diminution in the values of more central real estate. The really wonderful effects of street railways upon real estate values can only be appreciated by a study of the conditions existing in some of the western cities which are still in the formative state. Here the direction of growth is almost entirely determined by the way in which the car lines are laid out, and one frequently sees expensive street railways running through the open country with almost no present business but a large prospective one to come.

It becomes possible through improved transportation facilities to make use for residential purposes of regions which although far outlying are possessed of special physical features, as elevated land, land bordering upon rivers or lakes, or upon the seashore. Without rapid transit these advantages cannot be enjoyed, as the natural manner in which a city grows is into the form of a circle of more or less regularity, thus bringing the average inhabitant as near as possible to the business center, and it grows in this way very largely without respect to the physical features of the land.

We may say roughly that the trolley does practically all the electric railroad work of the country, and its rapid introduction into almost universal use has hardly a parallel among industrial advances. The trolley system distributes the electrical power to the cars from the central power station, by means of an overhead wire suitably supported over the tracks and with which the motors of the cars are connected by means of the trolley which runs upon the under surface of the wire. Under the trolley system I shall deal briefly with the general advantages of electrical propulsion at large, as well as with its own special advantages and disadvantages.

The most obvious advantage which the electrical system affords is an increase of speed over that which is now attained by other existing methods. The electric car is capable of any speed which may be desired under twenty miles an hour, and its actual speed in practical service is only limited by questions of safety or by municipal ordinances. It is always within the power of the electric car to make up time whenever high speed is allowable, as well as to maintain a continuously high speed whenever it would be safe to do so, as it is when an electric road runs on its own real estate. Fifteen miles an hour for considerable distance is a common speed for electric cars in suburban districts, and the writer has seen as high speed as seventeen miles per hour, maintained for miles, with occasional spurts of twenty miles per hour. But yet an electric car is not limited to high speeds and is just as able to crawl along at a two mile gait as at a twenty mile pace, as it is often required to do in crowded streets. The ease of control of the speed of electric cars is one of their greatest advantages and is far ahead of that attained by any other system, as the electric motors may be arranged to act as wonderfully effective brakes and with the assistance of the ordinary brakes are able to bring the car rapidly to a standstill. It is this ease of control that makes speed allowable for electric cars that would not be allowable in any other system.

There are other advantages which the electric system shares with other mechanical systems which come under the head of increased cleanliness and comfort. There is no doubt but that it is an unhealthful thing to use animal power in large cities, and it is certainly an unpleasant thing for a person having the slightest degree of humanity to see the struggles of a street car horse in starting a heavily-loaded car. Electric cars, moreover, are brilliantly lighted and sufficiently warmed from the same source of electrical supply from which the power comes, and this is an advantage which every one who has much street car riding to do is sure to appreciate.

In regard to the special advantages of the trolley system it is clear that its first cost is on the whole less than any other electrical system and experience has abundantly proved that its cost of operation is not only less than other electrical systems but less than any other system of propulsion at all The rapidity of the change from animal power to the trolley system by the largest roads in the country is sufficient evidence of this last statement. The ability of the trolley car to handle immense crowds, to overcome heavy grades with hardly a diminution of speed and to successfully operate in all conditions of weather has been so fully shown by the immense trolley system of Boston that it hardly needs to be restated here. During the past winter with its heavy snows the trolley system of Boston has suffered practically no interruption of service and the failures which have come to the public ear during past winters have been simply due to an inadequate supply of power to enable the cars to run over snowy rails. No fear of failure of the trolley system need be entertained where reasonable precautions are taken to remove snow from the tracks and where sufficient power is furnished from the central station.

Far too much has been heard of the danger from electric shocks due to the trolley wire. It has been exaggerated and dwelt upon by the newspaper press in an unhealthy desire for sensationalism and has been much talked about by interested persons who were the enemies of the system. In a great many instances electrical shocks really obtained from electric light wires have been laid to the discredit of the trolley, and even instances of persons run over by electric cars and thereby killed have been attributed to electrical shocks. After careful investigation I have not come upon a single instance of fatal electric shock sustained by a human being which could be rightly attributed to the current from a trolley wire. There have been a number of horses killed by it, although I have seen instances in which the shock was sustained by horses without injury, and it must be remembered that the conditions for receiving a severe shock are much more favorable in the case of the horse than in that of a human being, for the man is completely clothed and protected from the ground by his shoes, while the horse is connected to the ground by the iron with which he is shod. The electrical pressure which is employed upon the trolley wires is of five hundred volts and it has been clearly shown by the personal experience of almost every practical electrician that a momentary shock from 500 volts while very painful is not attended with any permanent injury. It has been often urged that there is a great liability of danger from fire in the use of the trolley system by the current escaping from the trolley wire to telephone and telegraph wires and doing damage in the building which they enter. This danger is almost entirely obviated by the use of guard wires on the trolley system and protective arrangements in the telephone wires. It is again claimed, with some degree of truth, that the trolley wires impede the firemen in the discharge of their duties, but as the trolley system is easily arranged so that any portion of the wires may easily and quickly be rendered safe to handle, and the wire then cut, this objection has no validity. With the means at present at our disposal a trolley wire may be so supported that the chance of its falling from place is extremely remote, and furthermore, the methods of supporting such wires have been so far developed that there is very little truth in the claim that is frequently made that they are so very unsightly. Supporting the wires from poles set along the curbing on either side of the street and provided with ornamental arms to hold the wire is a very neat method of construction, and even the use of the ordinary means of support from span wires stretched across the street does not look badly if the work is neatly done and the use of the ornamental iron poles is insisted upon. The trolley system, if properly constructed, may indeed be made so as almost to escape casual notice and the noise which proceeds from it may, by recent devices, be made almost nothing.

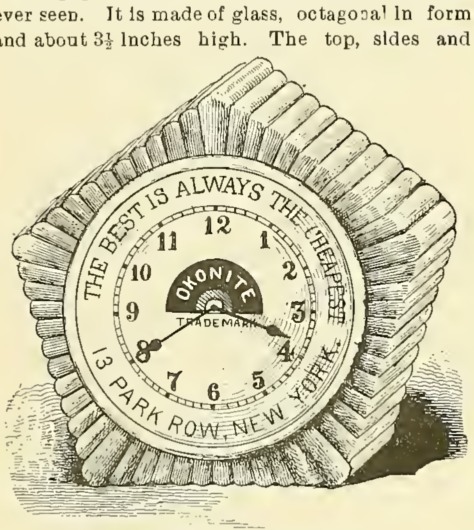
*Extract from a paper read before the Board of Trade of Manchester, N. H., March 13, 1894.

WESTINGHOUSE EQUIPMENT ON THE WEST END ROAD IN BOSTON.

President Samuel Little, of the West End Street Railway Company, Boston, announced on Wednesday of this week that the directors have closed a contract with the Westinghouse Electric & Manufacturing Company for 150 car equipments and 50 additional if needed. As is well known the entire present equipment of the West End road, aggregating over 1,600 electric motors, is entirely the General Electric system. This is the first order that has ever been placed with the Westinghouse company and it would seem to indicate that the new management proposes to give other motors a liberal chance to demonstrate the advantages claimed for them. The contract is certainly an important one for the Westinghouse company.

A Handsome Trade Souvenir.

The Okonite Company of 13 Park Row, New York, has designed one of the most unique and useful paper weights for desk use that we have ever seen. It is made of glass, octagonal in form and about 3½ inches high. The top, sides and



AN OKONITE TIMEPIECE.

bottom, are corrugated and in front is a "bulls-eye" underneath which a clock, of excellent make and a good time-keeper, shows its face. In the center of the dial is the well-known trade mark of the Okonite company, while around the margin is the familiar Okonite motto: "The best is always the cheapest."

Census Statistics Regarding Car Construction and Repairs.

Hon. Carroll D. Wright, Commissioner of Labor, in charge of the compilation of the Eleventh Census, has transmitted to the Secretary of the Interior a report which presents preliminary totals for all classes of mechanical and manufacturing industries in the United States, as prepared by the Division of Manufactures. The following are the statistics relating to the manufacture of cars for street railways:

CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STREET RAILROAD COMPANIES.

Number of establishments reporting	78
Aggregate capital represented	$76.192.477
Total value of plants	$54.733.171
Value of land	$814 006
Value of buildings	$777,721
Value of machinery, tools and implements	$525,202
Live assets	$434,233
Miscellaneous expenses	$78.761
Average number of employes	2 034
Total wages	$1,434,377
Officers, firm members and clerks above 16 years, males	25
Wages for same	23,172
Operatives, skilled and unskilled, above 16 years, males	1.998
Wages for same	$1,403,249
Childre operatives	1
Wages for same	240
Pieceworkers above 16 years, males	10
Wages for same	$7,716
Cost of materials used	$1,154,-40
Value of products, including receipts from custom work and repairing	$2,966.347

CARS, STREET RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES.

Number of establishments reporting	17
Aggregate capital represented	$2,468,315
Total value of plants	$988,958
Value of land	$489,500
Value of buildings	$2*0,700
Value of machinery, tools and implements	$218 756
Live assets	$1,479,359
Miscellaneous expenses	$140,462
Average number of employes	1,833
Total wages	$1,174,790
Officers, firm members and clerks above 16 years, males	48
Wages for same	$83,520
Operatives, skilled and unskilled, above 16 years, males	1,671
Wages for same	$989,312
Operatives, skilled and unskilled, above 15 years, females	2
Wages for same	$780
Children operatives	6
Wages for same	$1,560
Pieceworkers, above 16 years, males	106
Wages for same	$99.618
Cost of materials used	$1,699,235
Value of products, including receipts from custom work and repairing	$3,302,115

Comments and Views of Contemporaries.

FENDERS.—The low, fixed fender in use on some of the cars would doubtless do more to fasten and mangle a person unfortunate enough to fall in front of it, than it would to push him aside and save him. The long, protruding canvas bag in use on some of the Camden trolley cars is also as much an inducement to accidents as it is preventive of them. In Boston they have the swinging net, which is said to have picked up and saved several people without maiming or shocking them. The same plan is said to have been successfully experimented with in Brooklyn. What seems to be most needed in this city, where the cars stand so high from the tracks, is something that will prevent a person from falling under the wheels. The net would do it, but it should do it in such a manner as not to seriously bump against the dasher or mangle the victim. The fenders now in use would probably force a body off the track in some cases, but in others, where the clothing, or an arm or foot should be caught, it would drag and tear, and perhaps crush the body before the car could be stopped.—*Philadelphia Ledger*.

DEVELOPMENT OF SURFACE TRANSPORTATION.—Sixty years ago people thought they had reached the limit of rapid transit on the half hour system; fifty years ago on the fifteen minutes system; forty years ago on the ten, seven and five minute system; forty years later, 1894, to wait even a minute is often regarded as an infliction, and as a proof that rapid transit, so far as Boston is concerned, is yet an unaccomplished fact.—*Boston Saturday Evening Gazette.*

CAR SPEED INDICATORS.—If the electric cars were all equipped with an automatic speed indicator there would no longer be any difficulty at crossings, and the catastrophe involving great loss of life which every one anticipates could be averted. If this were done it would be possible to issue orders to motorneers to go at a certain speed as they approach a crossing, and, if a registering attachment were made, any disobedience on their part would remain in evidence against them. As it is now, men who think they are going four or five miles an hour are often going seven or eight, and a nervous man who rides on a car is in fear and trembling at almost every crossing. It is considered smart by a motorman to run up to within a yard or two of a passing car, and if he is traveling a little faster than he thinks, a collision comes as a matter of course.—*St. Louis Globe-Democrat.*

NEW ENGLAND NOTES.

(From Our Special Correspondent.)

AT MORTGAGEE'S SALE.—The mortgagee's sale of the Attleboro, North Attleboro and Wrentram electric street railway system is to take place on April 10 and it is expected that the United Traction Company of New Jersey, which already owns the Union Railroad Company in Providence, will be the purchasers. After the sale the road between Plainville and Attleboro will be put into operation as soon as possible.

PREFERS RAILROADING TO LAWMAKING.—In connection with the above it may be stated that rumor has it that Senator Nelson W. Aldrich, of Rhode Island, is to resign his seat at Washington for the purpose of giving more o' his time and attention to the affairs of the United Traction Company, of which he is president.

AGITATION FOR UNDERGROUND WIRES.—The public determination to force all electrical wires underground in Boston shows no signs of abating. Should it be finally decided that the electric light wires, both high and low tension, must be buried, the telephone wires having already been well interred, there will certainly be difficulty about the feeder wires of the West End street railway system. There are many miles of such wires stretched through the streets of Boston and the fight now concerns these in particular.

PFINGST FENDERS.—The Lynn and Boston Railroad Company is equipping all its cars with the Pfingst safety fenders. The company found these fenders to be a better protection than any others they had tested.

A HALF MILLION CONTRACT.—The Westinghouse Electric Manufacturing Company has secured the contract for equipping the Fair Haven and Westville street railway at a cost of $500,000.

A PENNSYLVANIA ROAD PURCHASED FOR THE JOHNSONS.—William A. Boland of Lynn, Mass., has just purchased from the Industrial Improvement Company of Boston, the stock of the Allentown and Bethlehem Rapid Transit Company of Allentown, Pa. It is reported that this property was secured for Messrs. Tom and A. L. Johnson. This company owns and controls several electric roads connecting Allentown with ten or twelve of the principal towns and cities in the Lehigh Valley. It is expected that this purchase will lead to a consolidation with the Allentown and Lehigh Valley Traction Company.

FINANCIAL DEPARTMENT.

Financial Notes.

Increase in Net Earnings.—Returns from several street railways in which local investors are interested show that net earnings at least begin to improve. Their managers, like the heads of our great railroads, have learned how to meet reduced gross earnings by introducing economies which reduce expenses proportionally. The earnings of the Columbus street railway for February decreased $1,638 in gross, but expenses were reduced $7,758, so that net earnings increased $6,119. The report of the Paterson (N. J.) street railway for the same month makes a similar showing, gross earnings having decreased $950 and operating expenses $6,708, thus making an increase in net earnings of $5,757. The February statement of the Buffalo Street Railway Company is, however, even more encouraging, gross earnings having increased $6,750, while expenses decreased $9.403, so that the increase in net amounted to $16,153.—*Philadelphia Stockholder*.

Boston West End Earnings.—The first seventeen days of March show a gain of $16,000 in the earnings of the West End Company, of Boston, as compared with the same period last year. The gross gain in February was $4,500 and in January $15,000, so that March bids fair to be the best month thus far in the present calendar year. President Little says the recent bond issue will cancel all the company's floating indebtedness and pay for the contemplated equipments this summer of the East Boston, Malden, Medford, Mt. Auburn, Watertown, Broadway extension, Somerville and Brookline lines, about thirty miles in all. It is not yet proposed to electrically equip the Marlboro street line.

Consolidation in Savannah.—Negotiations have been pending for some time to effect a consolidation of the Electric Railway lines, the City & Suburban Railway, the Coast line and the Montgomery lines of Savannah. An agreement has been reached and the lines will hereafter be under the management of the Savannah Electric Railway Company. The consolidation will insure better service in all parts of the city.

Twin City Earnings.—The comparative statement of operations for month of February of the Twin City Rapid Transit Company of Minneapolis shows gross decrease of 10.99 per cent. Expenses decreased 22.71 per cent. and surplus earnings increased 17.25 per cent. over the corresponding period of 1893. The gross earnings per car mile in 1893 were 19 36 per cent. and in 1894 19.23 per cent.

Keokuk Road to be Sold.—At Keokuk, Ia., March 21, Judge Bank ordered the mortgage securing $85,000 bonds foreclosed in the case of the Central Trust Company of New York against the Gate City Electric Street Railway Company of Keokuk and ordered the road sold in four weeks.

Pittston (Pa.) Railway Bonds.—Pittston (Pa.) Street Car Company 6 per cent. bonds to the amount of $200,000 are offered for sale at 103 and interest. The principal and interest are guaranteed unconditionally by the Wilkesbarre & Wyoming Valley Traction Company.

Brooklyn City Dividend.—The regular 2½ per cent. dividend of the Brooklyn City Railroad Company and the extra dividend of 2 per cent. from surplus account will be paid on April 2. Books will close on March 20 and will reopen April 3.

Nashville United Electric Receiver's Certificates.—Judge Lurton has granted a decree authorizing the issue of $75,000 receivers' certificates, which will be sold to raise money to pay taxes owing by the United Electric Railway Company.

Philadelphia, Pa.—At the annual meeting of the Omnibus Company General it was stated that during the year 6,660,000 passengers were carried, an increase of more than 450,000 over the previous year.

Brooklyn Earnings.—The gross earnings of the Atlantic avenue railroad for the second week in March showed an increase of $3,236 or 25 per cent. over those for the same time last year.

Receiver Appointed in Dennison.—R. S. Legate has been appointed receiver of the Dennison Land & Investment Company and the Street and Belt Line Railway Company of Dennison.

Cincinnati Street Railway Dividend.—The Cincinnati Street Railway Company has declared a quarterly dividend of 1¼ per cent

New Incorporations.

Richmond, Va.—Among the new laws enacted during the recent session of the General Assembly was one incorporating the Montgomery Electric Company. This law provides for a connection by an electric railroad of Blacksburg with Christiansburg, the nearest station on the Norfolk and Western railroad. The distance between the two places is about nine miles. John A. Harman, Asher W. Harman, W. A. Chesterman and William F. Shunk are incorporators of the road, whose capital stock is to be not less than $30,000 nor more than $300,000. The company is authorized to transport passengers, freight and express over its line at such legal rates of fare as it may adopt, and it may make contract for and furnish light for buildings, cars and streets and motive power for manufactories and other enterprises by electricity, gas or steam for such compensation as may be agreed upon. Work is to be commenced on the road within one year after the passage of the act, and it shall be completed within five years thereafter.

Detroit, Mich.—The City and Suburban Traction Company has been organized. The incorporators are: Elwood T. Hance, John A. Russell, J. E. Sullivan, John C. Calahan, Charles C. Kellogg and William P. Lane. The company proposes to build an electric railway from Detroit to St. Joseph's Retreat.

NEWS OF THE WEEK.

Boston, Mass.—At the hearing on the free transfer bill before the committee on street railways of the General Court, Eugene P. Ware, receiver of the West End road, submitted his account books for the inspection of the committee. The following statement was made in reference to the number of checks unredeemed during the year 1892-93: West End checks sold, 5,849,758; checks received by the West End, 5,319,120; checks received by Lynn & Boston, 362,913; checks not used by purchasers, 167,720, only one check in seventy being unredeemed. During this year there were 133,863,618 revenue passengers carried, and 10,823,201 free transfers carried. Mr. Ware further stated that during the fiscal year in question there were 5,849,758 transfer checks sold of which the Lynn & Boston collected 362,913. If the balance of these 5,486,840 had been sold for five cents, the loss to this company at three cents each would amount to $164,605.20. Mr. Ware admitted that he was responsible for the eight-cent check. The conductors were thoroughly instructed in the use of the transfers. He said: "The demands for free transfers could not practically be complied with. We now issue transfers to every point that we can without giving the public a chance to double on the road for the payment of eight cents."

Toledo, O.—It is stated that the electric railroad from Toledo to Detroit will surely be built. It is asserted that the right of way from Monroe, Mich., and Detroit has already been secured and the road completed as far as Trenton, Mich. It is also understood that 70 per cent. of the right of way between the Ohio and Michigan state line and Monroe has been secured. The portion between Toledo and the Michigan state line has been signed for already and an application with the signatures of all the property holders between Toledo and the Michigan line through Washington township will soon be presented to the county commissioners. The new road will commence out Lagrange street on the other side of the bridge over Ten-Mile creek in West Toledo. The Toledo parties interested in the road claim that it will be in operation before the first of next July.

Milwaukee, Wis.—The Prospect Hill property owners having agreed to pay a bonus of $5,000 the Milwaukee Street Railway Company has decided to extend the Farwell avenue line to that section. The road will run from Farwell and North avenues along Glen avenue to the new Lake park, passing through Folsom place or Park place. When the extension is made, the Whitefish Bay dummy line will cease to run into the city and stop at Folsom place. The company also contemplates the extension of the Russell avenue line to Cudahy. New rails will be laid on Sixth street, north of North avenue, and on Vliet street, west of Eleventh street. About $200,000 will be expended on the improvements.

Philadelphia, Pa—At a recent meeting of the select council trolley privileges were granted to the Manayunk & Roxborough Inclined Railway Company. It provides that the road shall run from the intersection of Ridge avenue, and the old Norristown railroad, at Wissahickon station and thence along Ridge avenue to the county line. The usual conditions are imposed of keeping the roads in good repair on streets used by the road and filing a bond of $25,000 for the faithful performance of the work. Another ordinance was unanimously passed granting consent to the Huntingdon Street Connecting Railway Company and the Philadelphia Traction Company to construct a single track railway on Huntingdon street, from Carlisle to Seventeenth street, and to use the trolley, with the usual conditions.

Toledo, O.—A strike was declared on the lines of the Robison Electric Street Railway Company March 22, 118 motormen and conductors refusing to take out their cars pending the reinstatement of four men alleged to have been discharged for unionism. An injunction restraining the strikers from interfering with the operation of the lines was granted, but, notwithstanding, the wires have been cut in many places.

Projected Consolidation at Sioux City.—The officers of the various transit lines in the city are making every effort to agree on some plan for a consolidation of the companies. The chief difficulty lies in the fact that such an arrangement would necessitate the abandonment of several miles of track on parallel streets. None of the companies are willing, however, that any of their own property should be given up in this manner.—*Sioux City Tribune.*

Montreal, Que.—At the annual meeting of the Montreal Park and Island Railway Company, it was decided to build a line around Outremont, Cote des Neiges and Notre Dame de Grace during the coming year, the lines entering the city by way of Sherbrooke and St. Catherine streets. The line to Lachine may also be built during the summer, and also the road to Longue Pointe and St. Vincent de Paul.

Philadelphia, Pa.—The Wissahickon Electric Railway Company has awarded the contract for the proposed extension of its line to Jones & Wallace, of Wissahickon. The entire extension will be about 8,400 feet in length, including turnouts. Work will be begun as soon as the material is delivered, and, with the exception of the Wood street portion, is to be completed within 60 days.

New Haven, Conn.—The Westinghouse Company will begin at once the work of equipment of the Fair Haven and Westville line for electric cars. The first work to be done is at the power house on Grand avenue. The plans for this house are completed and next week the piles will be driven for the foundations. The estimated cost of the improvement is $500,000.

Chicago, Ill.—At several of its stations where the business is small the South Side Elevated Railroad Company has decided to reduce the night force. The ticket seller will act as gate-keeper and "ticket chopper." In the further interest of economy the company will operate trains after midnight on an half hourly instead of a twenty minute schedule.

Norwalk, O.—The Sandusky, Milan & Norwalk Electric Railway Company has closed a five years' contract with the American Express Company for the transportation of express packages to all points along the line between Sandusky and Norwalk.

Brooklyn, N. Y.—The People's Railroad Company will apply to the council for a trolley franchise. The company is capitalized at $325,000. Francis I. Cullanan, of Rutherford, N. Y., is president and Frank Gardner, of New York, is secretary.

Peckham Trucks for Cincinnati.—The Cincinnati Street Railway Company has just ordered 75 6 B Peckham motor trucks in addition to those recently contracted for. This truck has been adopted as standard by the company.

Lock Haven, Pa.—It is probable that an electric railway will be built from Lock Haven to Mill Hall. The McDonough Construction Company, of New York has made an offer to build the road, taking bonds and stock in payment.

Hartford, Conn.—The city council after a long consideration of the matter and an investigation of various methods of traction have decided in favor of the trolley and work will be commenced at once.

New York, N. Y.—The state railroad commissioners have granted the application to connect the Sixth avenue surface road with the Ninth avenue road by a cable through Fifty-third street.

Memphis, Tenn.—The steam dummies have been withdrawn from the system of the East End Railway Company, and hereafter the lines are to be traversed by electric cars.

Sioux City, Ia.—Judge Ladd has dismissed the petition of employes of the cable company for the discharge of Receiver Moller on the ground that he has neglected his duties.

Philadelphia, Pa.—The officials of the Hestonville Railway Company announce that work will be begun at once on the equipment of the road for electric traction.

Bath, Me.—Electric cars are again in operation. For five weeks cars were prevented from running by snow and ice on the tracks.

Indianapolis, Ind.—The construction of the electric line to Mount Jackson has been begun by the Street Railroad Company.

Beaver Falls, Pa.—The Beaver Valley Traction Company has voted to expend about $1,500 in laying out a base ball park.

PERSONAL.

J. L. Barclay, Chicago representative of the Walker Manufacturing Company, of Cleveland, has been seriously ill and in all probability will not be able to resume his duties for two weeks. In his absence E. F. Seixas is in charge of the offices of the company in Chicago.

F. S. Pierson, formerly of the West End road, Boston, it is reported, has been appointed to succeed Major McNulty, who will hereafter be identified with the Columbus and Ninth avenue construction work in New York City.

J. H. Graham, president of the Graham Equipment Company, of Boston, was in New York last week. He says the Graham truck is gaining favor every day and that business with his company is increasing steadily.

E. Packer, well known to street railway men through his connection with the Rochester Car Wheel Works, has left that company and is now with James A. Trimble, the car builder of New York.

Herbert McNulla has accepted the position of superintendent of the Calumet Electric Railway of Chicago.

George Law, president of the Eighth Avenue Railway, New York City, recently sailed for Europe.

TRADE NOTES.

Westinghouse, Church, Kerr & Co. have removed their offices from 17 Cortlandt street, New York, to the Havemeyer Building, 26 Cortlandt street, where they have a suite of four large connecting rooms and a private hall on the sixth floor. The firm at the end of ten years has grown to be exceedingly prosperous and it is now recognized as "an old established house." It is a progressive organization with a large corps of assistants and with branch offices in all the principal cities. The firm pursues a rather unique policy in the engineering field. It is not merely an agent although it sells the products of others, it is not exactly a manufacturer although it has shops covering ten acres in Chicago, it is not simply a company of consulting engineers although consulted by a large clientage, finally it cannot be considered only as a contractor although it executes a vast amount of important contract work. The fact is the company's policy includes all these branches of work, and in addition devotes no little energy to the development of new appliances. Among the various undertakings with which the firm has been identified are the development of the Westinghouse engine, invented by H. H. Westinghouse, from the small simple form to the large compound type, the mechanical stoking of coal, the "steam loop" and refrigeration and ice making. The business as now conducted is extremely diversified and extends throughout the entire country. These facts may explain the activity of their business during the last few months when so many companies have been suffering from the depression. In their new quarters the company will have improved facilities for transacting its growing business.

Fisher & Porter, 1025 Monadnock Block, Chicago, report that they see evidence of a good business in the immediate future. They are equipping with machinery, for W. H. Roessle, of Pittsburg, a gold mine at Tellico Plains, Tenn., and have supplied kotine, a new material for painting iron structures, for the new Lincoln Park bridge, recently erected by the Pittsburg Bridge Company.

They have the contract to supply two 75 H. P. M. A. Green engines for the Leland Hotel in Chicago, and have several contracts of a similar nature ready to be closed. They have advices from the home office of the Altoona Manufacturing Company that the works are running full time with a complete complement of men, and are turning out engines as fast as their equipment will allow. One 150 H. P. engine for the Farmington Light and Power Company, Farmington, Ill., and one 125 H. P. engine for the Western Glass Company, of Colorado City, Colo., are among the plants recently installed in the West. From the Providence Steam Engine Company it is reported that the works are running day and night with a double turn of men, in the construction of the improved Green engine, of which the company is builder.

The Wallace Electric Company, of 104 Michigan avenue, Chicago, has issued its first catalogue of electric railway supplies, insulated wire and cables lamps, measuring and indicating instruments and electrical specialties. It is designated as catalogue "A" and contains 114 pages of illustrations and descriptions of the apparatus and appliances handled by the company. J. B. Wallace, the manager of the company, was the organizer of The Electrical Supply Company, and being one of the pioneers in the electrical business has had an extensive experience. Max A. Berg, the secretary of the company, was the former manager of the street railway department of the Ansonia Electric Company and will act as electrical engineer for this department of the Wallace company.

Wells Goodhue will hereafter conduct under his own name the business formerly carried on under the firm name of Goodhue & Lincoln. Mr. Goodhue is well known in the electrical trade. He will continue to handle the same specialties with which he has so long been identified. The Wagner direct and alternating current power motors, Wagner fan motors and Sunbeam lamps will receive a large part of his attention. He also has a large line of second hand Westinghouse and Slattery transformers.

"After the Fair" is the title of a souvenir catalogue issued by the Page Belting Company, of Concord, N. H., giving a history of the company's various exhibits at the World's Fair. Among other features the pamphlet contains a reproduction of published fac-similes, full size, of the two medals awarded to the company for its exhibit at the World's Fair. These were made from the St. Gaudens design about which we have heard so much in the past two months.

Wm. Baragwanath & Son, Chicago, report sales of two 1,500 horse power heaters for the Edison Illuminating Company, St. Louis; two large condensers for the Chicago stock yards, also several smaller orders. They predict a good business this season.

The Crocker-Wheeler Electric Company, of New York, has issued a handsome catalogue describing and illustrating the electrical machinery now manufactured by this company at its extensive factory at Ampere, N. J. Of course the larger part of the catalogue is taken up with the details of the well-known Crocker-Wheeler dynamos and motors, motor transformers and regulating apparatus. The pamphlet is from the press of Bartlett & Co. of New York. Messrs. Sargent & Lundy are the Chicago representatives of the company.

Stern & Silverman Bonding Chuck.—The bonding method of Stern & Silverman of 707 Arch street, Philadelphia, Pa., has been adopted by the Electric Traction Company of that city for its entire system. The company controls over 100 miles of road. The system of bonding consists in the employment of the special bonding chuck which was illustrated in the March 10 issue of the STREET RAILWAY GAZETTE.

Preparing for Larger Business.—Mr. Wormser, manager of the Chicago branch of the Page Belting Company, says that their business is rapidly improving. The orders are increasing both in number and size, and they are preparing for a larger business than they have ever before handled.

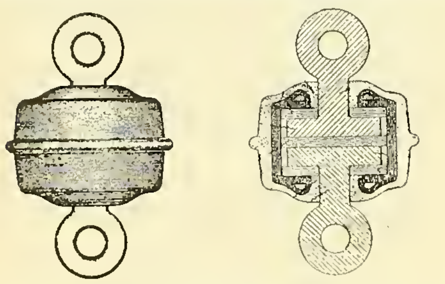
The Chicago Rawhide Company, Chicago, manuacturer of rawhide belting and pinions, is running its full force on full time in order to keep up with the demand for its goods. If the present rapid rate of improvement in it business continues the managers say that they will be obliged to work a day and night force.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued March 6, 1894.

515,751. Electric Switch Signal. Thomas L. Dalton and Nelson W. Dalton, Sandy Hill, N. Y. Filed August 5, 1893.

This consists of a train of gearing, a sprocket wheel on the shaft of one of the gears, a chain to turn the sprocket wheel and operate the gears, a rotating disk having oppo-



NO. 515,779.

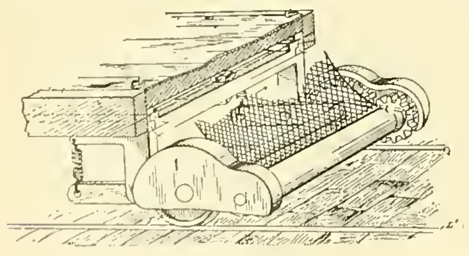
sitely arranged radial notches, a signal on an extension of the disk shaft, pivotally mounted pawl armatures to engage the notches in the disk, magnets to operate these armatures and an electric circuit to energize the magnets.

515,779. Strain-Insulator. Henry B. Luscomb, Hartford, Conn. Assignor to the John Pratt Company, same place. Filed November 4, 1893.

This is an insulator consisting of a pair of eyes having integral shanks with washers of laminated insulating material, and enlarged heads integral with the shanks, but insulated from each other and a sectional metallic drum surrounding the enlarged heads on the washers. (See illustration.)

515,823. Means for Switching from Main to Side Tracks John B. Duguid, Toledo, Ohio. Filed May 15, 1893.

The car carries a wheel guide, the standard movable therein, and carrying a wheel and a lever for operating the standard. This lever is so arranged that it returns to its



NO. 515,838.

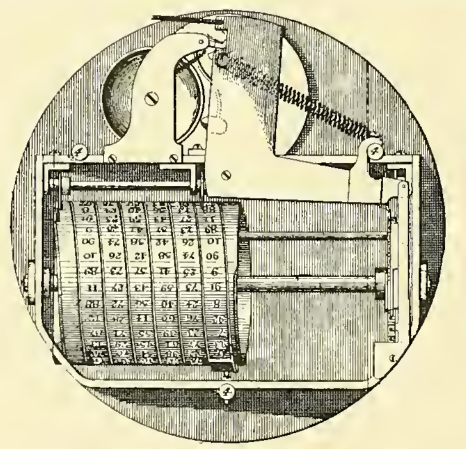
normal position by the action of a spring. There is upon the track a guide to operate in connection with the wheel.

515,868. Street Car Fender. Randolph C. Lothrop, Somerville, Mass. Filed October 13, 1893.

The first claim of this patent reads as follows: "A street-car fender embodying the combination of an advanced frame attached to the car: and the forward end thereof being capable of both a vertical and lateral movement for the purposes specified: a revolving guard roll attached to the front of said frame and arranged to be carried along thereby at a slight elevation above the track: means for revolving said guard-roll toward the car: and a safety net or platform immediately behind the roll." (See illustration.)

515,888. Fare Register. Edward T. Taylor, Oakland, Cal. Filed April 1, 1893.

This is a registering cylinder provided with helically arranged series of numerals progressing in regular suc-



NO. 515,888.

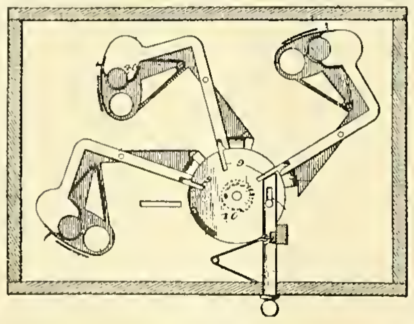
cession from one end, and a second series of numerals alternating with the first and progressing in regular succession from the opposite end of the cylinder. (See illustration.)

515,907. Hanger for Trolley Wires. George Forbus, Williamsport, Pa. Filed September 6, 1893.

This hanger is provided with two plates upon the inner faces of which are teeth projecting from the grooves made for the trolley wire.

515,920. Money Changer for Fare Boxes. Charles W. Muth and Henry Martin, New Corydon, Ind. Filed September 23, 1893.

This mechanism is made up of the combination of a casing, a coin chute, a disk arranged to receive a coin to be changed, a coin holding tube, a coin carrier, and a lever



NO. 515,920.

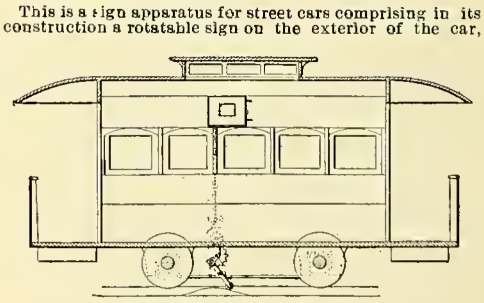
actuating the coin carrier, and arranged adjacent to the disk and adapted to be engaged by a coin. (See illustration.)

515,929. Street or Station Indicator. Bernard Barnett, New Orleans, La. Filed November 16, 1893.

This invention covers the combination with a car of the indicator arranged therein and having the two drums and the indicator hand wound thereon, the ratchet wheel on the shaft of one drum, the shaft journaled beneath the car, the toothed wheel on said shaft, the arm also on the shaft, a tappet lever or arm engaging said arm, the shaft carrying the pinion in engagement with the toothed wheel, the pulley secured to the pinion shaft, the vertically slidable and spring surrounded rod, carrying a catch at its upper end, and the flexible connection between said rod and pulley. (See ilustration.)

515,967. Street Car Sign. Edgar A. Rauch and Wilfred A. Keith, Brockton, Mass. Filed April 20, 1893.

This is a sign apparatus for street cars comprising in its construction a rotatable sign on the exterior of the car,

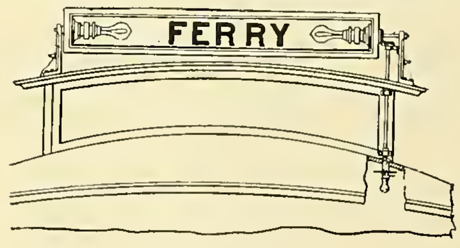


NO. 515,929.

and bearing inscriptions on its sides, a dial fastened on the interior of the car, and correspondingly inscribed, a rotary handle supported at the center of the dial and rotatively connected with the sign, and means for locking said handle in different positions it may occupy with respect to the dial. (See illustration.)

516,081. Fare Register. Charles Crook, Brooklyn, N. Y., assignor to Eli Baldwin, New York, N. Y. Filed January 24, 1893.

The first claim of this patent reads as follows: The combination in a fare register of the trip hand, a rotating direction indicator, a rotating disk or wheel provided with means for engaging with said trip hand and direction in-



NO. 515,967.

dicator, and a longitudinally movable rotating shaft adapted to be moved into or from engagement with said disk to either prevent or allow movement of the same.

516,161. Electric Cable Joint. Thomas C. Loe, New York, N. Y., assignor to the Standard Underground Cable Company, Pittsburg, Pa. Filed August 14, 1893.

This is a method of making a joint in electric cables and similar flexible lead covered constructions, which consists in applying about the cable a sleeve of lead or similar flexible material, extending outside the joint, and applying a wipe of solder about the inner end of the sleeve and joint.

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CONTENTS.

Water Pipe Corrosion. An interesting addition to the literature of this subject is found in the annual report of the Subway Commissioners of the city of Brooklyn, an abstract of which we print elsewhere in this issue. While adding nothing new to our knowledge of the method of avoiding the corrosion of lead and iron pipes by electric railway currents, the report emphasizes the importance of the phenomenon as a source of much prospective annoyance to the street railway companies operating trolley systems in large cities where underground pipes and cables are particularly abundant. All information on this subject seems to tend to the belief that the return circuit does not have sufficient conductivity. The bonds in many cases are absurdly small and perhaps in nearly all cases of insufficient carrying capacity. An important paper on this subject is in preparation and it is hoped that this will bring some new facts to light as to the best methods of avoiding these detrimental effects and serve to still further call attention to the importance of the subject.

Railway Motor Tests. Some excellent suggestions regarding the need of standardizing the methods of testing street railway motors will be found in W. Nelson Smith's article, "Electric Railway Motor Tests," printed elsewhere in this issue. Mr. Smith rightly calls attention to an obvious error that often creeps into the calculations of results of tests of this kind. In this connection it is worth pointing out that it is always of the utmost importance to state not only results but, when these are computed, the methods employed in deducing them. Various methods are likely to lead to different results and then comparisons based on these results lead to erroneous conclusions. This sort of work has caused much confusion and has led to the spreading of much misinformation in all branches of engineering, and the sooner the method of testing is standardized for the sake of making it possible to compare the results obtained the better it will be for all concerned. Mr. Smith's suggestion that the American Street Railway Association should give the matter careful attention is an excellent one.

Street Railway Accidents. The monthly record of street railway accidents which is published elsewhere in this issue, discloses the fact that accidents have materially increased within the last few weeks. As far as appears from the record no unusual causes operated to increase the number of casualties; yet the number of deaths in March attributed to street cars has doubled as compared with the number in the previous month. At the same time accidents that were not attended by such serious consequences have been on the increase. It is certainly not a matter for surprise that under these circumstances attacks on rapid transit companies have, if possible, become even more bitter than ordinarily. As we have frequently remarked the matter of decreasing accidents is worthy of far more time and study than is usually devoted to it. The problem is not an easy one, but like many another that has confronted street railway managers it may be solved, if the proper attention is paid to it. With better brakes, better guards and better discipline among the men the list of casualties should be materially reduced.

Liverpool Overhead Road. We begin in this issue the publication of an abstract of two interesting and important articles on the equipment and cost of operation of the only elevated road in England and the only overhead road in the world operated by electricity. Owing to the fact that engineers in this country have been eager to learn what were the operating expenses of the Intramural road at the World's Fair in order to use these figures for comparison in determining whether the saving was sufficient to justify the installation of such a system in preference to a steam plant, the figures given in these articles will be of very great interest. The cost of operation of the Intramural line is as yet a profound secret, known only to the company whose apparatus was used and to the engineers who made the test. Whether the figures obtained by the tests were so unexpectedly unfavorable that the company has refrained from making them public, or whether, on the other hand, they were so favorable that they prefer to make private use of them before giving the information to outsiders, is a question that the public is left to settle by an "educated guess." Most engineers will agree, however, that for the good of the electric railway industry, these figures ought to be made public. In the meantime, however, we may profit by a study of the figures that we find to be the results of operation in the Liverpool Overhead railway. The most important of these we will publish next week, when we will have some further comments to make on their significance.

Strike at Toledo. The decrease in the earnings of street railway companies due to unfavorable financial conditions has in many cases led to the readjustment of wage schedules, and in not a few instances strikes have been the result. Protests of this kind against reductions in pay are easily understood, for no one can view a decrease in his income with any degree of satisfaction. While labor troubles of this class are to be expected, however unfortunate and useless they may be, a strike like that which has within the last few days caused such commotion and inconvenience in Toledo is well-nigh incomprehensible. That men presumably intelligent should seize the present as a fitting opportunity for fighting for unionism is singular in the extreme. The company at first determined to fight the issue to an end, and while the city escaped the disgrace of a riot, a mob interfered with the operation of cars and assaulted those in charge of them. While the company would probably have had no great difficulty in carrying out its own policy in its own way, as Toledo, like other cities, has its share of unemployed men, the officers evidently concluded that a vast deal of trouble of various kinds might be avoided by a different course, and therefore willingly agreed to submit the controversy to arbitrators. Some such motive as this must have been effective, for the action of the officers during the strike disclosed the fact that they were not easily terrorized by threats or even by physical assaults. The order of injunction, which now seems to be a part of every strike of the employes of a common carrier, was forthcoming at Toledo. This was certainly one of the first instances in which its effectiveness was tested in a labor controversy on a street railway and the principal points in the petition are presented elsewhere in this issue. It does not appear that the restraining order was regarded by any of the one hundred and odd defendants with any particular respect, and certainly none of them has been held in contempt for disregarding the provisions although many of them by grounding the trolley wire and by other overt acts rendered themselves liable to the penalties of the law.

Contest for the Traction Prize. Those who follow the patent record as it appears each week in the STREET RAILWAY GAZETTE realize the great activity of inventors in the street railway field. A very considerable number of valuable inventions are produced, though it must be admitted that quite a number of patents are issued for inventions that are worthless and absurd upon their face. The announcement that the Metropolitan Traction Company of New York had offered a prize for a system of street car propulsion that would embody the merits of the trolley system, but would not involve the employment of aerial conductors, has served to show how great is the number of inventors and promoters who are interested in street railway problems. It seems almost incredible that 3,000 persons should have entered into a contest of this kind; yet this is the report from New York. It might be thought that among this surprising number at least a single meritorious plan would be evolved to commend itself to the Traction Company. Still we are inclined very seriously to doubt whether any system will be found satisfactory enough to lead street railway men to regret that they are so thoroughly committed to the trolley. Our sympathies go out toward the luckless examiners whose duty it will be to pass upon the various systems submitted for their inspection. There is probably scarcely an applicant who questions that the prize should be rightfully his, and the ears of the judges are bound to ring with the charges of partiality and injustice from the unfortunate and indignant inventors. The last report regarding the Traction prize will be exceedingly bad news to those who entered into competition for it. It is rumored that the Traction Company has withdrawn its offer altogether, inasmuch as the state railroad commissioners have not expressed their intention of acting as judges of awards. At the time the prize was offered the commissioners felt that they were not warranted in acting in this capacity unless they were authorized to do so by the legislature. A bill giving them the privilege was introduced but it has apparently been shelved, and as the acceptance by the commissioners of the positions as judges was a condition precedent to the award, it may now be true that the Traction Company has withdrawn its splendid offer, although the rumor to that effect has not been substantiated. If it proves to be correct it will be a tremendous blow to the competitors, many of whom entered the contest at not a little sacrifice of time and money.

STREET RAILWAY ACCIDENTS.

The monthly record of street railway accidents is presented herewith. In every way the record is more serious than that published a month ago. During the month of February the total number of accidents was 125, and this month the total is 188. In the former month 140 persons were injured and the table shows that the number has increased in March to 179. The accidents in March were of a more serious character than in the previous month. In the latter month 22 persons were killed and 50 were seriously injured; the accompanying record shows that in March there were 45 fatalities while 62 persons received serious injuries. No reason can be assigned for the increase in casualties; it will be noticed that considerably over one-half the number of accidents may be assigned to two causes—attempts to cross streets in front of cars and collisions of cars with vehicles. Following is a list of cities in which three or more accidents occurred: New York 16, St. Louis 16, Philadelphia 15, Chicago 10, Brooklyn 9, Cleveland 6, Pittsburgh 7, Cincinnati 7, Boston 6, Baltimore 6, Indianapolis 5, Jersey City 4, Detroit 3, Rochester 3, Worcester 3, Columbus, O., 3, Newark N. J. 3, Buffalo 3. The March list is as follows:

Number of places in which accidents were noted	68
Total number of accidents	188
Number of accidents to electric cars	152
Number of accidents to cable cars	35
Number of accidents to horse cars	1
Number of fatalities	45
Fatalities due to electric cars	37
Fatalities due to cable cars	7
Fatalities due to horse cars	1
Number of persons injured	179
Persons seriously injured by electric cars	57
Persons seriously injured by cable cars	5
Persons seriously injured by horse cars	none
Persons slightly injured by electric cars	95
Persons slightly injured by cable cars	22
Persons slightly injured by horse cars	none
Number of passengers injured	41
Number of employes injured	17
CAUSES OF ACCIDENTS	
Attempting to cross in front of cars	64
Collisions with vehicles	41
Collisions of cars	10
Fell from cars	6
Jumping from cars	8
Attempting to board cars	5
Collisions with railroad trains	2
Brakes failed to work	2
Car jumped the track	1

ST. LOUIS ELECTRIC RAILWAY MAIL SERVICE.

One of the St. Louis papers takes decided exceptions to an article going the rounds of the press in which the electric railway mail service in Ottawa and St. Louis are compared. The Ottawa car has greatly improved the local service by facilitating the distribution and collection of mail but no sorting is done en route. The St. Louis car on the other hand is equipped in the same way as a car designed for regular railroad post-office service. Postmaster Harlow of St. Louis recently made this statement regarding the electric railway mail department: "The St. Louis street car collection and distribution was put into operation on the Suburban line three years ago, and it can be found in no other city in the United States or Canada. While the Ottawa system is simply that of a mail carrier, who rides instead of walks, the St. Louis system is a complete railway postoffice in miniature, as complete as the St. Louis and Cincinnati or St. Louis and Chicago postoffices over the Baltimore and Ohio, Southwestern, the Vandalia or the Chicago and Alton roads.

"Starting from the Locust street terminus of the Suburban Railway, mails are exchanged at the postoffice, Eighth and Locust, and at 'rallying' points and substations, as follows: Thirteenth and Washington avenue, Eighteenth and Wash streets, Twenty-first and Wash streets, Twenty-eighth and Easton avenue, Grand avenue and Morgan street, Station C, near Vandeventer avenue and Morgan street, Taylor avenue, Bayard avenue, Bell avenue (Arcade), Cabanne avenue, Goodfellow, Hamilton, West Cabanne, De Hodiamont, Etzel, Plymouth avenue, Page avenue, Wells station and so on to Florissant, fifteen miles from the heart of St. Louis.

"Mails are distributed en route and the residue is turned into the St. Louis postoffice to be worked. This scheme has been in successful operation for three years and bids fair to be extended to the Lindell Street Railway system, with its thirty-five miles of double track, the Cass Avenue, Northern Central, Blue Lines, Mound City, Broadway Cable and other electric and cable roads in St. Louis, which is essentially a city of rapid transit. Chicago, by the way, tried on the Ottawa plan several years ago, and abandoned it when it was found impracticable."

SOME SEARCHING QUESTIONS FOR THE WEST END COMPANY.

The hearing before the committee on street railways of the Massachusetts legislature on the question of free transfers developed a spirited controversy last week between the counsel for the West End road and George F. Williams representing the petitioners. Mr. Williams submitted the following questions:

1—Value at which original properties consolidated were entered upon the books of the company, and the items of said valuation.

2—Depreciation on property of originally consolidated roads.

3—What has been allowed in the accounts of the depression of property, real and personal,and what have been the sales of personal property.

4—What real estate of the company is necessary for street railway purposes?

5—Amount of annual purchases and sales of real estate and amount paid for buildings and improvements.

6—Cost of construction.

7—Cost of equipment.

8—Total cost of overhead electrical equipment.

9—Total cost of cars of each class.

10—Contracts for construction of the electrical plant, including Thomson-Houston contract.

11—Items of the sundry accounts in the operating expense account as reported each year to the railroad commissioners.

12—All items for legal and legislative expenditures.

13—All payments made to John Shepard or others to prevent opposition to elevated railway charters and in what accounts entered.

14—Amount paid for accident losses and for insurance thereof.

15—Books containing all the returns of accidents made by employes of the road or others to the company.

16—Present cost of free transfer system.

17—Amount of transfers issued on each route of the company.

18—Prices realized upon sales of stocks and bonds of the company.

19—Monthly returns of earnings for the month of February 1893 and 1894.

Counsel for the West End were unable to say at once whether they would answer these questions or not, and asked more time. The committee decided that both sides should have an equal chance and adjourned to Monday April 2.

Car Barns Burned in St. Louis.

The Cardinal Avenue car barns of the Missouri Street Railway Company of St. Louis were struck by lightning on March 21, and were burned. Eleven motor cars, thirty trailers and two sweepers and sand and salt cars were destroyed. The total loss on the rolling stock and building was $100,000, covered by $198,750 insurance. The loss of the motors somewhat interfered with the regular service on the lines, but President Maffitt arranged with several of the other electric lines for the temporary use of motors until new ones could be purchased.

Brooklyn, N. Y.—It has been announced that the Long Island Boynton bicycle railroad will be connected with the Kings County elevated railroad at its eastern terminus and thus make connection between Brooklyn and the towns of Long Island.

THREE STREET RAILWAY STRIKES ENDED.

The strike on the system of the Toledo (O.) Electric Street Railway came to an end on March 27 when the company and its employes agreed to submit the controversy to an arbitration committee. Cars were immediately started out of the barns and have since been running regularly. The strike was the result of the discharge of four men whose only fault, as they claimed, was their activity in advancing the interests of the union. The company claimed that the men were discharged because their work was unsatisfactory. The day following the strike an effort was made to operate the cars but with little success. The officers of the Toledo Electric Railway Company manned the cars, and were pelted with sticks and stones. The strikers grounded the trolley wire at different points and adopted other means of interfering with the service. The streets were crowded with people and disturbance of the most serious character was prevented only by the activity of the police. During the course of the day an injunction was secured restraining the men from interfering with the operation of the cars. The defendants in the suit were the president of the Amalgamated Association of Street Railway Employes and more than one hundred of the men whose names were given in the petition. After reciting the facts that failure to operate cars would work a public inconvenience and might involve a forfeiture of franchise, the petition presented the following allegations:

"Plaintiff further states that all of said defendants have wrongfully and maliciously confederated and conspired together to obstruct and prevent plaintiff from operating the cars it has provided upon its said system of street railway in said city of Toledo, and that each and all of said defendants by force do prevent and in fact have prevented, said plaintiff from operating its said cars and system of street railway, as follows, to-wit: Those of the defendants who have been employes of plaintiff refuse to act as motormen or conductors or both, to run and operate said cars, as they have been heretofore employed by plaintiff to do; and each and all of said defendants are now preventing and obstructing other employes from acting as motormen and conductors to operate plaintiff's cars, as they are ready and willing to do, and whom the plaintiff has employed for that purpose. In pursuance of said wrongful and malicious conspiracy said defendants have forcibly, directly or indirectly, through said unlawful and malicious conspiracy, prevented said cars and said system of street railway from being operated, and for that purpose threatened and are about to do and have commited acts of violence to those who wish to and are ready to operate said cars. Plaintiff alleges that the main instigator and chief conspirator in causing and procuring all the wrongful acts and things to be done as aforesaid, is the defendant, W. D. Mahon, who is a non-resident of the city of Toledo, and has come here of his own motion, and has stirred up dissension and trouble among plaintiff's former employes, for his own pecuniary advantage, regardless of the interests of plaintiff and the public at large.

"Plaintiff further says that in pursuance of said wicked and unlawful conspiracy, said defendants have placed stones and other obstructions upon plaintiff's tracks, and threatens to injure with personal violence any employes of the plaintiff who attempt to perform any labor in operating plaintiff's cars. That said defendants have taken by force the cars of plaintiff from its said tracks and have placed some of the cars of plaintiff crosswise of said tracks. The defendants have directly or indirectly grounded and cut the electric wires of plaintiff, necessary to be used to propel the electric cars of plaintiff, in such wise as to interfere with and prevent the operation of said cars by means of said wires, all of which unlawful and malicious acts, each of said defendants have conspired together to do and accomplish, to defeat by the means aforesaid, the officers and agents of said plaintiff, from operating its cars and system of street railway.

"The plaintiff further says that the unauthorized and unlawful acts, as aforesaid, of said defendants in preventing plaintiff from operating its said cars, will greatly damage it by stopping and preventing its receipts of tolls and fares for the carrying over its said street railway, which said tolls and fares are of large amount daily, and from which plaintiff can only realize money to operate said railway, pay its taxes and assessments, together with the interest upon its outstanding mortgage bonds and indebtedness. And if plaintiff is not allowed to operate its said cars, but is prevented continually from doing so by defendants, as they threaten to do, then plaintiff's entire property and the interest of the stockholders therein will be subject to forfeiture and ruination and irreparable loss occasioned thereby.

"Plaintiff therefore prays that said defendants and each of them may be temporarily enjoined from in any manner interfering with the said plaintiff in operating its cars and electric apparatus used in connection with its system of street railway, or in any way interfering with the said plaintiff's officers, agents and employes while operating its said electric cars and apparatus or from doing and performing any acts of interference or violence toward the property of plaintiff, its officers, agents and employes, and that upon final hearing said injunction may be made perpetual."

On the following days the company continued its efforts to operate cars under difficulties. There were no sensational incidents, but the men who undertook to run the cars had lively experiences. Continued efforts were made to settle the controversy, but while the company expressed its willingness to confer with the men individually, it refused to recognize the union. On Tuesday last an arbitration committee was selected and cars were started out as already stated.

The employes of the Bellaire, Bridgeport and Martin's Ferry Street Railroad Company, whose main office is in Bridgeport, O., struck last week because their wages had been cut from 15 cents to 13 cents per hour. The strike continued four days, after which a compromise was effected, the company agreeing to pay 14 cents per hour.

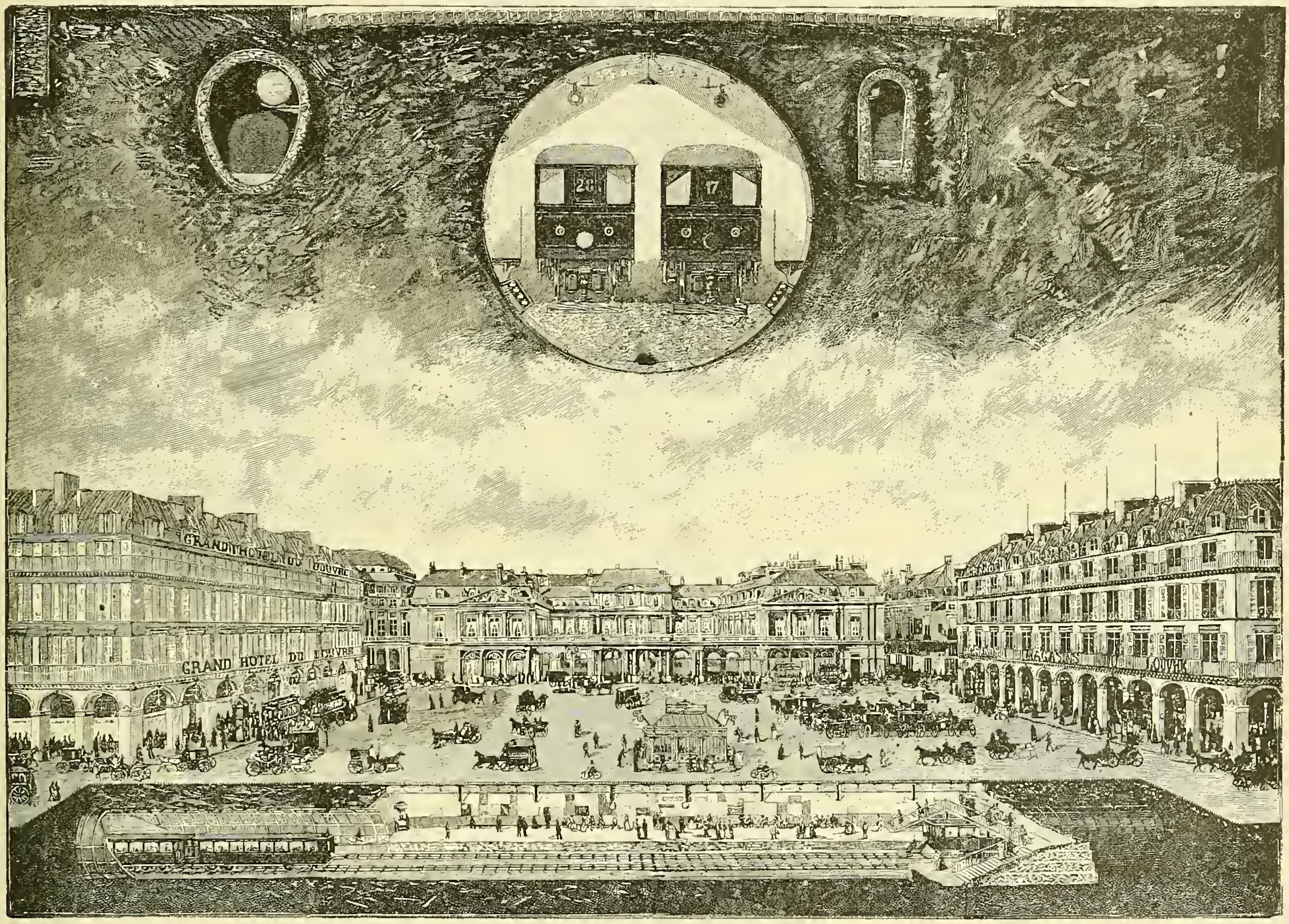
Mayor Sanford, of Long Island City, L. I., who consented to act as the arbitrator in the strike of the employes of the Steinway electric road, has made his decision. It was not as favorable as the men expected. The mayor finds that Long Island City citizens should be given preference when men are to be employed; that no discrimination against members of unions should be made; that employes dismissed because of height, or for being late once, shall be reinstated, if competent; that rules binding both the company and its employes shall be framed; that dismissals shall not be made upon charges without hearing given, and that pay shall not be deducted when runs are not made on time because of accident. A committee is named to pass upon the competence of dismissed men who desire reinstatement. These are Rapid-Transit Commissioner Eugene L. Bushe, George R. Crowly, secretary to the mayor, and Frank Johnson, selected by the employes.

PARIS UNDERGROUND ELECTRIC RAILWAY.

For twenty years projects for an underground railway similar to the Metropolitan road of London, have been under discussion in Paris, but one after the other they have been dropped, with a single exception. This latter enterprise, which contemplates the construction of an underground electric road from the Bois de Vinceunes to the Bois de Boulogne, was submitted to the Parisian authorities by M. Berlier in 1887. In was examined by the municipal council but for one reason and another no action was taken until July 1891, when this body decided to investigate its merits. A favorable report was made despite the fact that objections to the plan were made by surface companies and by the promoter of a rival project. The Berlier plan commended itself to the authorities because its execution did not involve excavations in the public streets and because it was proposed to operate the railway by electricity. The practicability of such construction and operation was at first doubted, but an investigation of the City and South London underground electric railway demonstrated that there were no grave difficulties in the way. The successful operation of this road, which was opened after the Berlier enterprise was under consideration, did more than anything else to convince the Parisian authorities that an underground electric road was an entirely feasible project. It is stated that the railway will be built without delay.

The construction of the line will be practically the same as that of the City & South London railway. As in that case the work will be conducted on the Greathead system, the walls of the tunnel being formed of steel tubing. The fact that in this construction it is not necessary to open up the street for long distances is considered of the utmost importance, as the municipal council flatly refuses to consider any plan the execution of which will interfere with the use of the public ways. In the construction of the stations, which will necessitate work on the surface, plans similar to those followed when streets are paved or repaired will be adopted and pedestrians and persons with vehicles will be subjected to very slight inconvenience. The council will not allow much use of the surface for stations in the central part of the city. A structure which will serve as a shelter for the stairway leading to the platforms below will be all that will be permitted. In the Berlier system the current is carried along the way by a conductor rectangular in section, placed midway between the rails and mounted on glass insulators. The current is picked up by a sliding shoe. The rails constitute the return path.

Passengers will be carried in single cars or in trains of two or three cars in accordance with the demands of the public. Each car will seat 52 persons. The speed of the trains will be about 12½ miles per hour and the trip from terminus to terminus, i. e. from the Bois de Vincennes to the Bois de Boulagne, will occupy 37½ minutes including stops at stations. There will be fifteen stations in all at each of which it is estimated twenty seconds will be lost in stopping. The

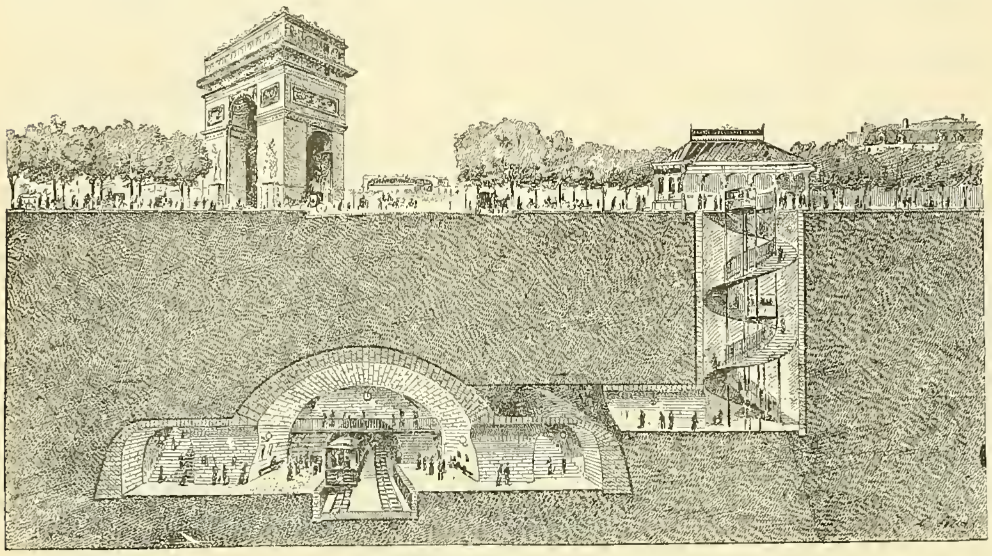


PARIS UNDERGROUND ELECTRIC RAILWAY.

length of the road will be slightly over seven miles. Over that portion on which the most of the passengers will enter and leave the cars trains for the greater part of the day will run every two minutes; on the rest of the road trains will run on a four minute schedule. It is stated that two features will make the road superior to the underground electric railway in London. Especial effort will be made to deaden the noise of the trains, and with this end in view the rails will be laid on wooden ties buried in ballast. Ventilation will be effected by means of pipes leading to the surface. In the London tunnel, which is quite short, there has seemed to be no necessity for adopting means of ventilation.

The coaches will be divided into compartments like the railroad coaches of England and the Continent, but whether they will be divided into first class and second class is not definitely decided. If so, the fare for the former will be 6 cents and for the latter just half that sum. Although the municipal council has favored this arrangement there is quite a little objection to it, as many persons think that the abandonment of the class system altogether and the establishment of a single rate of fare, 4 cents, would prove to be a far simpler and more satisfactory system.

The accompanying illustrations indicate the general features of the system.



PARIS UNDERGROUND ELECTRIC RAILWAY.

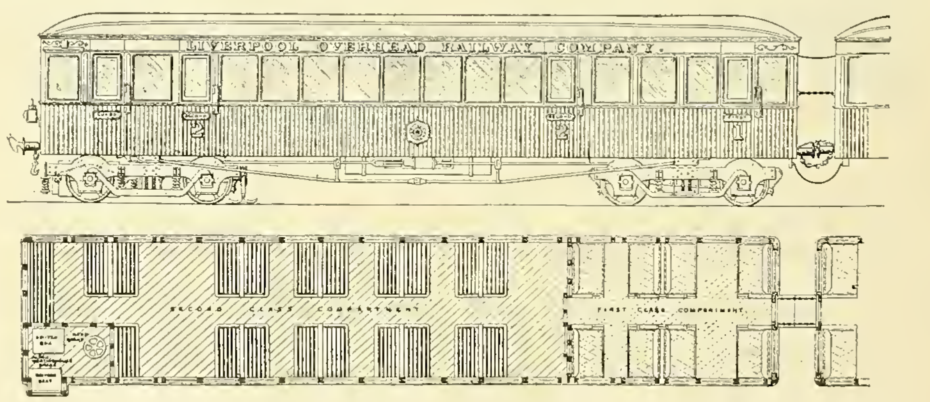
EQUIPMENT AND OPERATION OF THE LIVERPOOL OVERHEAD RAILWAY.

At a recent meeting of the Institution of Civil Engineers (London) Messrs. Greathead and Fox presented a paper describing the construction, equipment and results of operation of the Liverpool Overhead railway—the only elevated road in England and the only electrically operated elevated system in the world. For this reason the facts contained in the paper are of special interest and value to American engineers and railway men who have been watching the operation of that road for the purpose of ascertaining what advantages electricity possessed as a motive power for city transportation lines of this class. It is impossible for us to reprint the paper in full, but those parts which bear especially upon the method of working and the cost of operation are given in the language of the authors of the papers. The paper of Messrs. Greathead and Fox is supplemented by one on the electrical equipment of the road by Thos. Parker, the engineer for the Electrical Construction Corporation, the contractor for the equipment. Extracts from both papers are here given:

Motor Cars.—Where trains are heavy and long, and where the weight on the driving wheels is not a consideration, separate locomotives may be preferable, because it is undesirable to multiply machines, and it is an advantage to have all the machinery under the eye of the driver and readily accessible—in tunnel railways also there is more space for the motors in separate locomotives. In cases, however, where it is important to limit the weight on the driving wheels, motor cars afford an opportunity of running trains of any length without undue weight being thrown upon the structure. For instance, on the elevated railways of New York the structures will not admit of heavy locomotives; and though the traffic is such as to tax the carrying capacity of the trains, run at the shortest possible intervals, to its utmost limit, and beyond considerations of convenience, larger trains cannot be introduced unless the structures can be strengthened or motor cars be adopted.

Lighter trains, resulting in better speed with a given expenditure of power, also follow from the use of motor cars. As an illustration of this derived from actual experience, the trains of the Overhead Railway may be compared with those of the City & South London Railway. In the former case the electrical equipment for motive power adds 6 tons 7 cwt. to the weight of carriages seating 114 passengers; while in the latter the corresponding weight (the locomotive) is 10 tons 7 cwt., 96 passengers being carried. The avoidance of shunting at the terminal stations is another important advantage attending motor cars. Every separate movement of even a light locomotive absorbs a comparatively large current, thus accentuating the irregularities of demand, already sufficiently variable, upon the generating engines and dynamos. Time is saved at the terminal stations and siding accommodation is reduced in length. Wear and tear of all kinds are reduced, and the first cost of the trains is considerably less.

The design of the carriages, Figs. 1 and 2, received much consideration and the result is satisfactory both as regards weight and convenience. One train consists at present of two carriages, each 45 feet long and 8 feet 6 inches wide, on two bogies 32 feet apart from center pin to center pin, with 2-foot 9-inch wheels, 7-foot wheel base and pressed steel frames. The carriages are all exactly alike and contain accommodation for 16 first-class and 41 second-class passengers in each carriage, with three side doors and a passage from end to end. The first-class passengers are at one end of the carriage, and the driver's box, with switches, etc., is at the other. When the two carriages are coupled together to form a train, the drivers' boxes are at the extreme ends and the two first-class compartments consequently together in the middle of the train. A small door through the contiguous ends of the carriages enables the guard or attendant to pass from end to end of the train.



FIGS. 1. AND 2. PLAN AND SIDE VIEW OF CAR USED ON THE LIVERPOOL OVERHEAD RAILWAY.

The motors, one at each end of the train, are controlled from either end; the driver, of course, always traveling at the front end of the train and changing ends upon arrival at a terminus, carrying with him a key without which the motors cannot be operated. In a train thus arranged one driver and one conductor constitute the train staff, the guard as well as the driver having it in his power to cut off the current from the motors and to apply the brakes.

Brakes.—The trains are fitted with the Westinghouse automatic brake, deriving its supply of compressed air from a reservoir on the train, the reservoir having a capacity sufficient for two complete journeys and being recharged each journey from a receiver placed at the terminus at the north end of the line. This system of working the brakes was previously applied by Mr. Greathead and found to work well on the City & South London Railway, and has answered equally well here. The air compressors are in this case worked by a small electric motor with a gas engine in reserve; and pending the completion of the northern extension, the compressed air is conveyed a distance of about ¾ mile through one of the gas tube rails of the parapet to the present northern terminus at Alexandria Dock station. A hand-brake is also provided at each end of the train. The carriages are lighted by 32 candle power incandescent lamps connected with the working current, and the stations are lighted by similar lamps connected with a battery of accumulators placed under one of the platforms at each station. These batteries are in duplicate and are charged in series by the main generating dynamos.

Power Plant.—The coal is tipped direct from the railway trucks into large hoppers placed over the boilers, and is distributed by a conveyor to the shoots of the Vicars mechanical stokers with which the furnaces are fitted. There is thus no handling of the coal. Water from the adjacent dock is used for condensing, and the town water for the boilers. Mr. Thomas Parker, to whose skill is due the excellent design and construction of the electrical plant, supplements this paper with an account thereof, and it is therefore unnecessary to describe here the details of that work.

The boilers are of the double-flue Lancashire type, with cross tubes; they are of steel, six in number, each 8 feet in diameter by 30 feet long, with a working pressure of 120 pounds per square inch, and Green economizers in duplicate are fixed in the main flues. The steam and feed-pipe ranges are also in duplicate. The engines are four in number, each consisting of a pair of horizontal compound condensing engines, built by Messrs. Musgrave & Co., of Bolton, who contracted with the Electric Construction Corporation to supply the engines and boilers complete, and with the company to erect the chimney shaft (165 feet high), foundations of boilers, engines, etc. The high-pressure cylinders are 15½ inches and the low pressure 31 inches in diameter, with a stroke of 36 inches, fitted with Corliss valves driven by Tripp gear, acted on directly by the governor. Each engine will develop 400 I. H. P. at 100 revolutions per minute, with 120 pounds boiler pressure. All the engines exhaust to one condenser of the tubular surface type. The centrifugal circulating pump and air pumps are driven by a Musgrave "No-dead center" vertical compound engine, and the condensing plant is in duplicate.

Each engine drives an Elwell-Parker dynamo, from which the current is conveyed north and south along each line of the railway by the steel conductor already described. Hinged collectors of cast iron, sliding upon this conductor, the top surface of which is about $\frac{3}{4}$ inch higher than rail level, allow the current when required to pass through the motors and to return by the wheels and the rails to the dynamos. At the crossings the conductor is bent to form wings parallel to the rail to be crossed, in the same way as is usually done at rail crossings.

Relative Economy, Steam and Electricity.—The question of the relative economy of the working of steam and electric locomotives is of great interest at the present time. The nearest approach to the Electric Overhead Railway at Liverpool seems to be the elevated railways in New York, worked by steam locomotives. In each case the trains are comparatively light, though the New York trains are heavier than those at present running on the Liverpool line, and in each case the stations are on an average about one-third of a mile apart. In 1889 an experiment was made upon one of the New York lines to determine the possibility and cost of working by electricity. The results of this experiment, with a continuous current system of electric traction, were used with considerable effect in the Parliamentary Committee Rooms on behalf of the Metropolitan Railway Company against the proposed Central London Railway in 1890; and a description of the experiments and the results and conclusions derived from them, with details of the cost of working the steam locomotives on the Manhattan Railway, was published in a paper by Mr. Lincoln Moss in October, 1890.* The main conclusion arrived at was that "the cost of direct electric propulsion would be four times that of "steam locomotion" on the Ninth Avenue railway.

It is not necessary now to describe in detail the arrangements and results of those experiments, but it may be interesting to mention that the New York experiments were made with a train of $53\frac{1}{2}$ tons drawn by an electric locomotive of nine tons or more (the exact weight is not given) over a length of $1\frac{3}{4}$ miles of line, with four intermediate and two terminal stations, and having gradients of $\frac{1}{100}$, $\frac{1}{70}$ and $\frac{1}{54}$ against and $\frac{1}{100}$ with the load. The average speed attained was 9.4 miles per hour, stopping at the four intermediate stations. The average power of the generating engine was 176.8 I. H. P. and the average power applied on the railway was only 26.7 effective H. P., giving thus an efficiency of 15 per cent. as regards the indicated and effective power. Estimates were made in detail of the cost of installing and working an electrical equipment capable of dealing with the traffic on the Ninth Avenue railway, about five miles long. The total arrived at was £771,000, including 17 generating engines, each of 600 H. P., dynamos aggregating 11,000 H. P. and electric locomotives alone costing £126,000.

The estimated working expenses for motive power, excluding interest on the first cost, came to £135,000 per annum, or to over 3s. per train-mile.

The actual cost of the whole electrical equipment of the Liverpool Overhead railway, for six miles of line, has been little more than five per cent. of the above estimate for the Ninth Avenue line of five miles, and the working expenses for motive power are about 4d. per train-mile, the mileage being much below the capacity of the generating plant. With a train-mileage equal to that of the Ninth Avenue line the cost would not exceed 3d. per train-mile. The actual average consumption of coal on the Liverpool Overhead railway is about 16 pounds per train-mile for trains of about 38 tons weight with seating capacity for 114 passengers, running at an average speed, including stops at stations, of about 12 miles per hour; whereas the averages on the New York elevated railways are, as far as can be ascertained, 54 pounds of coal per train-mile for trains of about 92 tons weight (including locomotives weighing 23 tons) running at an average speed, according to the official time-tables, of about 12 miles per hour, including stops at stations. On the Liverpool railway, during the last half year, over 95 per cent. of the trains were punctual to time. No returns are available as to the punctuality of the New York trains. The coal used at Liverpool is bituminous small coal (slack), while in New York it is anthracite of good quality. The New York fuel consumption includes the heating of the trains in cold weather, but on the other hand that of the Liverpool line includes lighting of trains and stations and the working of the automatic signals. The working of the brakes is included in both cases.

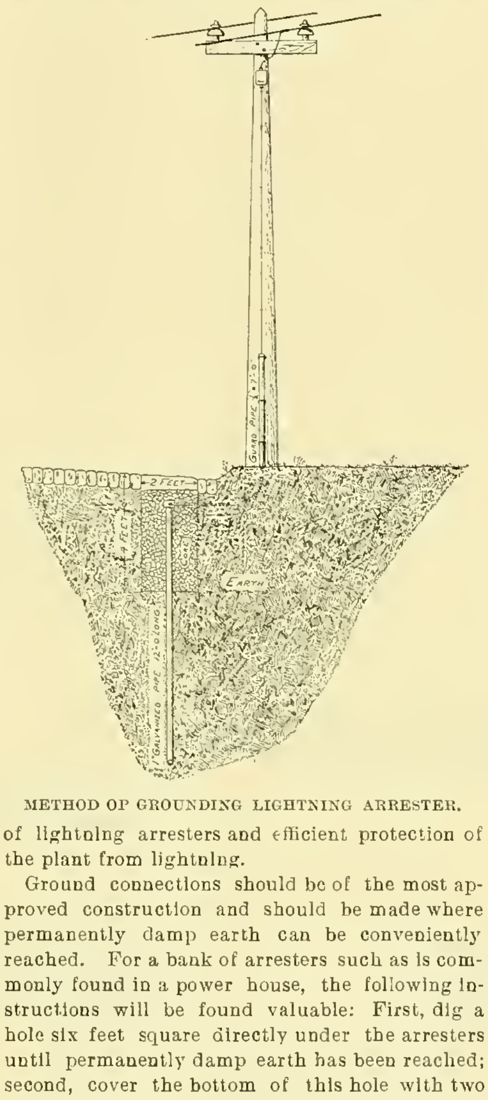
It will thus be seen that, far from electric traction costing four times as much as steam locomotive traction, it is actually less expensive after full allowance is made for the difference in the weights of trains and other circumstances, in the two cases considered; and when the mileage of the electric line increases, the difference will be still more marked in its favor.

(To be continued.)

*Transactions of the American Society of Civil Engineers, Vol. xxiii, 1890.

GOOD GROUNDS FOR RAILWAY CIRCUITS.

A pamphlet has just been issued by the Westinghouse company giving some practical hints on means for protection against lightning. The writer of this pamphlet says that an old rusty casting or an abandoned pulley hooked onto the end of a tangled piece of scrap wire and then thrown into a neighboring creek or tail-race of a mill, or a small iron spike driven conveniently into dry earth or sand, form ground connections not infrequently found in practice, which fact is greatly to be deplored, for upon the ground connection depends largely the successful operation



METHOD OF GROUNDING LIGHTNING ARRESTER.

of lightning arresters and efficient protection of the plant from lightning.

Ground connections should be of the most approved construction and should be made where permanently damp earth can be conveniently reached. For a bank of arresters such as is commonly found in a power house, the following instructions will be found valuable: First, dig a hole six feet square directly under the arresters until permanently damp earth has been reached; second, cover the bottom of this hole with two feet of crushed coke or charcoal (about pea-size); third, over this lay 25 square feet of No. 16 copper plate; fourth, solder the ground wire, which should not be smaller than No. 4, securely across the entire surface of the ground plate; fifth, now cover the ground plate with two feet of crushed coke or charcoal; sixth, fill in the hole with earth, using running water to settle. Additional connections to the water main if near at hand are recommended. For line arresters, particularly in city districts, the above method will not always be found convenient. The following, however, is considered an excellent substitute (see accompanying figure). Dig a hole directly under the arrester about two feet in diameter and deep enough to reach damp earth. From the surface down drive eight or ten feet of gas pipe having open ends, in the upper end of which screw a solid brass plug, and to which the ground wire of the arrester should be soldered. The hole should then be filled in with coke. In this manner advantage is taken of the deep damp earth as well as of the surface drainage. Well grounded tramway rails also make a good ground. In some instances it may be desirable to conceal or protect the ground wire between the arrester and the earth; for this purpose an ordinary gas pipe will offer a good mechanical protection and at the same time serve to decrease the inductive resistance of the discharge circuit.

DEATH OF J. L. BARCLAY.

Jacob L Barclay, the manager of the western interests of the Walker Manufacturing Company of Cleveland, O., died suddenly at Pittsfield, Mass., on Monday of this week. Mr. Barclay had gone east on a business trip and while at Pittsfield found it necessary to undergo an operation for appendicitis. Blood poisoning, the result of this operation, was the cause of his death.

Mr. Barclay's first venture in the electrical business was with Holmes, Booth & Haydens, in whose service he remained for a number of years. On the formation of the Sprague Electric Railway & Motor Company Mr. Barclay became manager of the western agency, with headquarters in Chicago. He continued in this position, selling both stationary and railway motors, until the Sprague company was absorbed by the Edison interests, when he took the western management of the railway department of the Westinghouse Electric & Manufacturing Company. This position he relinquished only about a year ago. As most of our readers know, Mr. Barclay's next move in the commercial branch of the business was to acquire an interest in the Walker Manufacturing Company of Cleveland, and to organize for that company, in connection with H. McL. Harding, an electric railway department. The western branch of the business was placed in Mr. Barclay's charge and he had only just completed the fitting up of his offices in the Monadnock Block, in Chicago, when he went east on the business trip mentioned above.

Mr. Barclay was an Englishman by birth, and was 35 years old. The funeral took place from his former residence in Chicago on Thursday of this week.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The eighty-fourth meeting of the Institute was held March 21, at which a paper "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp" was presented at the New York meeting by Prof. W. A. Anthony of Vineland, N. J., past-president of the Institute. The discussion was opened by Prof. Wm. Lispenard Robb of Trinity College, Hartford, Conn. A meeting of the Chicago members was also held simultaneously, at which the same paper was read and discussed at the Armour Institute. The author was represented at Chicago by Prof. Dugald C. Jackson of Madison, Wis. Through the courtesy of the Metropolitan Telephone and Telegraph Company, the American Telephone and Telegraph Company, and the Chicago Telephone Company, telephonic communication was established between the two meetings, with Mr. A. S. Hibbard at the Chicago terminal and Mr. J. J. Carty in charge of the arrangements in New York City. Both gentlemen are members of the Council of the Institute. The possibility of bringing distant audiences in touch with the author of a paper, was satisfactorily established, and before adjournment, President Houston at New York, spoke over the wire to attentive listeners in both cities extending congratulations upon the success of the dual meeting, and informing the Chicago members that the report of the committee on Units and Standards had been approved recommending the provisional adoption of the term "gilbert" for the C.G.S. unit of magneto-motive force, the "weber" for C.G.S. magnetic unit of flux, the "oersted" for the C.G.S. unit of reluctance and the "gauss" for the unit of flux density. About 80 members and guests were present at the New York meeting, and 50 in Chicago.

At the council meeting in the afternoon, upon recommendation of the sub committee on papers and meetings, it was voted to hold the annual and general meetings of the Institute in Philadelphia, May 15 and 16.

As required by the rules the council also canvassed the nominations received from the membership during the month of February, and prepared the following ticket for the coming election, ballots for which will be issued in April: For president, Edwin J. Houston; for vice-presidents, Wm. A. Anthony, Francis B. Crocker and James Hamblet; for managers, A. E. Kennelly, W. D. Weaver, Chas. S. Bradley and William B. Vansize; for treasurer, Mr. George M. Phelps.

ELECTRIC RAILWAY MOTOR TESTS.

BY W. NELSON SMITH.

It often happens that officials in charge of electric railway apparatus have occasion to measure the electrical horse power absorbed by a motor car, either on a regular service trip, or on a special trial. The prime object in making a commercial test is usually, either to determine the relative efficiency of two or more different styles of apparatus or to ascertain the performance of a given type under different conditions, generally with a view to improvement. "How much current does it take?" is a question frequently asked about every type of motor, on the supposition that the motor that requires the least current will make the smallest demand upon the power station. But it must be understood that there are other things besides the current that are to be taken into consideration. The results of such tests are sometimes published, or are used more or less extensively by manufacturing companies, either as advertisements of their own apparatus, or as potent arguments against the adoption of machinery that competes with theirs. But it is quite possible that if the true inwardness of the data obtained in some of these cases had been more carefully sought, they would never have been published.

In making a test of any description whatever, the first rule to be observed is, to have a distinct object in view at the outset, and to keep it in view to the end. It is also extremely important to provide reliable instruments, and competent persons to take the observations. Errors in instruments can generally be corrected by calibration, but errors of observation cannot be compensated for. Speed and accuracy are both essential, and without them the results are valueless.

The most desirable instrument for the measurement of electrical power is a watt-meter, provided one can be procured whose capacity is sufficient and whose readings will not be affected by the jarring and jolting from which no street cars are exempt. But the instruments most commonly used are the voltmeter and ammeter, whose readings are taken simultaneously every 15 seconds. The fluctuations in the current as required for ordinary operation, demand this frequency. If the instrument dials are so divided or graduated as to be quickly and easily read, the necessary skill may be acquired without much difficulty. There should be at least one person to each instrument, and another holding the watch and calling time. When there are other instruments, such as a tachometer or a dynamometer each should have its separate observer. As a general thing, the measurements of electromotive force, current and time overshadow all others in importance, because from them are calculated the rate of working, and the total work done.

These two quantities must be carefully distinguished from one another, in making all determinations that are intended to have a commercial or economic significance. The rate of working is measured in watts or horse power; the total work done is expressed in watt hours, horse power hours, or foot pounds. The rate unit is used to convey an idea of the size of the machinery needed to do work at the required rate, as well as to compare rates of working under different conditions. The watt and horse power are the accepted practical rate units. But it is only when this rate unit is multiplied by the time unit, that any idea can be conveyed of the actual work done and the cost of doing it; and as the dollars form the basis of all engineering work of this character, measurements taken for commercial purposes must be reducible to dollars in order to be of any value. The performance of a power station, for instance, is usually expressed as costing so much per car mile or ton mile, and it seems to the writer that the performance of motor cars should also be expressed in units that have an economic significance. The horse power hour, or the watt hour are the proper units for measuring power consumption, and are easily deducible from the data obtained from any well-conducted test. The use of these units will also eliminate any error that arises because of difference in the speed under different conditions. For instance, one car may make its trip in five minutes less time than another, because the motors are speeded higher. It may be that the decrease in the time of the trip may be compensated by the slight increase in the rate of working, so that the actual energy reckoned in horse power hours, may be practically equal in the two cases. Again, in a comparison of the performances of different cars, it should be remembered that if one is speeded higher than another and both run on the same time schedule, the faster car must run without current, or on its own momentum, considerably more than the slower, or else it would continually be ahead of time and following its "leader" too closely. The averages of current consumption of the two cars may differ considerably, but they cannot properly be compared without taking into account the actual number of seconds or minutes, respectively, for each car, during which the current flows. Clearly, therefore, time is a factor in the calculation, no less important than the electromotive force and current.

In such a comparison as that just outlined, a watt-meter of first-class make could be depended on for accurate results, because it would measure energy only when there was current flowing. But the usual way is to measure volts and amperes separately, every 15 seconds, and to compute the power from these readings, and this method carries with it the possibility of serious error in averaging the results, so that they are likely to be misleading.

As mentioned above, the current may be shut off at frequent intervals during a run, either to stop or to slacken speed. This happens so often that a large proportion of the readings are zero readings as regards current. Evidently, when no current flows, there is no power expended; a watt-meter in the circiut would not register anything during such intervals. Since, during a part of the time, there is no power used, it seems preferable to average it up only for the time during which it is used. In this way the actual performance of the motor can be determined, and compared with whatever expectations or guarantees there may have been put forward. Obviously, if the average current were based on the total number of observations, covering the entire time of the trip, there would be included a large percentage of zero readings, which lower the average in proportion to their number. To be sure, the smaller average so obtained covers a greater period of time, which partly compensates, but the writer's opinion is that an average so obtained does not mean anything, as regards the actual performance of the motors. It is not the way to judge of the electrical or mechanical capacity of the motors, because they are not in continual use; neither is it the right way to judge of their economic performance, because the actual consumption of energy is not measured.

Such errors and misleading results can be avoided, in computing results from volt and ampere readings, if the watts or horse power be calculated separately for each pair of readings, and the average computed from this series of results. This method may be long and tedious, unless a slide-rule, calculating-machine or table of electrical horse power be available. When finished, however, there is the satisfaction of knowing that the result is really the average of the observed watts or horse powers, and not some other quantity. It is the same, in all probability, as would have been registered by a watt-meter under exactly the same conditions.

A common, but inaccurate way, is to add up the volt readings (every reading being in significant figures), and then the ampere readings (a large number of which are denoted by zeros), and to divide both totals by the same number, which is the total number of readings, giving presumably the average volts and average amperes. From these two averages is then computed the average horse power, because at first sight it would seem that the average horse power must of necessity depend upon the averages of electromotive force and current. But this supposition is incorrect. Any one willing to take the trouble to set down a few numbers and try it, can easily be convinced that the average of a series of products, each made up of two factors, is not the same number as that obtained by averaging each of the two series of factors separately, and then finding the product of these two factor averages. It is natural enough to seek both the average electromotive force and the average current, in any test, but in such a case as this, any further use of these averages is likely to be misleading.

Attention has been called to the fact that a large number of the current readings are zero readings, while the simultaneous volt readings have always some significant value—barring accidents to the trolley or the line. Such observations, both of current and electromotive force, taken when the current is off, may be termed "idle" readings and the remainder "active" readings. It is the writer's opinion that, as far as concerns either the performance of the car or its influence on the line pressure, the idle readings are of no consequence whatever and ought to be left out when averaging. They neither represent any "drop" in the pressure nor are they concerned in the expenditure of energy, because no current is flowing. If they are so omitted the current average will be increased considerably (so many zeros being stricken out), and the pressure average will be slightly lowered, as the pressure is always a trifle lower when the current is turned on than when it is off. Instead of computing an average line potential (which concerns the line only) we then obtain the average working potential, on which the economical operation of the motor so largely depends.

Evidently, if the proper method for determining the power as outlined above, be followed, all idle readings will be eliminated, as no power can be computed for any observation when the current is zero.

The correct process may be summarized as follows: To compute the average power, or rate of working, multiply each volt reading by its corresponding ampere reading, add these products (watts) together and divide their sum by the number of "active" observations. The quotient so obtained is the average watts, and the horse power is found by dividing this by 746.

To compute the total work done, multiply the average watts (or horse power) by the time in hours over which the active observations extend, allowing 15 seconds for each one. 1 horse power hour=1,980,000 foot pounds. To compute the average *working* pressure, find the average of the "active" volt readings only.

To compute the average *working* current, find the average of the "active" ampere readings only.

Questions that are still to be settled quantitatively, such as the relative economy of single and double motor equipments, and of various methods of gearing, control, etc., require practical trials to test the comparative merits of the various devices. It frequently happens that small differences decide big questions, and accurate results, though sometimes tedious to reach, are decidedly worth striving for, even if they differ by but a small per cent. from results that are inaccurate though more easily obtained. By careful attention to the manner of computing, there is no doubt that many a puzzling discrepancy may be avoided.

It is extremely desirable to establish uniformity in all tests, whatever the objects in view, and it would appear that those who are most likely to have interests at stake ought to be ready and willing to advocate and accomplish it. It is the writer's impression that certain technical societies, in various branches of engineering, have recommended that the various tests which bear on their several lines of work be made in accordance with their established methods, and observations and results recorded on blanks of standard patterns. This subject would legitimately fall within the province of the American Street Railway Association, and it may not be out of place here to express the hope that the association will take measures to standardize motor tests scientifically, as the uniformity that will in time result from such action will be of the greatest benefit to all who have the technical and financial responsibility for the operation of electric railway machinery.

It is the writer's intention, in a future article, to compare results when computed in different ways from the same data, in order to show the difference between accurate and inaccurate work, and the mistaken conclusions that are likly to be reached in consequence.

CORROSION OF WATER AND GAS PIPES IN BROOKLYN.

The report for 1893 of the board of commissioners of electrical subways of the city of Brooklyn contains some matters of interest to street railway managers. Upon the subject of corrosion of water and gas pipes the body of the report contains the following:

One of the inconveniences incident to the introduction of the electric railway system was briefly referred to in the report of this board for 1892, as of uncertain character and extent. It has proven to be of a very serious nature. This is the corrosion of gas pipes, water pipes and the lead covering of telephone cables. Wherever the destructive action has caused a leak, either of water or gas, the fact has been discovered and the injured section removed. These discoveries have of late been so numerous that there seems no escape from the conclusion that metal pipes of all kinds extending below the surface along the routes of the trolley cars are being in many places destroyed.

The cause of the difficulty is now well determined. In many other cities a similar experience has been recorded. The electrical experts are in accord regarding the origin of the injury. The electric current which propels the car is discharged through the wheels to the rails. If the latter were continuous conductors the corrosion difficulty would not exist. But the imperfect contacts at the rail joints, even with the best devices for providing a path for the current around the joint, impairs the conductivity to such an extent that the earth in the vicinity becomes charged with the current which was designed for the rails, and plays to a considerable extent the part of a return wire. Iron or lead pipes extending along the route below the surface become charged with the current. This condition involves a discharge at some point, and here the electrolytic action is established which, bit by bit, carries away the metal, or rather converts it into a compound which in the moist earth is readily detached. When this action is confined to a limited area, as at an abrupt bend in the pipes, the corrosion is rapid, but when it is distributed along a stretch of several hundred feet, as in the case of a Court street telephone cable recently ruined by this means, the destructive action is slower but is, nevertheless, constant and sure.

A section of iron water pipe recently brought to the office of this board exhibits a complete perforation which was caused in four weeks. It had been part of a service pipe lying four feet below the trolley track. It is evident that better means must be provided for the conduction of the return current of the trolley system. In a few cases, where a rapid local corrosive action has been discovered, the expedient of making a copper connection between the corroding surface and the return conductor between the rails, has been successfully tried. A more comprehensive plan is in progress of trial on one or two of the electric railways in New England. It consists in welding the rails to continuous length of two thousand or more feet. The success of this experiment is not yet fully assured.

It should be said in behalf of the electricians of the trolley companies that there has been no lack of vigilance in aiding to discover the locations of injurious electrical action, or in applying the proper remedy.

A special report on the injury to telephone cables is given in a letter from Mr. J. C. Reilly, the general superintendent of the New York & New Jersey Telephone Company. Mr. Reilly's letter is as follows:

In response to inquiry regarding the action of the escaping trolley current upon the lead covering of our underground cables, I beg to say that five cables have been damaged so seriously as to cause failure and their removal from the underground conduits on Court street and on Flatbush avenue. Investigation shows that cables on Atlantic avenue, Third avenue, Court street, Flatbush avenue and Manhattan avenue are also affected, but not yet seriously. The destructive action is due to electrolysis of the lead cover of the cable, caused by the current which reaches the cable covering through the earth on its way back to the dynamo, leaving the cable at points where the cable is positive to the earth. We have been able in some cases to reduce the trouble by connecting the cables to the return wire of the trolley road, on poles and underground between the tracks, but as the trolley system is being rapidly extended, and the location of the source of power and the direction of the current both subject to change, we have had much difficulty in securing tests upon which reliable action can be taken. Along Fulton street, where the elevated railroad is used as part of the return circuit for the trolley current, we have so far suffered no injury, and it is probable that safety can be secured along other routes only by the use on the part of the trolley roads of copper returns supplementary to the rails of the track, and of *sufficient size* to carry the current which now leaks from the rails through the earth to all other metal conductors; much has been done in this direction by the several roads. Our experience would indicate that the safety of metal pipes of all kinds, placed in the earth, as well as economy of operation, requires that the return system should be complete.

In a supplement to the report from which the above extracts are taken, the commissioners add some further data upon this subject, together with some illustrations of corroded cables and water pipes. Two of these are reproduced herewith in Figs. 1 and 2. In Fig 1, No. 7 is an iron water pipe which had been in the ground under the trolley track in Second avenue for about a year. No. 8 is an iron pipe used to replace No. 7. The indentation and perforation which may be seen near the left hand end of the pipe were produced in 30 days. No. 9, shown in Fig 2. is a lead water pipe taken from four feet below the surface on Second avenue near Fifty-fourth street. In commenting upon these exhibits the commissioners say:

The experience of Brooklyn is not notably different from that of Boston and Cambridge, Mass., Milwaukee, Wis., Columbus, O., Indianapolis, Ind. and Hamilton, Ont. In each of these cities similar corrosions have been detected and in none is there any doubt as to the cause. It is known to be due to the imperfections of the means provided by the trolley companies for the conveyance of the electrical current back to the generator. It was at first supposed that the rails would be sufficient, but the current declines to take that route exclusively.

The remedy for the evil will have been applied when the trolley companies shall have provided an adequate route for the electric current now discharged into the rails. It was at first reasonably supposed that the rails would afford a sufficient path. Upon the failure of this plan, a copper connection to carry the current by the joint was tried. In most cases this expedient failed of complete success, except where the copper bond had unusual dimensions.

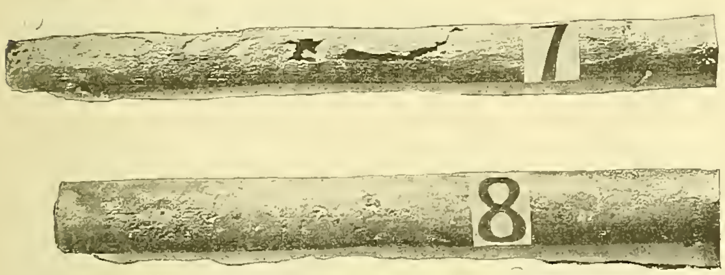
A better way to insure the conduction of the current is doubtless to make the car rail continuous by welding. This method will be employed on the new trolley line soon to be built in the southern part of the city. The most complete solution of the problem is afforded by the double trolley by which the return current is provided for by an overhead wire similar to the one for the outgoing current. But it is to be hoped that it will not be necessary to resort to this method.

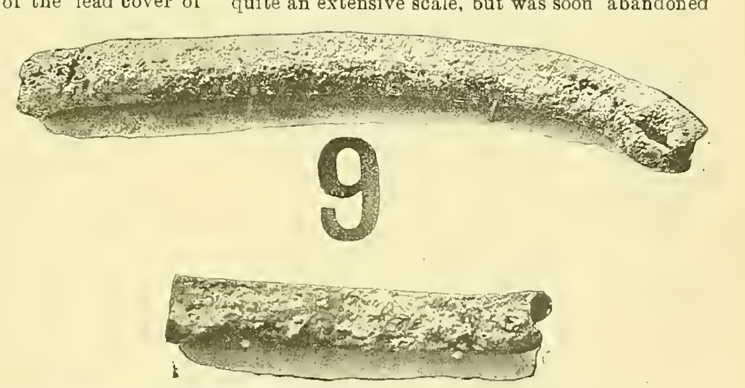
Some notes of experiments obtained through the kindness of Mr. I. H. Farnham, electrician of the N. E. Telephone Company and relating to the early experience in Boston are here given:

"When the action of the current was first noticed, the experiment of grounding the cables to lead plates buried in manholes, was tried on quite an extensive scale, but was soon abandoned as being impracticable. The quantity of electricity to be dealt with was so enormous that the buried plates offered no appreciable protection to the cables. If such a system were feasible, the expense for the constant renewal of plates would be very large.

"The severity of the action may be diminished, to a certain limited extent, by so arranging the direction of the current used for the street railways, as to make it pass out over the trolley wires, and back through the ground. In this way the direction of the current would be quite generally, from the earth to the cables, thus diminishing in certain places the corrosive action. This method would not be a complete protection from the corrosive action, as there would be places where the current would still flow from the cables. Even though the current is uniformly to the earth from the cables, there is the possibility of an action caused by alkaline substances formed about a cable, due to the decomposition by the current from the street cars of the soluble salts contained in the surrounding earth. These alkaline substances are capable, under certain conditions, of dissolving the lead, when the currents are shut off or much reduced, as would be the case at night.

"As there has been some misunderstanding in regard to the potential measurements made in connection with the numerous corrosion investigations, it should, perhaps, be impressed upon those who are about to carry on similar investigations, that the potential measurements between





FIGS. 1 AND 2. BROOKLYN WATER PIPES CORRODED BY ELECTRIC RAILWAY CURRENTS.

the cables or pipes, and the material surrounding them should, in the majority of cases, only be looked upon as indicating the direction in which the current tends to flow.

"To say that the pipes and cables are even practically safe from corrosion, when the measurements are below a specified figure, would be extremely misleading. These measurements are, in a certain sense, like the measurements which might be made in an electrolytic cell, between one of the electrodes and various portions of the electrolyte, so that it is possible to conceive of almost zero potentials in the immediate vicinity of the most violent electrolytic corrosive actions.

"The fact should be closely borne in mind that whenever we have a current passing from an easily oxidizable metal to the liquid, such as would be encountered in the earth, corrosion is bound to occur.

"A large number of electrolytic experiments have been carried out, showing the extremely low potentials (measurements between the electrodes) at which corrosion is found to take place. In many cases iron and lead were destroyed under the conditions encountered in the underground systems at potentials considerably under .5 volt,"

The conclusions fairly drawn from these notes and from our own experience is that considerable injury is being done to underground pipes and cables, and that it will continue along the lines of the trolley roads (except where the elevated railway extends above them) until better methods of returning the current to the generator are put in practice.

The electricians of the several trolley roads are fully aware of the situation and have speedily applied means of prevention in localities where the corrosion has been detected. But it is doubtful if the method of final cure of the difficulty has yet passed the experimental stage.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Twelfth Article.*)

DRUM AND RING ARMATURES.

Besides the two classes of armatures, open and closed coil, above outlined, there are also two other classes of importance, each of which may be either open or closed coil. Reference is here made to what are termed "drum" and "ring" armatures. Those heretofore have represented the wire wound lengthwise over a cylindrical or drum-shaped core. They are therefore for this reason termed "drum" armatures and, as before stated, may be either open or closed coils.

Instead of winding our wire on a cylinder we

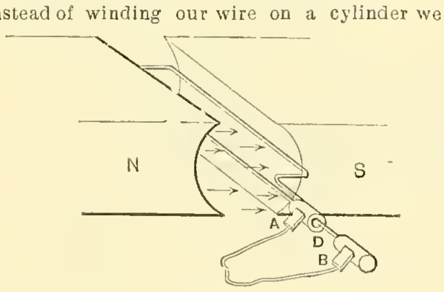
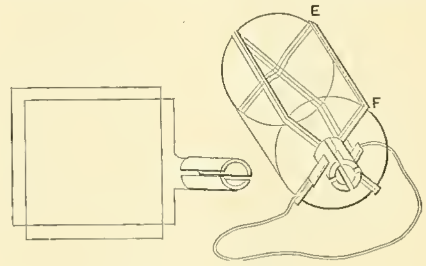


FIG. 20.

may wind it on an iron ring. Fig. 36 represents an elementary open coil armature of this kind corresponding to the open coil drum armature represented in Fig. 20. Another form, with two coils, is shown in Fig 37, which corresponds very closely with the drum winding in Fig. 31. Fig. 38 is the counterpart in the ring type of armature of Fig. 32 in the drum winding.

Fig. 39 shows a four-part ring armature of the closed coil type. In this can be shown more clearly than was possible in the drum armature drawing Fig. 35, how the various coils are connected together and to the commutator in the closed coil type of armature.

Of course in order to have the greatest output possible, whether the armature be drum or ring winding, open or closed coil type, the whole of the surface of the core is overwound with wire and this winding is divided up into as many coils as the designer desires, the two ends of each coil being connected to appropriate commutator segments, and if of the closed coil type also to the ends of the adjacent coils. In the closed coil ring armature, Fig. 40 shows how the winding is really one continuous coil all the way around the ring, its two ends finally being joined together. Then the number of turns of wire that shall constitute a coil having been determined on, the continuous coil is tapped at those intervals and connected by



FIGS. 31 AND 32.

means of a short piece of insulated copper wire with a commutator bar or segment, as is also shown in Fig. 40.

Now since the core of a ring armature may be regarded as a cylinder just like that used in the drum armature with its center cut out, it is evident that the former must be given a larger diameter in order to give it the same capacity for carrying lines of force, and the latter instead of cutting directly across from pole to pole of the magnet as they do in the drum armature, in the

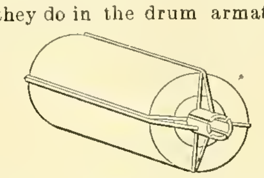


FIG. 35.

ring armature follow the iron in preference to the shorter path through the air space in the center, Fig. 41.

The fact that the ring armature must be of larger diameter than the drum armature for the same capacity prohibits its use where the greatest power is required in the smallest possible

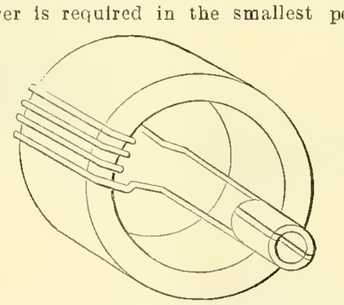


FIG. 36.

space, and since in the street car motor this is a first requisite, we never see the ring armature employed. On the other hand, in machines of great size, such as street railway generators, it is more frequently employed than the drum armature, chiefly for structural reasons.

CONSEQUENT POLES AND MULTIPOLAR FIELD MAGNETS.

Heretofore in considering magnets we have dealt only with those of a straight bar, or horse-

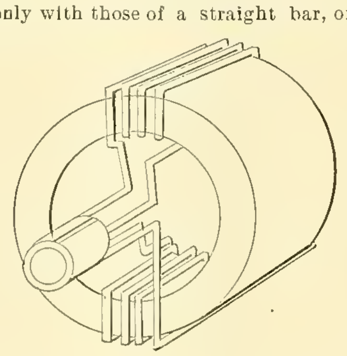


FIG. 37.

shoe shape, having two poles, or the closed iron ring, with the closed magnetic circuit having *no* poles at all. Before proceeding further it may be well to speak of two other forms frequently used both in dynamos and motors. Suppose we have a closed magnetic circuit as in Fig 42, and place upon it on one side a coil with a current passing around it so as to make its upper portion a north pole and its lower portion a south pole. If nothing more were done, the lines of force would flow around—part of them through the armature and perhaps a greater portion would flow around through the other leg on the right. All these latter would be lost, so far as our armature is concerned. But if we place a second coil so as to make the upper part of the magnet a north pole also, it will drive these lines back and send additional lines of its own in the same direction. In fact the effect of the two coils working in oppo-

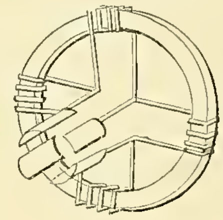
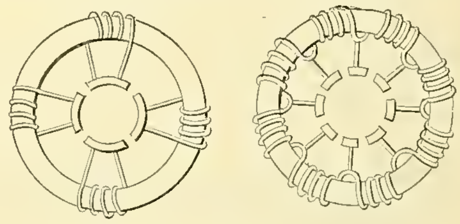


FIG 38.

sition is to make two north poles adjoining each other above and two south poles adjoining each other below, as shown in Fig. 42. As like poles repel each other their lines cannot pass each other but are forced to take the path indicated. When the direction of the current in two legs of a magnet is such as to bring two poles of the same kind together, the latter are called consequent poles.

It is possible, therefore, in any piece of soft iron such as a closed ring for instance, by dividing the winding up into any number of coils and passing the current through adjacent coils in opposite directions, to make a magnet of as many number of poles as is desired. In a closed ring or equivalent shape, with a single coil, if there be no leakage of lines across from one side to the other, there will



FIGS. 39 AND 40.

be no poles at all. If there be two coils upon this ring through which the current passes so as to compel the lines of force to pass around in opposite directions since the lines induced by one coil cannot pass through the other coil, the lines due to both coils will have to seek another path and will emerge from the ring somewhere between the two coils and jumping across to the other side along the path offering the least resistance, reenter the ring again, producing consequent poles as already discribed and illustrated in Fig. 42.

If we take an iron ring and wind it as in Fig. 43, with four coils *ABCD*, connecting them up so that the current will travel around the ring in the

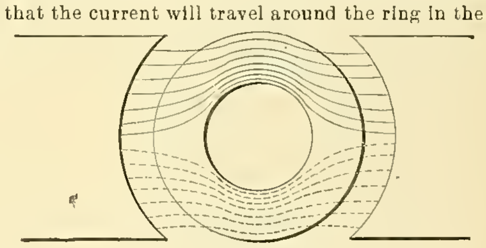


FIG. 41.

directions indicated by the arrows, we find that the directions of the currents in coils *A* and *B* if looked at from a point in the ring, midway between the two will be in the opposite direction to the travel of the hands of a clock. Therefore both currents tend to make the space between them a north pole. Moving along now and placing ourselves in the ring again between coils *A* and *B* and looking toward *B*, the current is found to be flowing around the ring in the same direction as the hands of a clock. That end of the coil B at which we are looking is therefore a south pole. Turning around and looking at the end of coil A nearest to us we find that the current as we see it from this point of view is also circling around in the direction of the hands of a

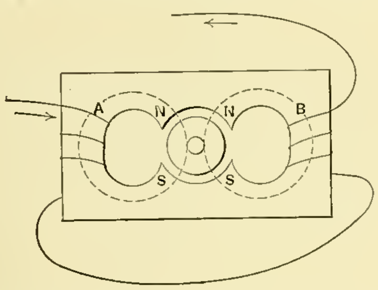


FIG. 42.

clock, so that this end of A must also be a south pole. We might have known this without looking at it, for if the other end of A was a north pole this end must be a south pole. We find that the two adjacent ends of the coils A and B are south poles, so the space between them will be consequent south poles. In like manner we will find consequent north poles between B and C and consequent south poles between C and D as lettered in the diagram. Thus we have a magnet with four poles—two south poles and two north poles. A magnet having but two poles such as described in the earlier chapters and also in Fig. 42 (for the

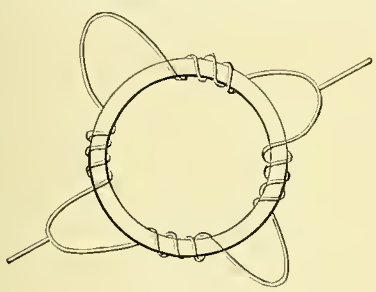


FIG. 43.

two consequent poles are counted as one) is called a "bi-polar" magnet and a magnet having more than two poles, as shown in Fig. 43 is called a "multi-polar" magnet.

A COMBINATION OPEN AND CLOSED CAR.

The Duplex Car Company of Boston is making a car of which the accompanying cuts show in detail the construction. It can be opened and closed, making it a summer or winter car; should a storm

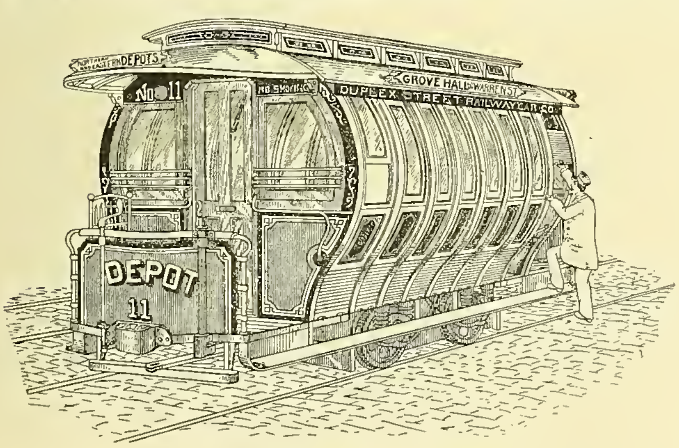


FIG. 1. DUPLEX CAR CLOSED.

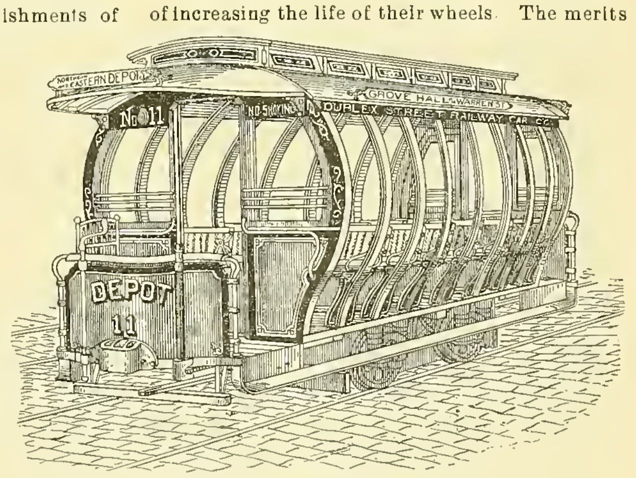


FIG. 2. DUPLEX CAR OPEN.

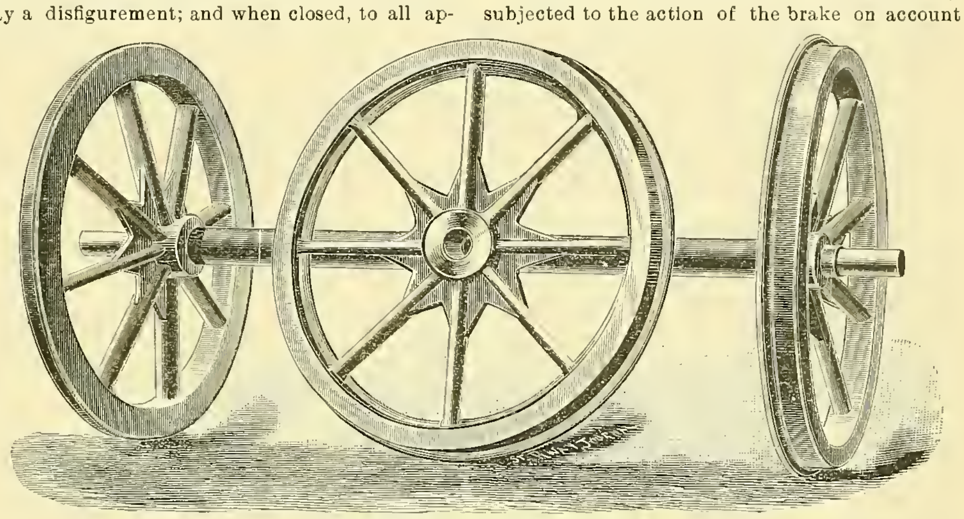
beat on one side, that side can be closed without interfering with the passengers, and the other side remain open. When sudden changes in the weather occur, it can be closed at once, or the forward half of the car can be closed and rear half remain open, accommodating all passengers alike. The windows are free to move upward independent of the panel. By throwing open one side, passengers can be discharged at once at depots, fairs, ball grounds, race tracks, and all places of amusement, thereby keeping the track clear and dispensing with the old way of passing out in single file. Conductors can discharge passengers on one side where there is danger of cars approaching from the opposite direction.

In cases where ordinances require street car companies to close the side of cars next the opposite track, this car will be found to meet all such requirements for by letting the windows remain up, and pulling down the panels the barrier against entrance or exit on that side of the car is complete. The step below the panels swings up against the side of the car.

The style of the Duplex car is in general appearance similar to that of other cars except in the slight curving of the body, which adds strength, the slides or panels being made of strong material in circular form moving in ways to the top of the car when open, and are in no way a disfigurement; and when closed, to all appearances, the car is the same as the present style. The economy to street railway companies is claimed to be in lessening the number of cars, requiring only a sufficient number of extra ones to keep the rolling stock in good repair, saving the expense of a full equipment of summer cars, ground, extra storage, buildings, insurance and the necessary changes of motors, etc.

FRENCH CAR WHEELS FOR AMERICAN SERVICE.

Mr. Pierre Arbel, a delegate of the French government to the Columbian Exposition and one of the directors of the Arbel Establishments of France, was somewhat surprised at the magnitude of the street railway business in the United States, which he carefully investigated during his six months' sojourn in this country. During his stay here he personally visited many railway companies, with a view to ascertaining the merits of the cast iron wheel with chilled rim, as well as other combination wheels in use. The Arbel Establishments being one of the largest manufacturers of wheels abroad, having supplied many of the European tramways with wheels and axles of their manufacture—the wheels being of entirely different construction from anything used here—and believing the wheel manufactured by his company if properly brought to the attention of the American street railway public would receive consideration, Mr. Arbel decided to establish an American office for the sale of wrought iron forged centers for tramway use, as manufactured by his establishments in France. This office has been placed in charge of Wm. Hazleton, 3rd, whose headquarters are in the Havemeyer Building, New York City. One of the finished wheels is shown in the accompanying illustration.



ARBEL CAR WHEELS COMPLETE.

It is a well-known fact that cable and electric traction is much more severe on wheels than is steam road service, the former having to operate on the surface, where mud, grit and dirt have to be run through, the wheels being continually subjected to the action of the brake on account of frequent stops. Surface roads are compelled to follow the lines of streets in cities necessitating many sharp curves, where guard rails are usually employed. In steam roads the route is usually laid out in as direct or straight a line as possible, a suitable roadbed is constructed, the rails being well elevated above the ground The importance, therefore, of securing a wheel which is strong and durable, one which will give increased mileage and traction over the so-called standard wheel as used in America to-day, should receive careful consideration and investigation from owners of street railway properties. Wheel manufacturers have experimented in many ways for the purpose of increasing the life of their wheels. The merits of cast steel wheels, combinations of cast iron centers with steel tires—rubber being inserted in some cases in the hub and in others between the center and the tire—and many other forms have been tried. The standard, however, seems to be the cast iron wheels with chilled rim.

Wrought iron wheels, it is claimed possess the following important points of superiority which the other wheels lack: 1st, owing to their exceptional resistance, they are much stronger and more secure; 2d, they admit of the use of interchangeable steel tires of a superior quality; 3d, the rolling surface of the steel tire when worn can be re-turned at little cost and always kept in good condition, thus obviating the jars caused by tires which, owing to service, are no longer perfectly true, or which have become flattened in consequence of the action of the brake: 4th, better traction is obtained by their use, they are lighter in weight, the brake grips the wheel better and stops the car more quickly; 5th, when the tire has become too thin to admit of being turned up, it can be easily replaced, and at slight cost.

It is further claimed that the spoked wrought iron wheel with steel tire is admirably fitted for long service: it gives rise to no noise when turning curves, better traction is obtained, and it shows minimum wear upon the rails.

It is well known that steel tires on locomotives, sleeping, parlor and dining cars in steam service have made over 500,000 miles; it is claimed therefore that it is reasonable to assume that in street railway service, they should make at least 200,000 miles. The average mileage made by an electric car in street railway service may be safely placed at 100 miles per day, or 36,500 miles per year, say 40,000. A steel tire, giving 200,000 miles, equals 5 years' service. One reason why steel tire makers are reticent on the guarantee question is due to the fact that steel tires for street railway service have not been used in America long enough and in a sufficient number of places for them to form any reliable opinion from records absolutely made. It is said that a record of over 120,000 miles has been made in an American city, with steel tired wheels in street railway service.

A COUNTRY ELECTRIC ROAD IN ILLINOIS.

The Rock River Electric Railway Company is the official title of an organization of capitalists and railway men who will build an electric line along the Rock river to connect Rockford with Dixon. The line will be about 40 miles in length and will pass through Grand Detour, Oregon and Byron. It will be almost exclusively a country road and will be used by the farmers for the transportation of produce. M. K. Bowen, of the Chicago City Railway Company, and Clift Wise, of the Complete Electric Construction Company, are interested in the project. Four water power plants will furnish electricity for the line.

Cleveland Car Shops Burned.

The machine shop of the Cleveland Electric Railway located in the rear of the disused power station on Pearl Street was destroyed by fire on March 21. It is assumed that the fire was of incendiary origin. The loss is about $35,000 on the building and its contents. There were destroyed seven railway motors, several machine tools, tools belonging to workmen, and two engines.

NEW PUBLICATIONS.

THE ELECTRIC TRANSFORMATION OF POWER AND ITS APPLICATION, BY THE ELECTRIC MOTOR, by Philip Atkinson, A. M. Ph. D., 233 pp Illustrated. Published by D. Van Nostrand & Co., New York. Price $2.

This is the latest addition of Dr. Atkinson to his series of electrical books which have enjoyed no little popularity. The book will be valuable to a great many readers who will find here much information that outside of it must be looked for patiently in the files of street railway and electrical periodicals. The design of the book is such as to appeal to the reader who dreads too technical descriptions and mathematical formulæ. It presents in plain language the essential facts regarding the means by which electricity is used for transmitting and transforming power. The first part of the book contains an exposition of the principles which underlie the construction and operation of stationary motors, and descriptions of various types of commercial machines. The explanations are such that the general reader will need no reference book to enable him to comprehend the author's descriptions. A large part of the volume is devoted to the electric railway from which a good idea of the general equipment and the method of operating overhead trolley lines may be gained. Brief references are made to the several conduit and storage battery systems, and to elevated and underground electric railways. It is noticeable, however, that no reference is made to the Intramural railway at the World's Fair, which is a rather surprising omission, as the volume did not appear until late in the fall of 1893.

PRACTICAL ENGINEERS POCKET BOOK AND DIARY FOR 1894, edited by W. H. Fowler; 325 pp.; price 1s. 6d. Published by the Technical Publishing Company, Limited, Manchester, England.

This little handbook seems to be an excellent compilation. Into its 250 reading pages is crowded a vast deal of matter, which is arranged in convenient form for instant reference. It would be difficult to name a book containing such a great variety of engineering information that could be procured at so reasonable a price.

Comments and Views of Contemporaries.

NEED OF LIFE SAVING APPLIANCES.—The list of casualties from street cars has been something awful * * * * and there is no hope that they will be lessened unless every car is so fitted that it actually cannot run over anyone. Cars must run at a high rate of speed, and there will be more of them as time goes on. New lines are being projected all over the county, and in course of time there will be hardly a street that will not be traversed or intersected by car lines. It is necessary that improvements in life-saving attachments should keep pace with the growth of rapid transit lines, if the tale of destruction is to be lessened. We do not want to pay too great a price in human life for rapid transit, nor is there any need that we should, if the inventions at hand are used by the companies. This is an inventive and progressive age, and it is not necessary that lives should be ground out, no matter how fast may be the travel on the public streets. It is only a question of care,—*Philadelphia Press.*

NEW ENGLAND NOTES.

(From Our Special Correspondent.)

TROUBLE WITH EMPLOYES.—The dispute that has existed for some little time past between the Lynn and Boston Railroad Company and its employes is not terminated yet, as Mr. E. C. Foster, manager, objects to the terms submitted by the Federation of Labor to the company. With a view to reaching a settlement Mr. Foster has submitted to the members of the organization a counter proposition regarding salary and hours of labor. In substance this proposition is the same as the agreement offered by the Surface Street Railway Association. This proposition is by no means agreeable to the Federation of Labor whose members emphatically declare they will either work under their own agreement or none. The question at issue is whether the company will recognize one or two labor organizations.

NEW LINE TO LYNN.—Work began Monday morning on the extension of the Wakefield and Stoneham street railway system to Lynn. The road will be completed in about a fortnight. Orders have been placed with the General Electric Company for complete equipments for four new open cars and a new horse car. The latter is the first one of its kind ever run on an electric road. Everything on this extension is to be of the best and most modern type.

AN EXTENSIVE SUBURBAN SYSTEM.—One of the most successful electric street railways in this state is the Quincy and Boston system which, starting from Neponset, the most southerly point in the city of Boston proper, runs through Atlantic, Wallaston, Quincy to North Weymouth in one direction, to West Quincy in another, and to the popular seaside resort known as Manet Beach in another. There are twelve miles of track in all, and the entire road is so well patronized and ably managed that it is a financial success. Extensions will be made and it will be but a short time, ere the connecting link will be completed, which will form a continuous line from Brockton to Boston, a distance of twenty-two miles. Many of the shoe towns adjacent to Brockton are already connected and a good business is being done on all the main and intersecting lines.

FINANCIAL DEPARTMENT.

Financial Notes.

Receiver for Marion (Ind.) Railway.—Howard Cale of Indianapolis, has been appointed receiver of the Queen City Electric Railway Company, of Marion, Ind., on application of Russell B. Harrison who represented certain bondholders. The company was organized about a year ago with $150,000 stock, $30,000 of which was preferred and $100,000 bonds. Mr. Harrison, who owns one thousand shares of the stock, alleges that, owing to defective construction, the road has been unable to earn the interest on the bonds, the second and third installments of which are now due and unpaid; that he has paid out of his own pocket $3,713.46 running expenses of the road. He asks that this amount be allowed him, with interest thereon, as a preferred claim. There are other claims against the company, he says, amounting to $2,500. A receiver is necessary, he urged, to preserve the property. The General Electric Company and the Metropolitan Trust Company, of New York, were also made defendants in the suit. April 2 was fixed as the day for the final hearing.

Street Railway Stocks.—Valentine & McAvoy bankers and brokers, 184 Dearborn street, Chicago, said yesterday: Street railway securities have been active and very strong at materially higher prices. Both West and North Chicago have been well bought and hold their advance. The new tunnel of the West Chicago company will be opened in a few weeks and will add materially to the receipts of the company. With returning confidence on all sides we do not look for lower prices but think a gradual improvement is assured. The feeling in Philadelphia in local securities is decidedly hopeful and buying orders have developed in Metropolitan and Philadelphia tractions as well as in others and have resulted in higher prices. The Philadelphia Traction Company is working actively on several of its lines and its expected the trolley will be started shortly with consequently larger earnings. A number of the Philadelphia financial institutions are buying underlying bonds on the traction systems and they are considered as likely to advance.

Consolidation of Chester (Pa.) Roads.—The consolidation of all the roads centering in Chester has been effected by Col. S. A. Dyer, president of the Union Railway Company. These railways are the Chester Street Railway Company, Chester & Media Railway Company, the Chester, Darby & Philadelphia Company, and the Union Railway Company. All these lines will be under one management and the consolidated company will be known as the Chester Traction Company.

Execution Against Sioux City Railway.—An execution was issued March 23 for the sale of the Sioux City Street Railway company's equipment and franchises. The execution is in favor of the Fidelity Loan and Trust company of Sioux City, trustees for first mortgage bonds amounting to $525,000. The bonds are mostly held in New York and New England. The date of sale is not fixed, but it is expected to be immediately after the publication period of three weeks.

Action Against Pueblo Road.—The State Trust Company of New York last week commenced suit in the federal court against the Pueblo (Colo.) City Railway Company, asking for the foreclosure, under direction of the court, of a trust deed to secure the payment of $500,000 first mortgage bonds. Application for this procedure is made by F. S. Bangs, president, and J. Q. Adams, secretary, of the trust company.

Westinghouse Earnings.—The Boston *Beacon* estimates that the net earnings of the Westinghouse Electric Company for January were between $125,000 and $150,000, or at the rate of over 15 per cent. per annum upon its total capitalization.

Sale of Nashville United Electric.—The sale of the property of the United Electric Railway Co., of Nashville, will take place April 18.

New Incorporations.

Portland, Ore.—The Portland Traction Company has been incorporated. The capital stock is $400,000, of which $333,000 has been subscribed. It is understood the new corporation is composed of the bondholders of the cable line. The bonds of the company amount to $400,000, which is the amount of the capital stock of the new corporation. The bondholders are now pushing the litigation in which the road is involved, and it is probably to facilitate this that the new company has been incorporated.

NEWS OF THE WEEK.

Boston, Mass.—Reynolds T. White has petitioned the city for a franchise permitting him to build and operate an elevated road in Boston and its suburbs. Mr. White proposes to construct a double track belt line, covering a total distance of 3½ miles, around the congested district of Boston proper, without traversing either Washington or Tremont streets, and to have various suburban lines come into the city and make a circle upon the belt line, leaving passengers from any suburb within at most five minutes' walk of any part of the principal business district. The capitalists associated with Mr. White are Hon. A. P. Martin, David S. Packard, George R. Chapman, Herbert B. Church, J. Henry Norcross, Walter L. Emery, E. S. Williams, Clarence A. Dorr, Chas. H. Brown, Rufus P. Kingman, John J. Whipple, J. G. Mackintosh, E. Howard Gay, James E. Potter, Eustis J. Fletcher, Everett T. Packard, George T. Cunningham, William H. Emery, Chauncey Coon and Edward M. Prindle.

Philadelphia, Pa.—The new car house built by the Electric Traction Company for the Tenth and Eleventh streets line, at Twelfth and Susquehanna avenue, is finished and tracks are being laid within it. The building is of brick, about 325x81 feet, with iron trusses supporting the roof, which is of corrugated iron and glass in which wire net is embedded. At the power station, on Hutchinson street, below Oxford, the work of installing the boilers is about finished, and one of the engines has been set. The street work on Tenth and Eleventh streets is nearly completed. It is likely that trolley cars will be in operation on the Tenth and Eleventh street line, if no unexpected delays ensue, by May 1.

St. Louis, Mo.—Almost the entire right of way has been obtained for the Kirkwood Electric Railway, which will be a nine-mile road from St. Louis to Kirkwood and Meramec Highlands. The road will be almost a straight line, and it will pass through all the densely populated suburbs between Kirkwood and St. Louis. The town of Kirkwood has granted a 50-year franchise to the company. Work will commence in a few days. J. D. Houseman, Jr., is the projector of the enterprise.

Easton, Pa.—The Easton Transit Company has awarded a contract for an extension of its line from Fourth and Washington Streets to Chain Dam Island, a pleasure resort, three miles up the Lehigh river. The road will be completed in season for operation this year. The company will also complete its lines in South Easton and will then be able to run cars in both directions continuously through the length of both Easton and South Easton.

Grand Rapids, Mich.—The Consolidated Street Railroad company has purchased the North Park steam dummy line. The purchase not only includes the railway but the summer resort of North Park, comprising fourteen acres. The new line will be operated by the dummies until May 1 by the old company. At that time an electrical system which is to be introduced will be finished and the dummies will be abandoned and motor cars will give a ten minute service.

Spartanburg, S. C.—It is announced that several northern capitalists have decided to build a line of road at Spartanburg, and extend it to the towns of Glendale, Whitney and Clifton. The line will be about twenty-six miles in length, connecting three factory towns with Spartanburg. It is also proposed to utilize a water power on the line for generating electricity, and the entire line will be operated by that power.

Chicago, Ill.—At the last meeting of the City Council an ordinance was introduced giving the North and West Chicago street railroad companies the right to introduce the trolley systems on their lines. The measure was proposed as an amendment to a previous ordinance which permitted the installation of an electrical underground system but prohibited overhead wires. The ordinance was made a special order for the next meeting.

Adams' Electric Company's Suit.—The suit of the Adams Electric Company of St. Louis against the Lindell Railway Company of that city for alleged infringement of the complainant's patent method of centering a motor over an axle, will be heard by Judge Hallett in St. Louis on April 20.

Norwalk, O.—The Sandusky, Milan and Norwalk Electric Railway Company has decided to build a line on West Main street, Norwalk. The company's business has been prosperous during the first six months of operation. During that time the road earned $16,573 and its operating expenses were $13,204.

Philadelphia, Pa.—The People's Traction Company is pushing its work in all branches. The span and trolley wires are being stretched on Fourth and Eighth streets and poles have been erected on Green street and Fairmount avenue and Norris street and Susquehanna avenue. Contractors will soon commence to lay new track on these streets.

Detroit, Mich.—Work will be begun within three weeks on the electric railway which will be built from the terminus of the Michigan Avenue line to St. Joseph's Retreat, a distance of about seven and one-half miles. All the right of way has been secured. Ellwood T. Hance is one of the principal owners of the proposed railway.

Waterloo, N. Y.—The Highway Commissioners have granted the Seneca & Waterloo Electric Railway Company the right to build a road through the turnpike under certain restrictions. It is expected construction will begin as soon as the season opens.

Phillipsburg, N. J.—The council has passed an ordinance permitting the company to use electricity instead of horse power on its line, and work will be begun this season.

Niagara Falls, N. Y.—The projectors of the Niagara Falls, Whirlpool & Northern Electric Railroad Company which recently obtained a franchise from the common council to build a road to the Devil's Hole, intend to push the line to a speedy completion.

Newburgh, N. Y.—The Newburgh Electric Railway Company has decided to commence construction on its road within a short time.

Windsor, Ont.—The Windsor Street Railway Company has decided to make three extensions of its system at a cost of nearly $500,000.

Philadelphia, Pa.—The Germantown line of the Philadelphia Traction Company was put into operation last week.

Sioux City, Ia.—The work of converting the cable railway into an electric line will commence at once.

Minneapolis, Minn.—Fire destroyed the street car barn at Second street and Eleventh avenue on March 22.

Warren, N. H.—An electric railway from Warren to the summit of Mount Moosilaukee has been projected.

New York, N. Y.—The 1,047 horses of the Third Avenue Railroad Company have been sold for about $69,000.

PERSONAL.

H Walter Brinckerhoff, M. Am. Soc. C. E., has resigned the position of principal assistant engineer of the Metropolitan Traction Company, which he has held during the construction of the Broadway cable road, and will resume his practice as consulting civil and mechanical engineer, in the office of Major G. W. McNulty, room 224 Aldrich court, 45 Broadway, New York City.

John L. Martin, of Horoe & Martin, Chicago, representatives of the National Electric Company, met with a painful accident last week. He fell at one of the suburban stations of the Illinois Central railroad and the wheels of a coach passed over his left arm, making amputation necessary.

John Walker, who has been known the country over as the founder of the Walker Manufacturing Company, of Cleveland, has accepted the position of general manager of the Fraser & Chalmers Company, of Chicago.

Mr. George E Pratt of the Jackson & Sharp Company, Wilmington, Del., was in New York last week and spoke encouragingly of the outlook for business. He says his company is quite busy in the street car department.

TRADE NOTES.

The McGuire Manufacturing Company, of Chicago, is making four steel frame trucks for the Johnson Company, Johnstown, Pa. The trucks are intended to carry the electric rail-welding machines of the latter company, and are constructed to run on any gauge of track varying from 3 feet 6 inches to 5 feet 3 inches. This sounds curiously, but it is true. An ordinary electric car wheel is used, 33 inches in diameter, 2¼-inch tread, ⅞-inch flange. There is a thread cut in the hub three to the inch, 16 inches long, and the keys are double jointed and so arranged that they can readily be taken out and the wheel adjusted to any gauge of track desired. There are two key-ways cut in the hub, and two key-ways are cut in the axle on the quarter, so that there is a quarter turn adjustment. The McGuire Manufacturing Company, of Chicago, which was selected to do the work, has certainly performed it in the most creditable way. The McGuire Company has also built within the last month seventy steel frame trucks for the Electric Traction Company, Philadelphia, fifteen for Memphis, Tenn., five for Davenport, Ia., twelve for the Cicero & Proviso electric railway, Oak Park, Ill., and has orders yet unfilled from the Derby street railway, Derby, Conn., Buffalo & Williamsville street railway Buffalo, N. Y.; Philadelphia, Neville Island & Coraopolis railway, Coraopolis, Pa.; Hamilton, Grimsby, & Beamsville railway, Hamilton, Ont.; Sandusky, Milan & Norwalk Street Railway Company, Sandusky, O.; Philadelphia & Delaware County railway, Philadelphia, Pa., and others.

The National Water Tube Boiler Company, of New Brunswick, N J., has just completed the installation of 2,500 horse power of boilers at Youngstown, Ohio, for the Ohio Steel Company. This boiler plant is considered by experts to be a model one, embodying all the improvements of modern mechanical construction, and the results will be carefully noted by iron and steel manufacturers throughout the country. The boilers are arranged in units of a little over 300 H. P. each, have automatic smoke consuming furnaces, automatic carriers and feeders, and every provision for convenient handling of fuel. The same company purchased the National boilers which were used in the World's Columbian Exposition at Chicago, and these boilers are now being delivered, and will soon be erected. These, together with those just erected, will give a total of over 4,000 horse power. The National boilers are very heavy in comparison with others and the 4,000 H. P. referred to required for their transportation about 36 large freight cars.

E. J. Spencer has severed his connection with the General Electric Company and has established himself at 513 Security Building, St. Louis, as consulting and contracting electrical and mechanical engineer. Mr. Spencer's experience of nearly nine years in the Corps of Engineers of the United States Army, of three years of special work at the factories of the Thomson-Houston Electric Company, at Lynn, Mass., and then latterly of more than a year in charge of the installation, maintenance and removal of exhibit and contract material of the General Electric Company at the World's Columbian Exposition, well equips him for his new work. Mr. Spencer is a member of the several national engineering societies. His patrons will secure the benefits of a wide experience and a large acquaintance with the work of the leading engineers of the day.

The Berlin Iron Bridge Company, of East Berlin, Conn., is doing considerable iron bridge work at the present time. Among other contracts, it has 17 signal bridges for the Boston & Maine railroad; two bridges 200 feet long for the town of Roxbury, Conn., a bridge 400 feet long to span the Connecticut river at Stratford, N. H., a bridge 350 feet long at Turner, Maine, a bridge 200 feet long at Houlton, Maine, and a bridge 200 feet long at Moosup, Conn. The same company will furnish the iron roof for the new car barn for the Colonial Electric Street Railway Company, of Kingston, N. Y.

The Ball & Wood Company has issued a large number of invitations asking that the persons to whom they are addressed visit the works at Elizabethport on March 31 to inspect the new 600 horse power vertical engine previous to its shipment to the Chicago Edison Company. The engine is new in design and possesses many novel features of interest.

Frederick Pearce, of New York, has been awarded the contract for electrical supplies for the Police Department of the city of Brooklyn for 1894. Mr. Pearce is the inventor of the electric signal system now in successful operation on the Third avenue cable road in New York, which was recently illustrated and described in the STREET RAILWAY GAZETTE.

To Replace Battery Telephones.—The Strowger Automatic Telephone Exchange of Chicago, has ordered one hundred No. 1 standard magneto telephones from the Western Telephone Construction Company of Chicago, to replace the battery telephones of the exchange at La Porte, Ind.

The Breeze & Mansfield Company has been appointed agents for the electrical department of the Walker Manufacturing Company, for Pennsylvania, Delaware and Maryland, and has established headquarters in the Betz Building, Philadelphia.

The Manhattan General Construction Company, whose offices are at 50 Broadway, N. Y., and Equitable Building, Baltimore, has been appointed by the Buckeye Electric Company as its sole agent for New York and vicinity and Baltimore and vicinity.

Railway Equipment Company's Stock to be Sold.—George O. Fairbanks, assignee of the Railway Equipment Company, Chicago, will receive bids for the entire unsold stock of the company until April 4 at 5 p. m.

J. H. Shay, of the Charles Munson Belting Company, Chicago, is in the east this week on the trail of several important orders.

RECORD OF STREET RAILWAY PATENTS.

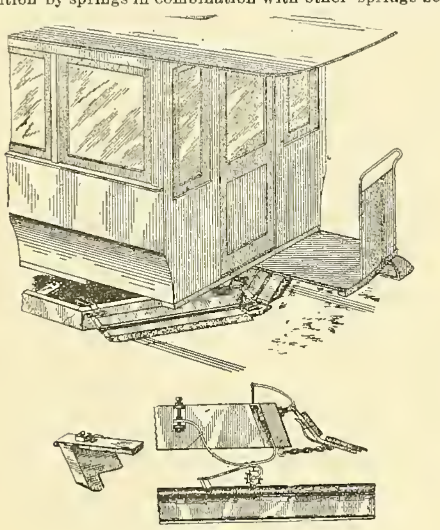
Patents Issued March 13, 1894.

516,188. Electric Railway. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed July 6, 1889.

In an electric induction railway, a source of irregular or alternating currents, a conductor extending therefrom along the way, a movable coil in electrical connection with the conductor, a vehicle, a magnetic device on the vehicle to move the movable coil, an electric conductor on the vehicle in suitable inductional relation to the coil, and a translating device connected with the latter conductor.

516,266. Street Car Fender. Thos. Davis, Toronto, Canada. Filed May 18, 1893.

Angular plates connected to bars and held in a normal position by springs in combination with other springs behind said plates, arranged to act as buffers when an obstacle is struck. (See illustration).



NO. 516,266.

516,374. Closed Conduit Electric Railway. Frederick L. King, Chicago, Ill. Filed May 5, 1893.

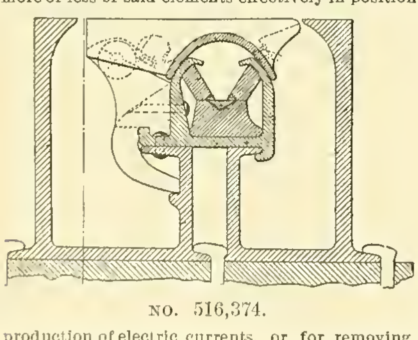
In an electric railway, the combination of a metal chamber provided with a movable cover; with a conductor an insulating base piece on which the conductor rests; two pieces of hardened steel resting upon each side of the conductor, and an insulating superstructure, having an inclined or dove-tailed socket for retaining the conductor and steel pieces, and projected against the inside walls of the chamber. (See illustration.)

516,408. Safety Car Fender. George Q. Seaman, Alexander Wilson and William Jones, Brooklyn, N. Y. Filed July 14, 1893.

This is a safety fender, comprising a frame capable of a yielding longitudinal movement in relation to the car, a lever centrally connected with the inner end of the fender frame and pivoted to the car frame, said lever having a lateral arm, a connection between the said lever and the brakes, and a connection between the said lateral arm and the grip. (See illustration.)

516,487. Electric Current Regulator. Chas. D. Haskins, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed April 1, 1889.

The combination with a number of elements instrumental in producing electric currents, of means for placing more or less of said elements effectively in position for the production of electric currents, or for removing the same from such effective positions, and an electric motor of the continuously revolving type included in said circuit and adapted to actuate said means



NO. 516,374.

516,492. Electric Trolley Device. Charles Knapp, St. Louis, Mo., assignor to Ashton G. Bean and Herbert O. Rockwell, same place. Filed November 20, 1893.

A trolley consisting of a pole the terminal thereof forming bearing surfaces, a fork supporting the trolley wheel and having a yoke at its opposite end embracing the bearing surfaces of the pole, a pivotal connection between the fork and pole, a spring for restoring the fork to its normal position, and means on said pole for limiting the degree of twist or movement of the fork.

516,515. Sanding Device for Cars. John Ballard, Boston, Mass., assignor of one-half to Thomas W. Berry, same place. Filed June 26, 1893.

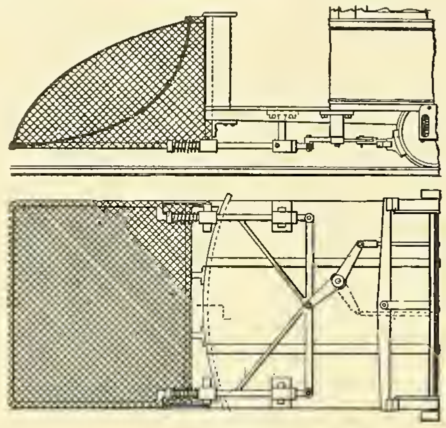
In combination with a street car having the curved brackets depending beneath the same, a receptacle oval in cross section eccentrically pivoted between said brackets and parallel therewith and having a filling opening and delivery spout, a projection on the bottom of the receptacle, and a rod connected to said projection and adapted to be operated from the platform of the car.

516,516. Electric Motor for Street Cars. William Baxter Jr., Baltimore, Md. Filed April 4, 1891.

The first claim reads as follows: "The combination with the car wheel and axle; of the motor supported by and mounted concentrically upon said car wheel axle, said motor having the field divided into two parts arranged on opposite sides of the vertical diameter of the armature and the upper and lower poles lying in substantially horizontal planes between which the entire machine is included."

516,565. Electric Railway Supply System. James F. Cummings, Detroit, Mich., assignor of one-half to Eugene M. Eogleman, Milwaukee, Wis. Filed September 22, 1892.

The combination with the motor, the car, the conduit and the two distributing conductors therein with which said motor is in traveling connection, of a traveling contact device suspended from the car and provided with two independent laterally and vertically spring pressed rotary travelers arranged horizontally and contacting with the inner faces of said distributing conductors.



NO. 516,408.

516,626. Closed Conduit Electric Railway. Edward H. Brown, Salem, assignor to the Magnetic Electric Company of West Virginia, Boston, Mass. Filed April 23, 1893.

In a closed conduit electric railway system, in combination with a car provided with magnets, a main electric supply wire, magnet contacts, and separate and independent inclosures for the same, said inclosures forming sections of a continual central rail, said main wire independent of said inclosures and directly connected with said contacts.

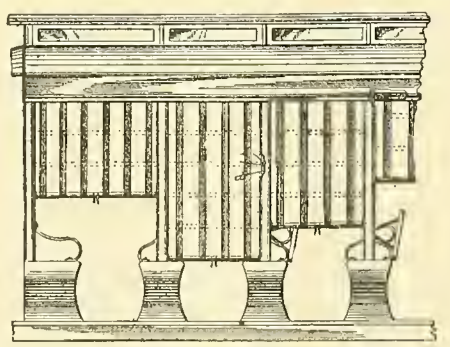
516,631. Closed Conduit for Electric Railways. William Lawrence, New York. N. Y., assignor to the Lawrence Electric Company, same place. Filed May 2, 1893.

The claim reads as follows: "In a system of electric distribution, a main conductor, a contact, a connection from the main conductor to the fixed part of said contact, a weighted lever carrying the movable part of the contact, a sectional working conductor, a rod connecting the moving conductor with the weighted lever, and a water tight casing inclosing the contacts and lever."

Patents Issued March 20, 1894.

516,666. Electric Railway System Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed May 29, 1891.

This consists of the combination with the vehicle electrically propelled along a line of way, and having definite stopping and starting points thereon, of one or more conductors at such points making connection with the electric motor on said vehicle, and an energy storage device in connection with said conductors.



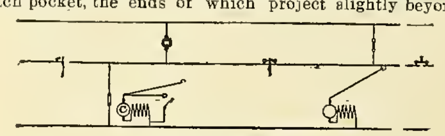
NO. 516,762.

516,731. Electric Railway Switch. Charles M. Fitch, South Norwalk, Conn., assignor to the Fitch Excelsior Switch Company of New Jersey, Filed June 17, 1893.

This is the combination of a switch point, a pivoted lever connected therewith, sliding cams operating said lever, a rotary shaft operating said cams, a rotating armature centered upon the shaft, and an electromagnet permanently fixed within attractive distance of the armature.

516,762. Awning or Curtain for Open Cars. Edward T. Burrowes, Portland, Me. Filed May 26, 1893.

This is a spring actuated awning or curtain for open cars, provided with pockets, a flexible piece of material within each pocket, the ends of which project slightly beyond the edges of the curtain, and a projection upon each side of the curtain near each end of each rod, whereby the edges of the curtain are prevented from coming in contact with the posts of the car, and means for securing the curtain at any desired point. (See illustration.)



NO. 516,806.

516,791. Car Truck. Norman C. Bassett, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 5, 1891.

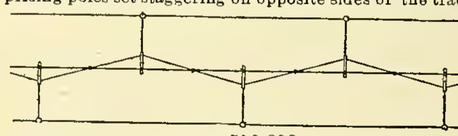
This is a railway car truck having a driving axle and an idle axle, a center bearing for the car body located near the driving axle and side bearings for the car body located between the line of the center plate and the driving axle.

516 806. Block System for Electric Railways. John W. Gibboney, Lynn, Mass., assignor to the General Electric Company, Boston, Mass. Filed October 12, 1893.

This is a safety cut-out for electric railways comprising a trolley line divided into sections, feeders conveying current to the sections, circuit interrupting means between the feeders and the sections, and short circuiting means between the sections and the ground return adapted to operate the current interrupting means. (See illustration.)

516,808. Overhead Electric Railway. John C. Henry, Westfield, N. J. Filed March 8, 1893.

A line structure for an overhead electric railway, comprising poles set staggering on opposite sides of the track, a trolley wire, rigid supports carrying insulating hangers for said trolley wire, transverse guy wires connecting said rigid supports with the poles, and a zigzag guy wire attached at its angles to the rigid supports. (See illustration).



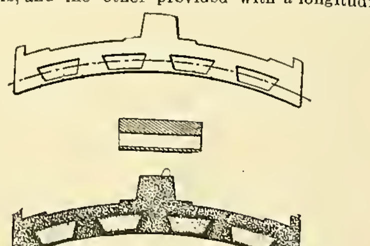
NO. 516,808.

516,834. Series Parallel Controller. Edward D. Priest, Lynn, assignor to the General Electric Company, Boston, Mass. Filed December 1, 1893.

This covers the method of changing three or more motors from series to parallel connection, which consists in shunting one motor, disconnecting it from the series and connecting it in parallel with another but in series with the remaining motors, and afterward successively shunting the remaining motors, respectively disconnecting them from the series and bringing them into parallel with those already in parallel.

516 876. Conduit for Electric Railways. Herluf A. F. Petersen, Milwaukee, Wis. Filed March 10, 1893.

The first claim reads: "The herein described conduit for underground conductors for electric car lines, comprising a suitable casing divided into two longitudinal conduits or passages, one of which is arranged to contain the conductors, and the other provided with a longitudinal slot in its upper wall, arranged out of line with said conduit or passage containing the conductors and a suitable longitudinal cover arranged to normally close the conduit or passage in which the said conductors are located."



NO. 516,992.

516,934. Street Car. Peter M. Kling, St. Louis, Mo. Filed August 14, 1893.

A street car platform having a partition at one end thereof extending transversely of the length of the car, and dividing the platform into two parallel passageways between the car body and dashboard.

516,992. Brake-Shoe. William D. Sargent, Chicago, Ill. Filed October 28, 1893.

A brake shoe comprising a body portion of cast iron, steel or equivalent metal having recesses or perforations formed therein and plugs of iron, steel or equivalent metal cast in said perforations or recesses, whereby such plugs become chilled or hardened. (See illustration).

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CONTENTS.

Railways over Sidewalks. There have been various projects proposed in the great cities for building railways over sidewalks so that the second stories of buildings would become almost as desirable as ground floors. D. H. Burnham, the director of works at the World's Fair, believes that such roads are likely to be built. In an address relating to high buildings before the Architectural League in New York, this week, he remarked: "There is talk of building a tramway over the ordinary sidewalk on a level with the first story, so that people can get along the street. The plan is feasible and will in time come about."

Detroit Street Railway Controversy. During the last few weeks the announcement has frequently been made that the Detroit street railway controversy was practically settled, but in each case the report has proved to be premature. The city officials and the street railway company are apparently as far away from a compromise as ever. The city has been thus far successful in the courts in its attack on the company's right to the streets and the mayor will entertain no ordinance giving the company a franchise unless it embodies such provisions as would make the operation of the street railway a decidedly losing business. While the city has had the best of the fight, the state of the litigation is such that it cannot in the near future deprive the company of the use of the streets, and it cannot therefore, grant a franchise that will be of value to any other company. The mayor simply persists in his demand that the company shall submit to unfair treatment; the latter as firmly refuses, and so the controversy drags slowly along. Chief among the conditions upon which Mayor Pingree insists is a clause in an ordinance providing that eight tickets shall be sold for twenty-five cents. This proposition is certainly unreasonable, as this rate of fare would not yield a sufficient income to pay the operating expenses and the interest on the investment. Meanwhile the city of Detroit is paying a heavy price for the failure of its municipal officers to find a satisfactory settlement of the controversy. The company naturally does not incline toward the expenditure of money for improvements until its rights are defined, and the introduction of rapid transit is therefore indefinitely postponed. That a city of the size of Detroit is without modern transportation facilities is felt by the citizens to be a reproach and they are rather touchy when the matter is referred to as evidence that it is behind the times and lacking in enterprise. Such an impression is not calculated to advance the city's material prosperity. The officers should discard the notion that the company is at their absolute mercy, for it is by no means in as bad shape as that, and should endeavor to reach a settlement on some basis that will be fair to the company as well as advantageous to the municipality. While the mayor is trying to deprive the company of all hope of profit the city is steadily losing all the benefits that follow the introduction of an electric railway system.

Chicago Trolley Ordinances. The ordinances which permit the introduction of the overhead trolley system on most of the horse car lines in the South Division in Chicago have been adopted, but if it accepts them the Chicago City Railway Company must contribute a very handsome sum to the city treasury. The conditions which Mayor Hopkins has urged should be incorporated in the ordinances were adopted only in part by the aldermen. In his message to the city council the mayor has argued that the company should be compelled to light by arc lamps the streets on which it might operate electric cars and should also pay unconditionally a quarter of a million dollars to aid in the elevation of the steam railroad tracks. The former suggestion was utterly disregarded by the council as it felt under no circumstances would the company accept it—a conclusion that was undoubtedly correct. The second suggestion of the mayor met the approval of the council and the company must pay at least $250,000 for its trolley privileges. There are two contingences which may arise to prevent the immediate introduction of the trolley system. The mayor may again veto the ordinances in their amended shape as they fail to include all his suggestions, and the company may refuse them because of the requirement of a quarter of million dollars. The company has agreed to pay this sum to the city under certain conditions, but the council did not see fit to incorporate them in the ordinances. It is certainly to be hoped that terms can be agreed upon which will make possible the improvements that the company proposes to make. The South Division is greatly in need of rapid transit on its cross-town lines, and its postponement would be extremely unfortunate. Mayor Hopkins it seems to us goes too far in his attack on the company whose great sin in his eyes appears to be that it has been prosperous. He has no words of commendation for the admirable even liberal service it has given the public, or for the important part it has played in developing one of the great divisions of Chicago. His message teems with cheap clap-trap expressions common to the speech of persons who attack corporations for selfish purposes. The language of the labor agitator should not be employed by the mayor of Chicago. His comprehensive knowledge of electric railways is indicated by the fact that he refers to the trolley as "antiquated." He might have searched through the dictionary without discovering an adjective less applicable to the overhead trolley system. Mayor Hopkins has in many respects proved himself to be an admirable executive but he has not appeared to advantage in his final connection with the trolley ordinances. We hope he will reach an understanding with the company and let the improvements proceed.

General Electric Report. Elsewhere in our columns will be found a rather full abstract of the second annual report of the General Electric Company. The report was sent out to stockholders during the week in advance of the annual meeting which takes place on the 10th instant. The report made one year ago was for only a fraction of a full year, since the companies had not been consolidated long enough to admit of a complete record of business for 12 months. The present report, while covering a full year, includes a record for six months of prosperity and six months of business depression. There is, therefore, very little basis for comparison of results or opportunity to draw conclusions as to the possibilities of the electrical business. The report is good evidence that a conservative spirit is the dominant one in the present management of the company. The statement of assets and liabilities seems to have been made with a view of avoiding the mistake made in compiling the former report, when the stocks and bonds of every kind of wild-cat organization, with which the treasury was full to overflowing, were rated at an extremely high figure. This year these securities, or what is left of them, are put down at figures much nearer their actual value. It is barely possible that had the business of the company continued in its former prosperous condition and the general trade and monetary conditions remained unchanged, the management would have been able to dispose of many of these so-called securities at a sum approximating their value as estimated a year ago. But the risk involved in the handling of such a mass of this class of securities was very great and under the pressure of the financial depression, the company was compelled to sacrifice the choicest of these securities, aggregating a par value of over $12,000,000, at less than one-third their face value. Many of those that remain are practically worthless, as appears from the statement. In other ways as well the assets of the company have experienced a tremendous skrinkage. Had the figures of the last report, however, been more carefully and more conservatively made, the comparison would not show such an apparent decrease during the past twelve months. In another respect the report is no less conservative. It contains no boast of great expectations for the future; no prophecy of large returns to investors; and no indication that the policy of absorption and consolidation as carried out for the past two years is regarded or has proved to be satisfactory, nor even that it is not considered responsible for the present condition of the company's finances. The holdings of stock of some of the sub-companies have in fact been reduced to a merely nominal figure. The showing made in the following statement would have been more satisfactory to the stockholders if the increase had not been obtained at such a sacrifice and on a more nearly cash basis: Total number of companies operating arc and incandescent lighting plants: February 1, 1892, 1,158; 1893, 1277; 1894, 1479; total number of railway companies for the same dates, 214, 435 and 541 respectively. It is evident that the company places considerable dependence upon the business of the licensee companies. It would be interesting to know just what proportion of the whole business comes from this source. It is reported this week that it has been decided to retain Mr. Coffin at the head of the company as the best available man to carry out the wishes of the controlling stockholders.

CHICAGO TROLLEY ORDINANCES.

The ordinances which give the right to the Chicago City Railway Company to install the trolley system on most of its horse car lines came before the City Council on April 4th and after amendments most of the measures were adopted. These ordinances had been vetoed by Mayor Hopkins who returned them to the council with the request that action on them be postponed as he proposed to send a message to the aldermen in regard to them. This communication was forthcoming at the last council meeting. The document is long but contains little of general interest. He says the ordinances grant to the Chicago City Railway Company the right to use overhead wires on thirty miles of streets and to erect 3,000 poles. He then speaks of the great prosperity of the company and attacks it for its unwillingness to pay what he considers an adequate price for the trolley privileges He has insisted that the company should light by arc lights the streets on which trolley cars should operate, but the company had refused to agree to the demand. It agreed however under certain conditions to the payment of $250,000 to the city to aid in the elevation of the steam railroad tracks. The amendments which the Mayor suggested are as follows:

"1. Iron or steel center-poles, whenever the width of the street will permit, iron or steel side-poles in narrower streets.

"2. An independent electric return circuit for the protection of the water and gas pipes in the streets.

"3. No trolley lines in Archer avenue east of the river, or in 22d street, these streets being too close to the heart of the city.

"4. The space between the poles to be not less than 115 feet, the distance determined by the council in the case of the Lincoln avenue and Milwaukee avenue electric roads.

"5. No right to use any other motive power but electricity without the previous consent of the city council.

"6. Poles for the conveyance of wires from the power houses to be erected in alleys wherever feasible.

"7. No right to lease the use of poles or wires to any other companies without the previous consent of the city.

"8. No interference with the surface of the streets except upon a cash deposit of the amount of the possible cost of the restoration of the streets, as estimated by the commissioner of public works.

"9 Rails used to be subject to the aproval of the mayor and commissioner of public works.

"10. Limiting the franchises to a term of ten years, so that they will expire about the same time as the general franchises of the company.

"11. Proper provisions of indemnity to the city for any damages sustained.

"12. A provision for lighting the streets affected by these ordinances with electric arc lights, to be attached to each of these ordinances.

"13. Payment of $250,000 to the city as a contribution for the expense arising from track elevation and to defray the increased cost of deepening the subways so as to accommodate trolley cars to be made a condition of each ordinance.

"14. Limitation of the franchise to the Chicago City Railway company so as to exclude successors, lessees and assigns.

"15. Amendments in matter of form rather than in matter of substance."

In taking up the ordinances the aldermen first voted to grant the company the right to introduce an overhead electric railway system on Sixty-third street with the single condition that the city possess the privilege of using the poles for electric lights.

The omnibus ordinance giving the company the right to substitute electric power for horses on the cross-town lines was amended by omitting Twenty-second street and Archer avenue east of the Chicago River and by providing that $250,000 be paid the city by the company in eleven installments as each of the subways to be built when the tracks are elevated is completed. As thus amended the ordinance was adopted by a vote of 51 to 11. No attention was paid to Mayor Hopkins' recommendation that the ordinances embody clauses compelling the company to light the streets.

The blanket ordinances giving the West and North Chicago Street Railroad Companies the right to introduce the trolley system was brought up but the council adjourned before a vote was taken on it.

SECOND ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

The second annual report of the General Electric Company for the year ending January 31, 1894, has just been published and will be sent to the stockholders in a few days. It tells a story which thousands of interested people have been anxious to read these many months. It covers the year ended January 31, 1894, and the contents give evidence of the use of the pruning knife upon assets as it has rarely been wielded by the management of a solvent corporation. The shrinkage of assets is simply tremendous. A profit and loss surplus of $1,024,954 February 1, 1893, becomes a profit and loss deficit of $12,454,967 twelve months later. Factory profits for the year are $3,189,884, against about $5,200,000 the previous year. Notes and accounts payable are reduced from $4,554,348 to $1,067,426. The consolidated statement of profit and loss covers the General Electric Company, Edison Electric Light Company, Edison General Electric Company, Thomson-Houston Electric Company and Thomson-Houston International Electric Company, and shows:

DEBTOR: Interest on debenture bonds, $499,893; dividends. $1,655,150; taxes. $195,457; World's Fair expenses, $241,877; total, $2,592,378. Amounts now charged off: Patents, $733,870; notes and accounts receivable and on stocks and bonds sold and on hand, $10,444,318; manufacturing plants, $902,0:8; inventories and consignments, $2,157,507; machinery, tools. instruments and fixtures other than at factories, $221,205; sundry losses, $125,205; total, $17,179,845.

CREDITOR: General Electric Company's surplus, January 31, 1893, $1,024,954; manufacturing and selling profits, less general expenses, $3,189.884; dividends and interest on stocks and bonds owned, $433,293; interest, discount and exchange, $76,745: debit balance carried forward, $12,454,967; total, $17,179,845.

The consolidated balance sheet, January 31, 1894, was:

ASSETS.

Patents and franchises		$8,159,264
Manufacturing plants		3,941,128
Real estate (not including factories):		
Edison building, New York City	$412,356	
Less mortgage thereon	200,000	
	$212,356	
Other real estate	111,329	
		323,685
Stocks of manufacturing companies	$2,767,470	
Stocks and bonds of local companies	2,723,493	
		5,490,963
Cash	591,143	
Notes and accounts receivable (face value $14,984,697.42)	8,934,159	
		9,525,303
Inventories:		
At factories	3,349,042	
At sales offices (including consignments	1,485,749	
		4,834,792
Work in progress		1,198 343
Profit and loss		12,454,967
Total		$45,928,449

LIABILITIES.

Capital stock:		
Common		$30,459,700
Preferred		4,251,900
Five per cent. gold coupon debenture bonds		10,000,000
Mortgages		26,200
Accrued interest on debenture bonds.	$ 83,333	
Notes payable	744,341	
Accounts payable	323,084	
		1,150,759
Sundry credits		39,889
Total		$45 928,419

The floating debt statement in the current report shows this contrast:

	July 31, 1893.	Jan. 31, 1894.
Notes payable	$4,446,000	$744,000
Dividend	609,000	......
Accts. payable and interest	1,579,600	406,000
Total direct	$6,634,000	$1,150.000
Cash	1,294,000	591,000
Net direct	$5,340,000	$559,000
Indorsed paper discounted	3,394,000	1,425,000
Total direct and indirect	$8,734,000	$1,984,000

The footing of assets and liabilities January 31, 1893, was $50,934,974. Investment accounts were $21,875,373; stocks and bonds of local companies, $9,173,252; cash, $3,871,034; notes receivable, $5,151,951; accounts, $7,078,879; inventories, $2,076,503; materials in process, $2,207,982. The liabilities, less the capital stock and bonds were interest accrued, $83,333; dividends due, $608,538; notes and accounts payable, $4,554,348.

The reduction of debt in six months was $6,750,000, of which $4,050,000 was received from the sale of rising $12,000,000 assets to the Street Railway & Illuminating Properties, and $2,700,000 principally from the collection of notes and accounts receivable. The report says:

This reduction does not disclose all the improvement of the last six months. The indirect obligations of the company, arising from its indorsement of discounted notes receivable, were six months ago almost as embarrassing as its direct debt, as the larger part of them had to be provided for by your company at maturity, their makers being unable to take care of them. To-day no paper is under discount except such as it is believed will be paid by the makers; consequently the interest obligations of the company are nominal rather than real. At the date of this report (April 2) the direct obligations have been reduced to about $750,000.00, which was partly offset by about $400,000.00 cash on hand, and the paper under discount is reduced to about $750,000.00.

In addition to the above, there are still outstanding some important guarantees given two years ago by the Thomson-Houston Company to the United Electric Securities Company, whereby in one form and another it is claimed that the Thomson-Houston Company (and practically the General Electric Company) is bound to take back from the Securities company certain bonds of local companies at a valuation of $702,000. This liability has been in part arranged for by substitution of other securities, and it is not thought that such guarantees will involve any considerable cash outlay, although their ultimate adjustment may result in some loss.

Your directors believe that the notes and accounts receivable, and such stocks, bonds etc., as it is undesirable for the company to hold permanently, can, with some delay and patience, be collected and marketed to such an extent as shall not only liquidate the small amount of remaining obligations, but shall also supply all necessary working capital. Earnest attention is being given to the sale of these assets.

While the liquidation of the debt has been going on, the company has also readjusted its basis for sales, either to cash or short credits, to desirable customers. In view of the extreme depression and the uncertainty as to the early future, your directors have not felt justified in any other course than that of adhering strictly to sales on this basis. It is believed that your company has lost little legitimate business in consequence of its curtailment of credit to customers. It intends to confine its business to this basis, and to accept smaller profits.

Your directors do not believe that it will be possible for some time to come to do as large a business as was done by the company prior to the panic, although a gradual improvement has been apparent during the last two months. The street railway business, which to a considerable extent was formerly done through syndicates and promoters, many of whom have become embarrassed, promises to be smaller than during the previous year. Arc lighting business is also reduced largely because of the inability of local companies to secure capital with which to extend their business for the purpose of carrying out municipal contracts. The business of the company, with respect to incandescent lighting, which is to a great degree performed by strong and conservatively managed local companies, is in a more healthy condition, and has not suffered so severely. The business in plants for the distribution of electrical power is promising, and many important installations are in progress. The application of electricity to various mining purposes, such as hauling, hoisting, drilling, etc., is increasing. The future in this respect is promising. The increase in the number of local lighting and railway companies is shown by the following table:

Feb. 1.	1892.	1893.	1894.
Local companies operating incandescent and arc lights	1,158	1,127	1,479
Railway companies	214	435	541

The report refers to the "grave mistakes in the estimates of value of accounts, securities and inventories of merchandise" in the previous annual report, although at that time especial emphasis was put upon the fact that a competent committee had scaled those items to bed rock valuations. The work of consolidation of sub-companies and of operating and selling departments is rehearsed. The following paragraph illustrates the working down of assets:

As you are aware, the Thomson-Houston Company had large interests in various construction and manufacturing companies, notably the abovementioned Northwest Company, the Fort Wayne Electric Company, the Brush Electric Company and others; the whole standing on its books at about $5,500,000. At the time of the last annual report, statements were obtained from the officers of such companies, and it was estimated that something less than one-half of this investment was represented by patent rights, and something over one-half by other assets. Unknown to your board of directors, some of the companies became unduly expanded during the winter and spring of 1892–93, and the stringency which began in April and culminated last autumn caused them to suffer greatly. Your directors have reduced your entire holdings of Fort Wayne and Northwest stocks to a valuation of $1 each, exclusive of the amount carried in patents. After protracted negotiations, the Northwest company has been put in liquidation, and the territory controlled by it has reverted to your company.

Regarding concentration of work at Schenectady the report says:

The business management of the company has been concentrated at its principal office at Schenectady, and its whole organization has been greatly simplified. All accounts are kept there, and all sales and credits are supervised there. So far as practicable, your manufacturing business has been and will be concentrated at Schenectady; and the operations of its other factories are now directed from there.

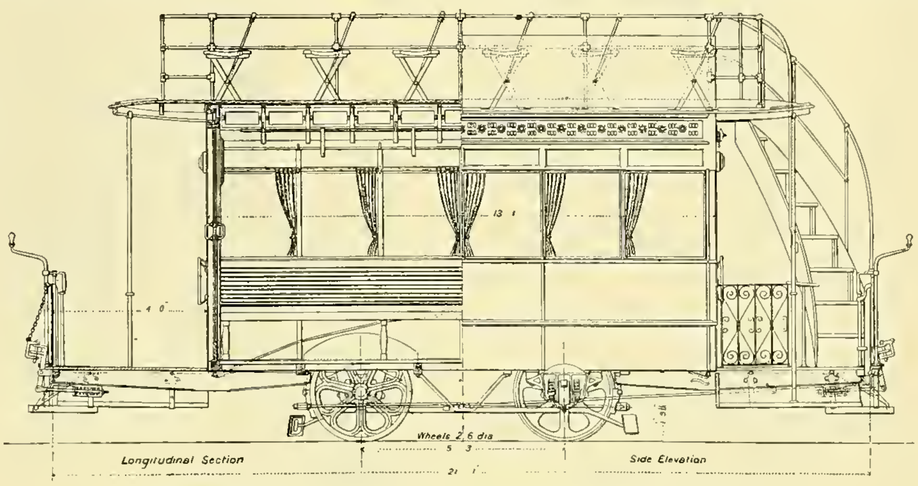
Of especial interest as bearing upon the report of the development of electrical science, is a shrinkage of $2,382,012 in the inventory value of apparatus and materials at the factory and machinery and fixtures at storerooms. "This shrinkage," the report says, "is partly due to the fall in value of material manufactured and in process of manufacture, and partly to the development in electrical science, which has been so great during the last year or two that apparatus which at the time of the last inventory was looked upon as commercial has been superseded by entirely new and superior types. Consequently the older apparatus has become unsalable, or of slow sale, and most of it has been reduced to 'scrap' value, and the remainder to much less than cost."

Although the company expended $884,659 upon manufacturing plant during the year, the valuation at the end was marked down $17,399 less than at the end of the previous year. The amount charged up off plant is $902,058; on raw material and goods manufactured or in progress, $1,217,142; on goods in salesrooms, $940,365. The notes and accounts receivable represent dealings with over 6,000 customers, and are valued at the lowest estimate among those placed upon them. These include $2,531,609 due by the Fort Wayne, North West and other allied interests. The stocks of manufacturing and other companies, placed in the balance sheet at $2,767,157, have a par value of $8,279,706. Other stocks of the par value of $6,037,310 are set down at $313. Stocks of local companies of the par value of $2,750,313 are set down at $1,362,294. Stocks of other local companies of the par value of $3,713,717 are placed at $4,754.

Bonds of various companies of the par value of $2,785,940 are figured at $1,356,431, and others of a par value of $146,621 are placed at $12. It will thus appear that if the valuation of treasury assets a year ago was attended with "grave mistakes," there was no intention that the error should be repeated on this occasion.

CARS TO BE USED ON THE GLASGOW CORPORATION TRAMWAYS.

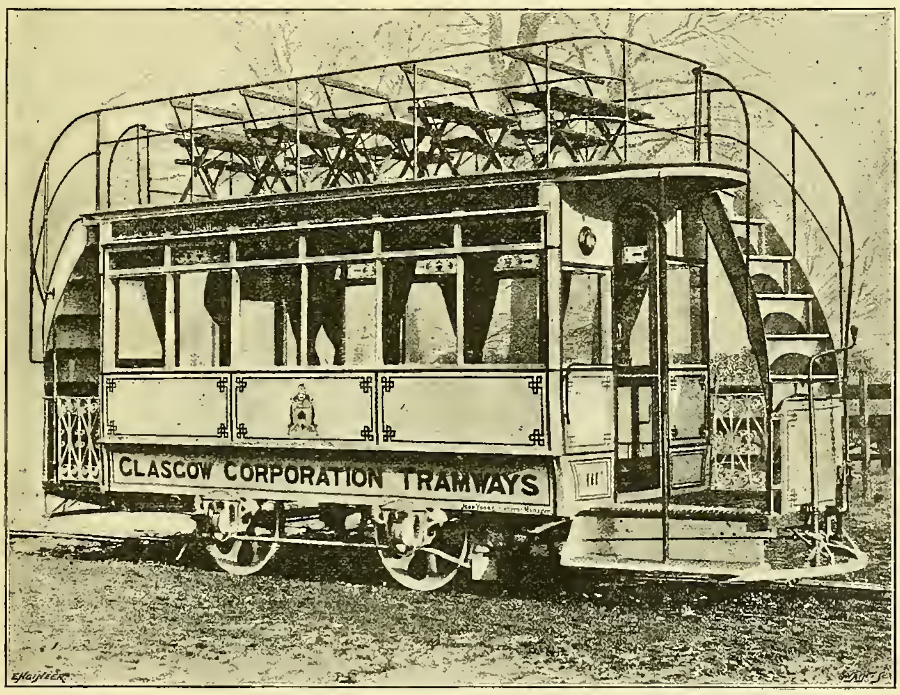
The accompanying engravings illustrate the type of car which has been ordered by the city of Glasgow, Scotland, for use on the municipal lines. New rolling stock is required in the city because of the expiration of the lease under which the Glasgow Tramway and Omnibus Company has been conducting the tramway service in the city. The city has the right under certain legislative grants to operate the tramways and it has determined to exercise the authority. The city proposed to take over the real estate, working plant and horses of the tramway company but a difficulty arose because of the company's claim that it had the right to run omnibuses in competition with the tramcars. The city refused to admit that the company had any such right and negotiations for the purchase of the latter's property fell through. The city was then under the necessity of purchasing new tramcars so that it could operate the system by July 1. A large order for cars has been given, and the type shown in the illustration is that designed by the Midland Railway Carriage and Wagon Company of Shrewsbury.



TWO-HORSE FORTY-SEAT TRAMCARS OF THE GLASGOW CORPORATION.

It will be seen from the illustrations that the cars present a handsome appearance, and that they have an unusually large window-space. Each car, though it will afford accommodation for eighteen passengers inside and for twenty-two outside, will not weigh more than 4,600 pounds. One of the objects aimed at by the constructing company was to reach the minimum weight which would safely and serviceably support as many as forty passengers. To secure this object the somewhat slender-looking framework of the body is made of first-class white English ash, in the selection of which great care has been taken. The length of the body is 12 feet 6 inches, the length over platforms being 21 feet 1 inch, and the width 6 feet 6 inches. The height is 6 feet 7 inches from floor to roof. Inside, the seats and the interior roof are of alternate strips of pitch pine and sequoia, the effect of the contrast of color being very satisfactory. The interior casings are of teak, paneled with Trieste oak. The outside panels are of mahogany painted in crimson lake with gold linings. The wheels are of chilled cast iron, and the axles of Siemens-Martin mild steel. The lighting is by one incandescent electric lamp at each end of the car, furnishing light to the roof lamps also. Current for these lamps is supplied by secondary batteries under the stairs on the platform. A special feature of the car is the excellent means of ingress and egress afforded by the long stepboard, conveniently divided, as will be observed, by the upright brass standard suporting the canopy.

The car wheels are 30 inches diameter, bored to 2.687 inches, the axles being 2.75 inches diameter at center and 2.562 inches in the bearings. Each axle is guaranteed to bear bending double cold without flaw, and to have a breaking strength of thirty tons with 25 per cent. elongation.



TWO-HORSE FORTY-SEAT TRAMCARS OF THE GLASGOW CORPORATION.

West End Transfer System.

At the meeting of the street railway committee of the Massachusetts legislature on last Wednesday the following figures were submitted relating to the transfer system of the West End Company of Boston: During the year ended September 30, 1893, there were issued 11,716,557 free transfers, and of this number 10,823,201 were collected; 11,652,843 four cent and four and one quarter cent checks were issued and collected. It cost last year for the free transfer system $18,067.50 for wages, $3,928.58 for printing and $1,612 for rent of necessary waiting rooms, or a total of $25,608.08, not including anything for heating, lighting or care of waiting rooms, or any charge for places where the property belongs to the company.

The company's attorney stated in regard to the sale of stocks and bonds that the stock of the corporation had been issued at par, except $3,000-000, which was sold at auction at $70, the par value being $50. The road issued last year $3,-

000,000 5 per cent. bonds, sold at par minus a commission of three-fourths of 1 per cent.

This year the company had negotiated the sale of $2,000,000 debenture bonds at 4½ per cent. They were sold at from $91 to $94.

NEW ELECTRIC RAILWAY APPARATUS OF THE WALKER MANUFACTURING COMPANY.

When the announcement was made several months ago that the Walker Manufacturing Company of Cleveland had determined to engage in the manufacture of electric railway apparatus, the news excited the keenest interest for several reasons. The company had for years been engaged in the construction of cable railway machinery and its name is closely associated with much of the best work in the cable field. It was felt that the new departure was a significant endorsement of the electrical system by a company thoroughly competent to pass upon its merits. Not a little speculation has been indulged in regarding the character of the machinery which the company would put on the market, but little accurate information has until now been forthcoming. It was assumed, however, that the apparatus would be of a high standard as the products of the Walker works have always belonged to the highest class. Speculation turned rather toward a consideration of the character of the changes that would distinguish the machines from existing electrical machinery. It was the general impression that nothing of a startling description was to be expected, but that the apparatus would approach those standards that experience has shown to be best adapted for actual practice. That this conclusion was correct is shown by the descriptions and illustrations of the new machines which are presented herewith.

The new generator which the company is building for street railway and direct current power transmission shown in Fig. 1, is of 250 horse power, of the well-known four-pole type and is a slow speed machine. The frame is cast in one piece with three bearings, which are of ball and socket self-oiling type. The field magnets are of wrought iron and are wound with enough copper to allow them to run perfectly cold.

The armature is series wound and insulated entirely with mica. With these two-path windings —the only kind used by this company—there can be no unbalanced armatures, no sparking, and no heating.

The windings are entirely below the surface of the armature, which is iron-clad, with no binding wires. There are no joints in the windings, except where the wires connect with the commutator bars; the insulation throughout the entire machine is sufficient to withstand at least ten times its normal requirements. The armature and commutator are thoroughly ventilated, as a current of cool air passes all through the interior of the machine. The commutator is large and runs cold in regular operation. The small machines of this type are belted machines, and the larger ones are usually built on the engine shaft.

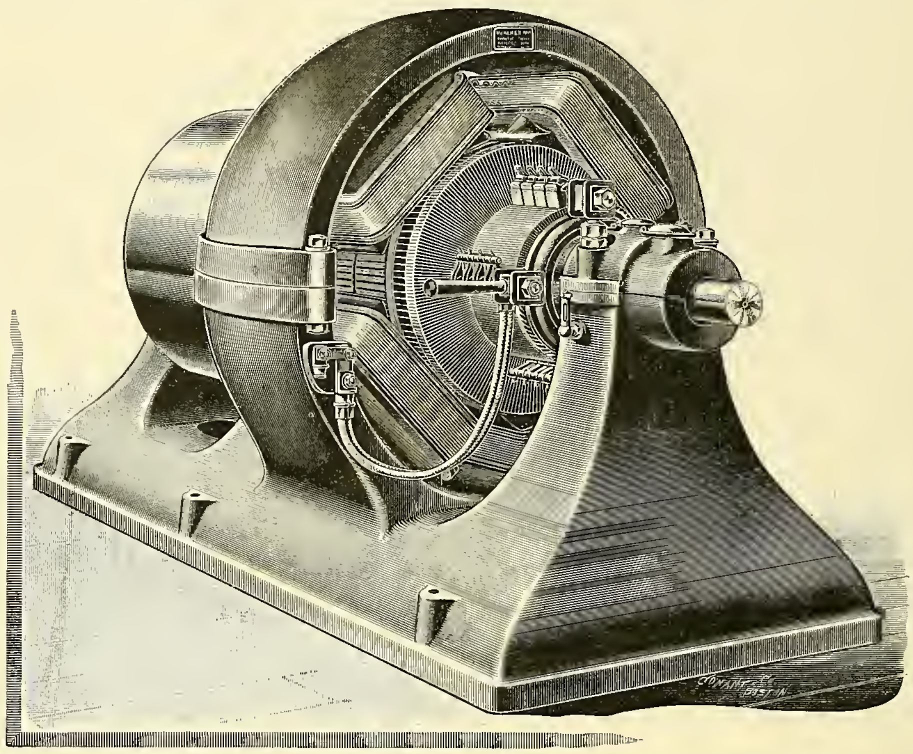


FIG. 1. GENERATOR.

Experience has shown that one of the great expenses in operating roads by electric motors has been the repairs made necessary by the rapid deterioration of the track and rail joints. The Walker company holds to the view that the only way to correct this evil is entirely to disconnect the motor itself from iron to iron contact with the axle and thus prevent not only the hammer blow due to the weight of the motor, but the inertia blow due to the unyielding mass of the motor. Attempts have been made to accomplish this by suspending the motor at or near the center of gravity. This eliminates the weight, but not the inertia blow, which is the most serious. This has forced those interested to the conclusion that the perfect motor must weigh as little as possible, be extremely strong in mechanical construction, and should work up to 25 horse power without heating, and not be in any way attached to the axle and wheels, except through springs which will to the greatest possible extent do away with the hammering of the track. This method of suspension gives the freedom of movement necessary for the removal of strain in rounding curves. The motor being built by the Walker Manufacturing Company embodies these suggestions of practical experience. It is a four-pole steel motor, weighing 1,200 pounds, has an easy capacity of 25 horse power, will run at any speed up to 25 miles an hour, is controlled by a series parallel controller, of excellent design and great simplicity, and is not attached to the axle in any way, except through yielding supports.

Fig. 2 shows the general form of the motor, mounted upon 30-inch wheels and an ordinary truck, portions of the latter being cut away so that the machine may be more readily seen. The motor is entirely water and dust tight, the only opening being the lid over the commutator, by opening which the two brushes can be easily reached. The frame is in two parts and is made of steel. The gear housing and commutator lid are of malleable iron. Both gears and pinions are of steel.

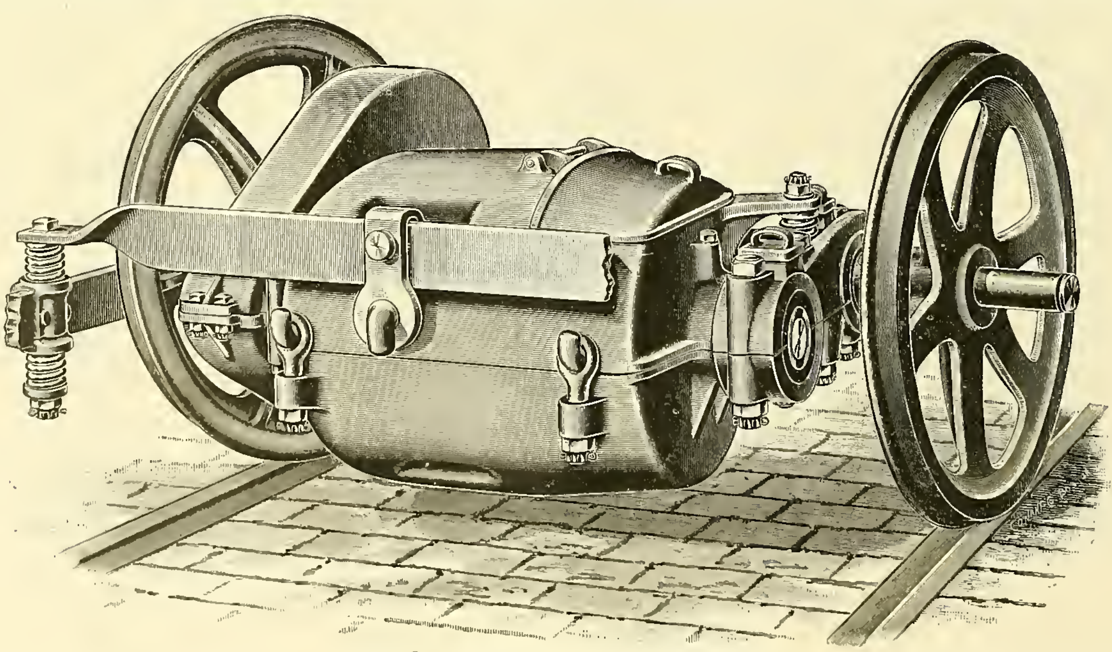


FIG. 2. STEEL MOTOR, SPRING MOUNTED.

The shaft is large, being $3\frac{1}{2}$ inches in diameter and $2\frac{1}{2}$ inches in the bearings. The bearings are very long and arranged for thorough lubrication with grease. The efficiency of the motor is stated to be 90 per cent.

The detail cuts give a more complete idea of the flexible support and other important points.

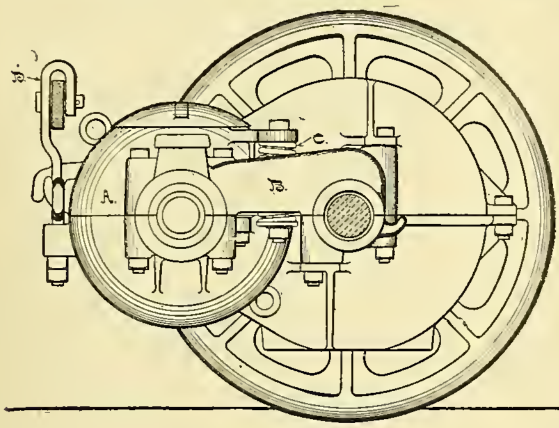


FIG. 3.

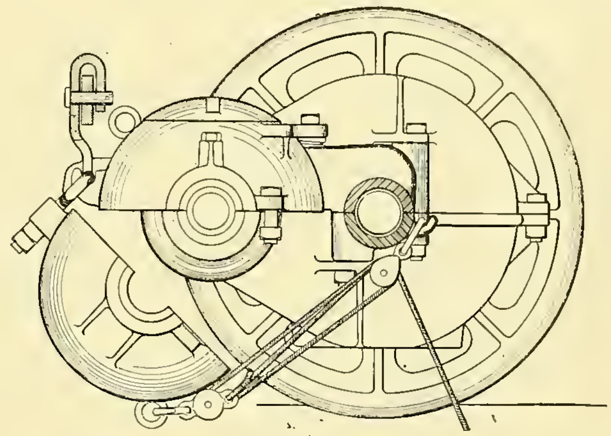


FIG. 4.

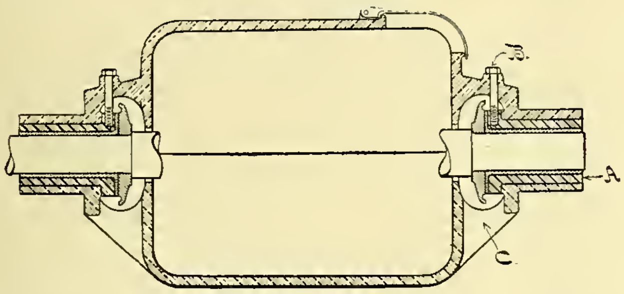


FIG. 5.

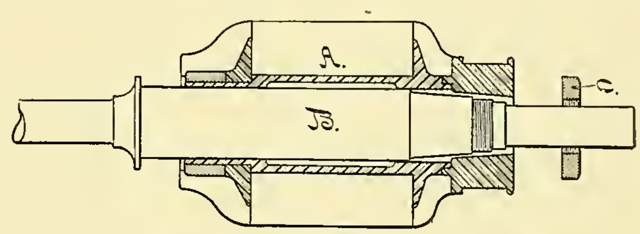


FIG. 6.

Fig. 3 shows an end elevation of the motor with one wheel taken away. B is a cast-iron U-shaped frame, the rounded end being journaled on the car axle in the ordinary way. Swinging freely between the arms of this U is the motor A, trunioned by its bearings, but not touching the

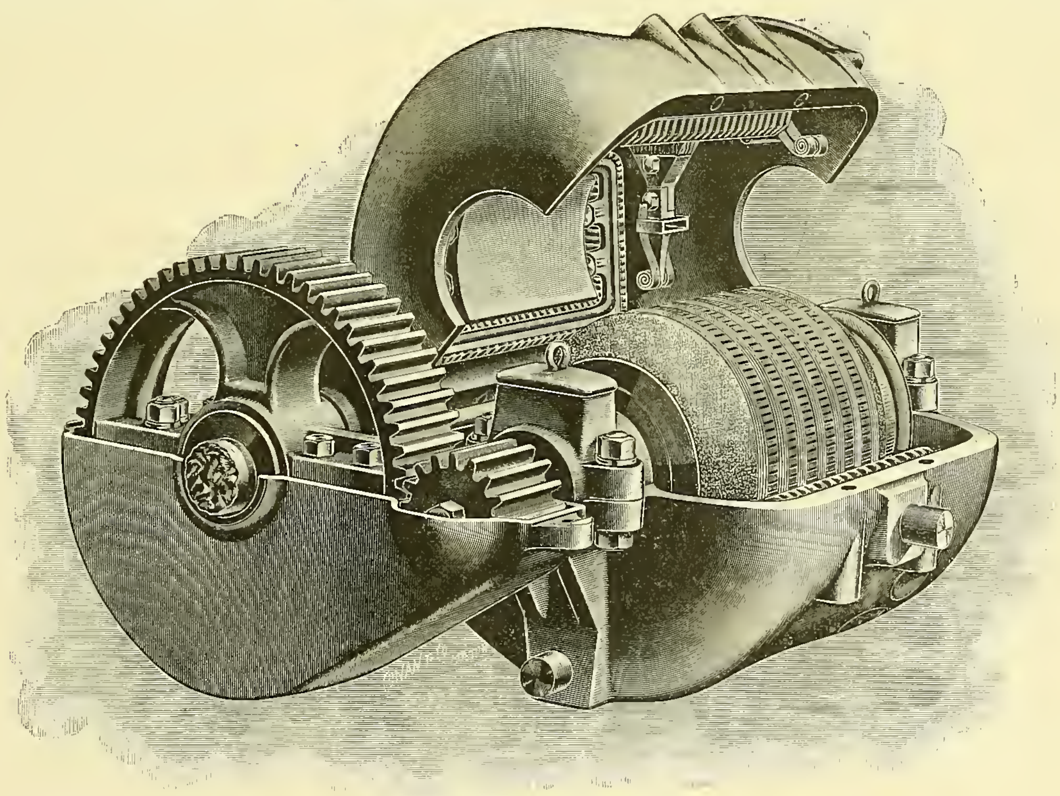


FIG. 7. CAST IRON MOTOR.

axle. The motor is then supported at the rear by spiral springs, C, between lugs on the frame and the arms of the U, and at the front end is supported by a swinging arm from the ordinary spring truck bar D. It can be seen that, with this suspension, the motor rides freely on springs, readily adjusting itself to varying conditions, without bringing a strain or shock on any part. The gear centers are always maintained because of the U-shaped frame.

Fig. 4 shows how the lower half of the frame is made to swing down, while the armature remains in place, one man being able to let it down and replace it after inspection and cleaning. The armature may be removed, if desired, from below; or, if the motor should not be over a pit, the upper half may be swung up and the armature removed from above.

By referring to the figures it will be seen that all the bearing caps come off from below, and all the bolts pass down from above; and, should a nut come off, no part of the motor can fall. The bolts are not made to take the weight of the motor, and the nuts are all locked with pins.

The bearings are entirely outside of the motor casing or frame, as shown by Fig. 5. They are solid shells, A, filled with the best babbitt and are supported by the bolt B. The grease, which comes out between the end of the thrust collar and the inner end of the bearing, falls to the ground through the opening C, which is 4 by $2\frac{1}{2}$ inches, and cannot be clogged. No grease can get into the motor.

Fig. 6 shows a section of the armature. The core A is built on a separate sleeve, which receives the shaft B. This shaft, when worn out, can be replaced by removing the nut C, drawing out the shaft and inserting a new one, thus saving the expense of tearing the armature down and rebuilding, as not a wire connection is disturbed.

The commutator is on a tapered portion of the shaft, the same as the pinion, and can be more easily drawn off for refilling. Both commutator and pinion are held in place by nuts properly locked by an ingenious lock washer.

This motor contains all the long-tried constructional points which experience has proven to work well, and the weak points existing in motors of other types have been eliminated. Being flexibly supported, it will remove all trouble with rail joints. Not even the gear noise is heard, as the gears are inclosed in air-tight housings and run in oil.

Fig. 7 shows a cast-iron motor of 35 horse power for heavy work, weighing 2,500 pounds. This motor is designed for use where very large cars or trains of cars are operated. It is made of cast-iron, and has an efficiency of nearly 90 per cent. It is built on the same general type as the steel motor, but is not spring mounted, being journaled on the axle. This motor is small and light for its output. It will operate on 30-inch wheels with plenty of clearance.

The designs are already completed by the company for large motors to operate elevated trains, or suburban and interurban railways which will be run at high rates of speed.

*ELECTRICAL ENGINEERING AS A PROFESSION.

BY R. H. THURSTON,

Director of Sibley College, Cornell University.

Within a very few years an exceedingly important and most intensely interesting branch of mechanical engineering has come to be distinguished —electrical engineering. In this subdivision, we find classed all those designers and builders having such knowledge of the sciences and the arts which underlie the profession, who devote themselves to the production of that class of machinery and apparatus which is intended for the production and distribution of power in the form —usually the intermediary form—of electrical energy. The engineer may be said to be the producer and dispenser of energy; the electrical engineer gives his time and thought and talent and labor to the production and distribution of this particular form of energy. The science of his art is a combination of all contemporary knowledge of physics and chemistry, and mathematics and mathematical physics, as the peculiar distinguishing feature of his scientific preparation with all the scientific and practical knowledge of the engineer engaged in any other branch of construction of machinery, a knowledge of the strength and mechanical properties of all materials of construction, of the applied mechanics of construction and of structures, of machine-design, or the art of proportioning parts of machinery, and a familiarity with the forms, standard proportions and methods of application, and with the economic efficiencies, of the prime motors and all machinery of transmission employed in the development and distribution of energy for power and light-production, in every department of human industry. He must be something of a physicist, an accomplished electrician, something of a chemist, and a talented engineer and constructor, if he is to succeed in the highest degree in his chosen profession and specialty; in fact, he must add to these essentials, also, those of good business capacity and excellent judgment, in all matters both of construction and of business.

To succeed in this branch of mechanical engineering the young man proposing to prepare himself, professionally, for entering it should always consider whether he is naturally a good mechanic; for otherwise he will most assuredly fail; whether he has a talent for mathematics without which he can never secure even the elementary basis of the scientific side of the profession; whether he has a real and abiding interest in natural science and especially for physics, upon which is based the whole distinctive part of the chosen vocation; and, especially, whether he has that combination of a scientific cast of mind with that practical good sense and intuitive mechanic's sense and judgment, which together constitute the rarest, but perhaps also the most important, of all the elements of success in any branch of engineering. The aspirant for its highest honors will find himself in direct competition with strong and bright men, and must show himself equal to every emergency which confronts him, and readier, more accurate, more economical than they; or his opportunity will be lost, and he will never attain the highest levels of his profession. If he can not clearly see this promise of success, he should turn to other fields of industry, in which he may be more certain of advancement.

The preparation for entrance into electrical engineering has during the generation just passed come to be through the schools primarily; and a good education has come to be demanded, supplemented by a thorough professional training in a school having an extensive and complete equipment, a good professional course of instruction, and—most important of all—a staff of capable and experienced specialists in engineering. The engineering schools are now turning out large numbers of well-educated and well-trained young men, who are taking possession of the best work of the profession in all its branches; and competition with them, on the part of less well-educated, and especially less well trained, professional engineers must be usually hopeless. This is especially the case in electrical engineering; where a strong mathematical preparation, a familiar knowledge of physics through the experimental and formal training of the laboratory devoted largely to applied electricity, and a complete and fundamental course of study and practice in designing electrical and other kinds of machinery are all needed to insure success in professional practice. The best engineering schools now have extensive laboratories in which are taught the principles and practice of the trades accessory to engineering, and the best methods of determination of the strength and other essential properties of materials of engineering, testing steamengines and boilers, and solving all the practical problems of research which constitute in large degree the really difficult and genius-testing work of the engineer. It is this class of problems which affords the talented engineer his opportunity in times of emergency and trial to place himself in advance of his fellows. It is only in the higher class of engineering schools that he can learn satisfactorily the essential methods of this branch of his vocation. The schools of engineering, when actually professional and not semi-educational, demand of the student a good knowledge of the ordinary high-school studies and especially of mathematics. They sometimes require some knowledge of a modern language or two, and occasionally even an elementary knowledge of Latin; although this is not either usual or, probably, wise. No young man should be barred out of a profession because he has not acquired learning unessential to the study and practice of that profession. It is wise, however, where the youth can afford time and the cost, to secure the best education that the country can offer before entering upon his professional work. A professional training is the acquirement of the special and narrow learning of that profession; it is not an education. Education must usually precede professional training; but the broadest education may and often does come in part before, in part after the professional studies. It is coming to be usual for young men in the universities to choose their electives in the liberal courses from among the advanced mathematical and scientific subjects, and thus to secure a very extensive and essential portion of the professional preparation; then entering the engineering course after graduation in arts or philosophy as the case may be. It is, however, unfortunately, as a rule only those who are well-to-do who can thus secure the best modern education supplemented by the best professional training, and go out into the world equipped to make the most of life in its every desirable field.

Electrical engineering is taking a more important and fruitful place among the professions, every day. The applications of electrical science and engineering are rapidly increasing in number, extent, and value; and the practitioner who chooses this branch as a specialty—and all professional men, to succeed, must become specialists —finds himself given daily greater opportunities for usefulness, and able constantly to demand greater returns; while the brilliancy and importance of his discoveries, and inventions constructions, procure for him exceptional respect and distinction. But he must have the natural talent, the thorough preparation, the peculiar abilities requisite to insure the power of taking advantage of these remarkable opportunities, if he is to succeed at all, in the coming competition among the brightest minds, the most active, ambitious, and talented young men the country is to-day producing. As in all professions—but, perhaps, even more so than usual—the crowds will barely live; many will be driven out by failure and starvation, and comparatively few will attain to honor, professional distinction and wealth.

Electricity has come to be the right arm and hand of the steam giant and of the genius of the waterfall, and reaches out to do their work at points miles away from the source of the thus distributed energy. The outcome of this, which is now come to be a veritable revolution in modern methods of application of the great powers of nature to the purposes of man, through the art of engineering, can hardly be imagined or foretold; but we can readily believe that such an industrial revolution as this—paralleled, as is already evident, only by the wonderful extension of the uses and powers of steam after the work of Watt, in the first half of the century behind us—must have enormous influence upon the progress of the world, and must give increasing opportunities, for many years to come, to the men who have the essential mental and physical strength and talent, and the needed scientific and professional training to enable them to do the work as it offers itself to them. Such young men will find here their very best opportunities; but all others should carefully avoid being drawn into a profession which exacts so much of special talent and serious study and arduous labor. A course of instruction in an engineering school of the highest class is the most exacting and arduous line of work known, to-day, in any profession or department of human activity. A real natural talent for the work and the best possible preparation for entrance upon such a course, should be understood to be the pre-requisites, by every young man looking in this direction for his life's work.

My experience, as the head of the largest school of mechanical engineering in the world, and with the largest body of students graduating in that branch proving so seductive to these young men of ability and ambition, who combine a talent for mechanics with fondness and capability in the departments of natural science and the higher mathematics, has been that no line of mechanical engineering is as interesting to those well-fitted for it as this, and that none offers so interesting a variety of practical and scientific problems to the professional and the practitioner. But while the number of positions opening to the young men just entering upon this field of work is comparatively large the number in the higher grades is comparatively small, and probably must long, perhaps always, remain so. Only the very best of the competing crowd will be likely to attain any great success. The pecuniary returns come to the capitalist and investor, rather than to the workers. The commercial side, in all departments of engineering, offers more promise of pecuniary gain than the constructive, except that the men making a business of contracting for constructions do well, as commercial men, not as constructors.

We are instructing over two hundred and fifty men, in this department of Sibley College, and graduate about fifty each year. All find employment and interesting and instructive work; but

*From *The Interior*, Chicago

most of the brightest of all our young men in this country at this time must be content with small salaries: a few may secure handsomely paying positions, or opportunities for speculative gain.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Thirteenth Article.*)

[A few slight errors crept into three of the figures used in the last article, and these, Figs. 38, 39 and 43, are here reproduced in their corrected form.]

MULTIPLE ARC AND SERIES ARRANGEMENT.

As observed in Fig. 43 the current before it comes to the magnet coils divides—part of it going through coils A and B and part of it going through D and C, and then the two parts unite again after having passed through their respective coils. It is evident that instead of dividing the current into two circuits each half going

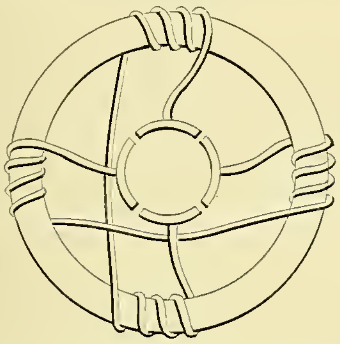


FIG. 38.

through two coils in succession, we might have divided it into four circuits and have placed each coil in a separate circuit, or we need not have divided the current at all, but have compelled the whole of our current to pass through first A, then B, then C and finally through D. Fig. 44 represents the latter arrangement. When current is supplied to several coils or lamps or other electrical devices or groups of the same so that each device or group receives a certain fraction of the whole current independently of all the others, viz.: so that the current which passes through one device or group does not pass through any of the others, as would be the case were we to divide our circuit into four in one of which each of the four coils are placed, these four coils would be said to be in "*multiple arc*" or "in multiple" with each other or "in parallel." In Fig. 43 the current divides between two circuits, the current of one of these circuits passing through the group of coils A and B and the current of the other passing through the group D and C. These two subordinate circuits are therefore in multiple arc with each other and the groups of coils supplied by each circuit are said to be "in multiple arc" or "in parallel" with each other, because none of the

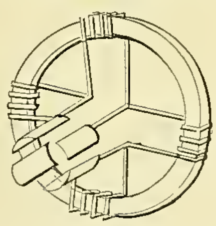


FIG. 39.

current which passes through the coils A and B subsequently passes through the coils D and C.

If however the current reaches its translating devices (the term "translating device" is used to designate anything through which the current passes or which is operated by the current either directly or indirectly) not at the same time or independently as in previous example, but passes through them in succession so that the same current which passes through the first one also passes through the second and the third and so on until all are thus supplied, the various devices are said to be "in series" with one another. Thus in Fig. 43, while coil A and B, considered as a group are on a separate circuit from D and C, and the current which goes through A and B does not afterward pass through D and C and the two groups are in multiple arc with each other, still if we regard the coils separately, the same current

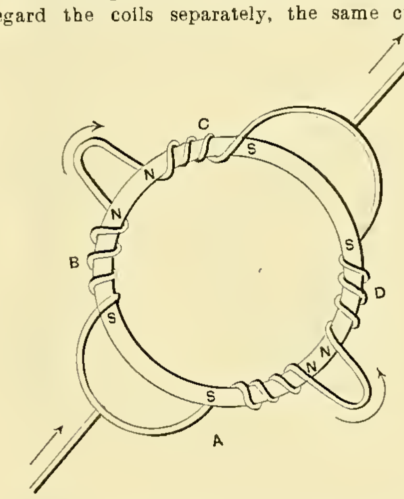


FIG. 43.

which passes through A, subsequently passes through B, and that which first passes through D, also passes through C.

A and B are therefore in *series* with each other and D and C are likewise in series with each other, but if we arrange our coils as in Fig. 44, so that the same current which passes first through A and then through B also passes through C and D in the order named, the four coils are then said to be in series with one another. If the circuit divides before it comes to A—one branch going around the four coils as just described and the other branch supplying in similar manner the coils of another field magnet, then the two groups of field magnets will be in parallel with each other, while the various coils in each group are in series with the others of the same group. This

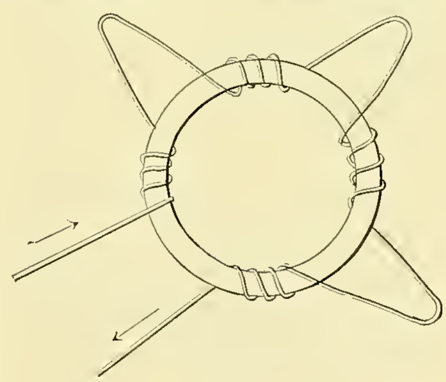


FIG. 44.

is exactly a similar case to that represented in Fig. 43 where the group of coils A and B, while its constituents, A and B are in series with each other, is in multiple arc or in parallel with the other group of coils D and C whose constituents, D and C, are in series with each other.

Such an arrangement as this, where the translating devices are divided up into groups, the members of each group forming a series, but the various groups being in multiple arc with each other, is called a "multiple series" arrangement.

If in Fig. 44 the current after having passed

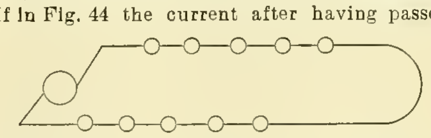


FIG. 45.

through all four coils is carried to another group of magnets or coils, these two larger groups will be in series with one another.

Figs. 45, 46 and 47 represent respectively the series, the multiple arc and multiple series arrangement for 10 translating devices. There is also a fourth arrangement represented in Fig. 4 which is sometimes called the "series multiple" arrangement.

It is well to fix thoroughly in mind the characteristics of the series, multiple arc and multiple series arrangements as they will be frequently referred to hereafter, and a thorough understanding of them is essential to an intelligent reading of what follows. To facilitate this understanding it may assist us if we remember that the incandescent lamps in a street car are arranged five in series. The street cars themselves are in multiple arc with each other, as are also the generators at the power house if there be more than one connected to the same feeder. Most of the

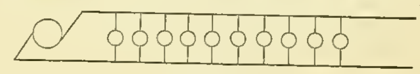


FIG. 46.

incandescent lamps except those in street cars are arranged in multiple arc, whereas almost all the arc lamps used for street lighting are arranged in series. The motors under the cars are connected up in various ways according to the position of the controlling switch and the system of equipment employed—sometimes the two motors are in multiple arc with each other and sometimes they are in series, and the coils of their field magnets are thrown into various combinations of series, multiple series and multiple arc—each arrangement being employed for some specific purpose.

CURRENT CHARACTERISTICS OF MULTIPLE AND SERIES ARRANGEMENTS IN GENERATORS.

If two pumps standing side by side pump water into the same main they will not increase the pressure of the water but will increase the amount of water only. So if two dynamos are connected

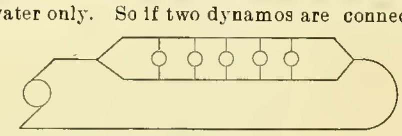


FIG. 47.

in parallel or multiple arc with the same trolley or feeder wire, the potential of the resulting current will not be increased, but the number of amperes which may be drawn from that circuit, or the number of cars or lights or other translating devices that may be supplied will be equal to the sum of those that could be supplied by both separately.

If, however, one of two pumps delivers to the other so many gallons of water per minute at a pressure of say 100 pounds per square inch and the second pump receives that water into its cylinders at that pressure and passes it on to the main with an additional pressure of say 50 pounds per square inch, the amount of water pumped into the main will not be increased by reason of the second pump, but its pressure will have been increased so as to equal the sum of the pressures imparted by both pumps, in this case equal to 150 pounds per square inch.

So if one dynamo pumps current into another which passes it on to the line wire or in other words, if two dynamos are connected in series,

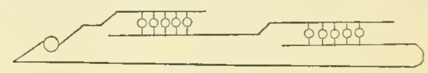


FIG. 48.

the number of amperes that can be drawn from that circuit will not be greater than if but one machine were working, but it will be at a pressure equal to the sum of the pressures impressed upon the current by both.

If in our power house we have a 500-volt dynamo capable of furnishing sufficient current to operate ten cars, and it becomes necessary to double our equipment of cars we would put in another 500-volt dynamo of the same capacity and connect it up in multiple with the first one, and the question is solved.

If, on the other hand, we had a 100-volt incandescent lighting dynamo and wished to supply a 500-volt circuit for street car car purposes, we

9

would have to connect up others in series with it whose potentials were such that when added together and to that of the machine already installed they would equal 500. Thus we might add four more machines of 100 volts each, making five machines in series whose combined electromotive forces would be 500, or two machines of 200 volts each, or one machine of 100 volts and another of 300 volts. But if the original machine only had a capacity of say 100 amperes, the five connected in series would have no greater output.

The rule, therefore, may be laid down that a combination of generators in multiple arc gives an output in amperes equal to the combined output of the several machines, but with no increase in pressure, while a combination of generators in series gives a pressure equal to the combined pressures of the several machines but with no increase in amperes.

EQUIPMENT AND OPERATION OF THE LIVERPOOL OVERHEAD RAILWAY.—II.

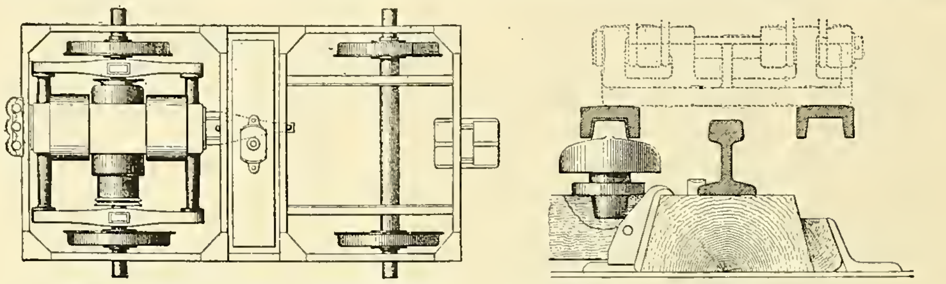
Ratios of Useful and Dead Loads.—The Liverpool empty train weighs 31 tons 2½ cwt., of which the electrical equipment for locomotion weighs 6 tons 7 cwt. With all seats occupied by passengers, the total weight is about 38 tons 6 cwt., but on occasions the standing-room in the train is also fully occupied, bringing the weight to perhaps 50 tons. The weight of locomotive equipment is thus about 125 lbs. per passenger, and about 20 per cent. of the total weight of the train with all seats occupied, each passenger being taken at 140 lbs. weight. A comparison of these figures with those of trains on other railways using electric and steam locomotives is given in Table A:

TABLE A.

	Electric motors.			Electric locomotives.			Steam Locomotives.					
	Liverpool Overh'd Railway.			City and South London Railway.			Manhattan Railway, N. Y.			G. N'th'n Railway Sub'rban Trains.		
	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.
Weight of motors or locomotive....	6	7	0	10	7	0	23	4	0	53	10	0
Number of passenger seats in train.		114			96			240			414	
Weight of motors or locomotive per passenger in lbs..		125			241			217			290	
	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.
Weight of full train (all seats occupied.)......	38	5	2	37	7	0	104	1	0	188	11	0
Weight of motors or locomotive relatively to weight of full train, *ex* motors or locomotives, per cent.		20			38			29			40	
Average weight of empty carriages (*ex* motors) per passenger seat, in lbs............		487			490			615			590	
Weight of full train per passenger, in lbs........		752			871			972			1,020	

It need only be observed in reference to the above table that the comparison is very favorable, so far as weights are concerned, to the adoption of electric motor carriages where practicable and otherwise suitable.

Comparative Efficiency.—In other respects also, not indicated in the above table, the advantages of the Liverpool arrangement are considerable. The weight on the driving wheels of a full train is 13 tons 15 cwt., or about 36 per cent. of the whole weight of the train. Taking the minimum available adhesion at one-seventh of the weight on the driving wheels, this gives about 115 pounds per ton of train, and the motors give an equal tractive force with a current of 133 amperes. The electric locomotives of the City & South London railway, weighing 10 tons 7 cwt. each, give on the driving wheels 28 per cent. of the whole weight of the train similarly loaded, and an adhesion (at one-seventh of the weight) of 90 pounds per ton, while the motors give a tractive force of 100 pounds per ton with a current of 150 amperes. For comparison with steam locomotives, the district railway trains may be taken. A train of 9 coaches, weighing empty 87 tons, and seating 400 passengers, is drawn by a locomotive of 46½ tons weight (of which 35 tons 13 cwt. is upon the driving wheels), having cylinders of 17 inches diameter and 24-inches stroke, and driving wheels, when new, of 5 feet 9½ inches diameter. The weight on the driving wheels is therefore 19 per cent. of the full weight of the train; and taking again one-seventh of this, the available adhesion is 61 pounds per ton of train. With 120 pounds mean effective pressure in the cylinders, the tractive force, allowing for the friction of the engine, would be about 70 pounds per ton of train. It should be observed that the tractive force given above for the electric motors is available only so long as the stated currents pass through the motors, and that, as the speed increases, the current and, to a corresponding extent, the tractive force, are reduced.



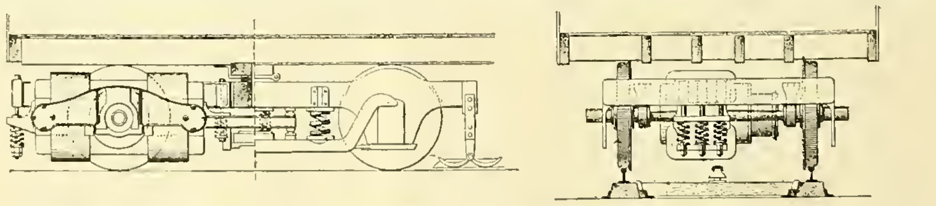
FIGS. 4 AND 5. TRUCK AND TRACK WORK OF THE LIVERPOOL OVERHEAD RAILWAY.

These comparative figures are shown in the following table:

TABLE B.

	Liverpool Overhead Railway.			'City and South London Railway.			District Railway.		
	T.	C.	Q	T.	C.	Q.	T.	C.	Q.
Weight of train (all seats occupied)................	38	5	2	37	7	0	157	10	0
Weight on driving wheels	13	15	0	10	7	0	35	13	0
Weight on driving wheels per cent. of train weight		36			28			19	
Adhesion at one-seventh of weight on driving wheels, lbs. per ton of train......		115			90			61	
Tractive force, lbs. per ton of train:									
Motors with 133 amperes		115			..			..	
Motors with 150 amperes		120			100			..	
Locomotive with 120 lbs. mean effective pressure in cylinders..............		..			..			71	
Maximum tractive force per ton of motors or locomotive, lbs.............		730			367			231	

The last line of Table B brings out a strong feature of the electric motor or locomotive, viz., that, weight for weight, it is much more powerful than the ordinary steam locomotive. The latter has not only to apply, but it has also to carry, the materials for and to generate the motive power. In a separate electric locomotive this advantage cannot be utilized to the same extent as is the case in the motor cars, but it is still considerable; because, in the one case, the whole of the weight of the locomotive is available for adhesion, and the motors can always be relied upon to exert a tractive effort exceeding the adhesion due to their own weight and that of the frame and wheels carrying them; while, on the other hand, even in the case of tank engines, only about two-thirds of their weight is usually available for adhesion. Having regard to the large tractive force available, relatively to the weight of the train, on the overhead railway, as shown in the table, it is not suprising that the promptness with which the trains get up speed is frequently remarked upon by passengers.



FIGS. 6 AND 7. TRUCK AND MOTOR USED ON THE LIVERPOOL OVERHEAD RAILWAY.

THE ELECTRICAL EQUIPMENT—BY THOMAS PARKER.

When the Overhead Railway Company in 1891 took into consideration the employment of electric traction for their trains, the Electric Construction Corporation, of Wolverhampton, tendered for the equipment of the line, and secured an order for the complete installation, comprising boilers, engines, steam pipes, dynamos, rolling stock, station lighting and signals. The plant was required to run a three minute service on a double line six miles in length, and to accomplish this distance in 29 min., including stops of half a minute at each one of 13 stations. Each train was to consist of two cars, each car carrying 56 passengers, and being of an estimated weight of 12 tons 10 cwt. without motors.

To meet this service, 20 trains running at one time would be necessary, and in considering the power required at the dynamos, the subject was approached from its elementary basis. Curves were drawn to show the energy absorbed by one loaded train at every point in the whole length of the line, assuming various accelerations and intervals during which the brakes might be applied to bring the train to a standstill, the weight of a loaded train with motors being assumed to be 34 tons. These curves were modified and checked by the results of experience on ordinary railways, until results were obtained which would meet the service required. In most cases the stations were so near one another (in one instance under 300 yards, and in others 400 yards) that the brakes had to be applied long before the train could attain a uniform speed, the greater part of the energy supplied to the motors being expended in accelerating the motion of the train, which was required by the specification to attain a speed of 30 miles per hour if necessary. From these curves it was an easy matter to calculate the power required for the whole service. This gave, allowing for the various electrical losses which were capable of being estimated, 1,200 to 1,400 amperes at 500 volts, which was the electrical pressure decided upon, or nearly 900 E. H. P. This was split into three units, and to allow for one spare, it was decided to use four dynamos for the generating plant, each having a normal output of 475 amperes at 500 volts, at 420 revolutions per minute, or say 1,200 E. H. P. in all.

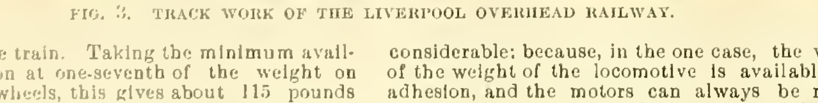


FIG. 3. TRACK WORK OF THE LIVERPOOL OVERHEAD RAILWAY.

Conductor.—The main conductor is of steel, 4 sq. in. in section (Fig. 5) rolled in lengths of 32 ft. 6 in., and weighs about 40 lbs. per lineal yard. It is supported between the main rails on wooden cross sleepers and rests on porcelain insulators. The insulators were designed for use with oil, but as the average leakage over the whole line is only 2 or 3 amperes, this has been thought to be an unnecessary refinement. The steel channel is not rigidly attached to the insulators in any way, and is supported by them at every 7 ft. 6 in., except where joints occur in the conductor, in which cases the insulators are 2 ft. 6 in. apart. The lengths of conductor are electrically connected by flexible copper straps. There are no feeders, and the return circuit is through the rails, which are united by wrought iron bonds riveted to the web and bridging across the fish-plates. All four rails are cross-bonded at the stations, but are insulated from the structure by longitudinal sleepers. They weigh 56 lbs. per lineal yard. The return circuit has thus a sectional area of approximately 22 sq. in. At each station there is a cross-over road, and in order to surmount the difficulty of carrying the charged conductor past the main rails at these points, it was broken, and each end was bent parallel to the main rail for some distance on each side of it (Fig. 3), being electrically connected under the rail, and fixed ¾ in. above it. The collectors on the cars were made wide enough to bridge across the gap thus formed, without breaking the circuit.

The tractive force of each motor at the rim of the wheels (2 feet 9 inches in diameter), with 100 amperes exceeds 1,450 pounds (about 87 pounds per ton of train). The weight of each motor with its axle, but without the wheels, is 3 tons, and that of the motor truck complete is 5 tons 7 cwt.

That these motors will stand any stresses they are likely to be called upon to bear has been proved, and this fact has been found to be of great service in actual running; for, before the drivers were properly educated to their work, they frequently, on finding any difficulty with either motor on the train, such as brush-leads working loose, or brushes making bad contact, cut that motor out of circuit by means of a plug provided on the driving switch, and continued the traffic with one motor to the end of the line.

(*To be continued.*)

ENGLISH TRAMWAY REGULATIONS.

In several acts of the British Parliament and in provisional orders authorizing the introduction of electric traction on tramways the duty was imposed on the Board of Trade to prescribe regulations to be observed by the tramway companies. After hearing those interested in the matter the board has adopted the following regulations:

1. Any dynamo used as a generator shall be of such pattern and construction as to be capable of producing a continuous current without appreciable pulsation.

2. One of the two conductors used for transmitting energy from the generator to the motors shall be in every case insulated from earth, and is hereinafter referred to as the "line;" the other may be insulated throughout, or may be uninsulated in such parts and to such extent as is provided in the following regulations, and is hereinafter referred to as the "return."

3. Where any rails on which cars run or any conductors laid between or within three feet of such rails form any part of a return, such part may be uninsulated. All other returns or parts of a return shall be insulated, unless of such sectional area as will reduce the difference of potential between the ends of the uninsulated portion of the return below the limit laid down in Regulation 7.

4. When any uninsulated conductor laid between or within three feet of the rails forms any part of a return, it shall be electrically connected to the rails at distances apart not exceeding 100 feet by means of copper strips having a sectional area of at least one-sixteenth of a square inch, or by other means of equal conductivity.

5. When any part of a return is uninsulated, it shall be connected with the negative terminal of the generator, and in such case the negative terminal of the generator shall also be directly connected, through the current indicator hereinafter mentioned, to two separate earth connections which shall be placed not less than 20 yards apart. Provided that in place of such two earth connections the company may make one connection to a main for water supply of not less than 3 inches internal diameter, with the consent of the owner thereof and of the person supplying the water, and provided that where from the nature of the soil or for other reasons the company can show to the satisfaction of an inspecting officer of the Board of Trade that the earth connections herein specified cannot be constructed and maintained without undue expense, the provisions of this regulation shall not apply. The earth connections referred to in this regulation shall be constructed, laid, and maintained so as to secure electrical contact with the general mass of earth, and so that an E. M. F. not exceeding four volts shall suffice to produce a current of at least two amperes from one earth connection to the other through the earth, and a test shall be made at least once in every month to ascertain whether this requirement is complied with. No portion of either earth connection shall be placed within 6 feet of any pipe except a main for water supply of not less than 3 inches internal diameter which is metallically connected to the earth connections with the consents hereinbefore specified.

6. When the return is partly or entirely uninsulated the company shall in the construction and maintenance of the tramway (*a*) so separate the uninsulated return from the general mass of earth, and from any pipe in the vicinity; (*b*) so connect together the several lengths of the rails; (*c*) adopt such means for reducing the difference produced by the current between the potential of the uninsulated return at any one point and the potential of the uninsulated return at any other point; and (*d*) so maintain the efficiency of the earth connections specified in the preceding regulations as to fulfill the following conditions—viz.: (i) That the current passing from the earth connections through the indicator to the generator shall not at any time exceed either two amperes per mile of single tramway line or 5 per cent. of the total current output of the station. (ii) That if at any time and at any place a test be made by connecting a galvanometer or other current indicator to the uninsulated return and to any pipe in the vicinity, it shall always be possible to reverse the direction of any current indicated by interposing a battery of three Leclanché cells connected in series if the direction of the current is from the return to the pipe, or by interposing one Leclanché cell if the direction of the current is from the pipe to the return. In order to provide a continuous indication that the condition (i) is complied with, the company shall place in a conspicuous position a suitable, properly connected, and correctly marked current indicator, and shall keep it connected during the whole time that the line is charged. The owner of any such pipe may require the company to permit him at reasonable times and intervals to ascertain by test that the conditions specified in (ii) are complied with as regards his pipe.

7. When the return is partly or entirely uninsulated a continuous record shall be kept by the company of the difference of potential during the working of the tramway between the points of the uninsulated return furthest from and nearest to the generating station. If at any time such difference of potential exceeds the limit of seven volts, the company shall take immediate steps to reduce it below that limit.

8. Every electrical connection with any pipe shall be so arranged as to admit of easy examination, and shall be tested by the company at least once in every three months.

9. Every line and every insulated return or part of a return except any feeder shall be constructed in sections not exceeding one-half mile in length, and means shall be provided for isolating each such section for purposes of testing.

10. The insulation of the line and of the return when insulated, and of all feeders and other conductors, shall be so maintained that the leakage current shall not exceed one-hundredth of an ampere per mile of tramway. The leakage current shall be ascertained daily before or after the hours of running when the line is fully charged. If at any time it should be found that the leakage current exceeds one-half of an ampere per mile of tramway the leak shall be localized and removed as soon as practicable, and the running of the cars shall be stopped unless the leak is localized and removed within 24 hours. Provided that where both line and return are placed within a conduit, this regulation shall not apply.

11. The insulation resistance of all continuously insulated cables used for lines, for insulated returns, for feeders, or for other purposes, and laid below the surface of the ground, shall not be permitted to fall below the equivalent of 10 megohms for a length of one mile. A test of the insulation resistance of all such cables shall be made at least once in each month.

12. Where in any case in any part of the tramway the line is erected overhead and the return is laid on or under the ground, and where any wires have been erected or laid before the construction of the tramway in the same or nearly the same direction as such part of the tramway, the company shall, if required so to do by the owners of such wires or any of them, permit such owners to insert and maintain in the company's line one or more induction coils or other apparatus approved by the company for the purpose of preventing disturbance by electric induction. In any case in which the company withhold their approval of any such apparatus the owners may appeal to the Board of Trade, who may, if they think fit, dispense with such approval.

13. Any insulated return shall be placed parallel to and at a distance not exceeding 3 feet from the line when the line and return are both erected overhead, or 18 inches when they are both laid underground.

14. In the disposition, connections and working of feeders the company shall take all reasonable precautions to avoid injurious interference with any existing wires.

15. The company shall so construct and maintain their system as to secure good contact between the motors and the line and return respectively.

16. The company shall adopt the best means available to prevent the occurrence of undue sparking at the rubbing or rolling contacts in any place and in the construction and use of their generator and motors.

17. In working the cars the current shall be varied as required by means of a rheostat containing at least 20 sections, or by some other equally efficient method of gradually varying resistance.

18. Where the line or return or both are laid in a conduit the following conditions shall be complied with in the construction and maintenance of such conduit: (*a*) The conduit shall be so constructed as to admit of easy examination of and access to the conductors contained therein and their insulators and supports. (*b*) It shall be so constructed as to be readily cleared of accumulation of dust or other *débris*, and no such accumulation shall be permitted to remain. (*c*) It shall be laid to such falls and so connected to sumps or other means of drainage, as to automatically clear itself of water without danger of the water reaching the level of the conductors. (*d*) If the conduit is formed of metal, all separate lengths shall be so jointed as to secure efficient metallic continuity for the passage of electric currents. Where the rails are used to form any part of the return they shall be electrically connected to the conduit by means of copper strips having a sectional area of at least one-sixteenth of a square inch, or other means of equal conductivity, at distances apart not exceeding 100 feet. Where the return is wholly insulated and contained within the conduit, the latter shall be connected to earth at the generating station through a high resistance galvanometer suitable for the indication of any contact or partial contact of either the line or the return with the conduit. (*e*) If the conduit is formed of any non-metallic material not being of high insulating quality and impervious to moisture throughout, and is placed within 6 feet of any pipe, a non-conducting screen shall be interposed between the conduit and the pipe, of such material and dimensions as shall provide that no current can pass between them without traversing at least 6 feet of earth, or the circuit itself shall in such case be lined with bitumen or other non-conducting damp-resisting material in all cases where it is placed within 6 feet of any pipe. (*f*) The leakage current shall be ascertained daily, before or after the hours of running when the line is fully charged, and if at any time it shall be found to exceed half an ampere per mile of tramway, the leak shall be localized and removed as soon as practicable, and the running of the cars shall be stopped unless the leak is localized and removed within 24 hours.

19. The company shall, so far as may be applicable to their system of work, keep records as specified below. These records shall, if and when required, be forwarded for the information of the Board of Trade.

DAILY RECORDS.

Number of cars running.
Maximum working current.
Maximum working pressure.
Maximum current from the earth connections (*vide* Regulations 6 (i)).
Leakage current (*vide* Regulation 10 and 18 (*f*)).
Fall of potential in return (*vide* Regulation 7).

MONTHLY RECORDS.

Conditions of earth connections (*vide* Regulation 5).
Insulation resistance of insulated cables (*vide* Regulation 11).

QUARTERLY RECORDS.

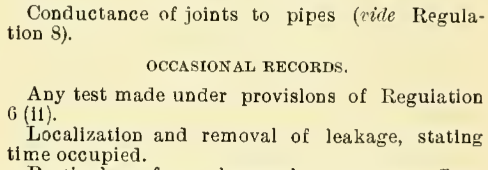
Conductance of joints to pipes (*vide* Regulation 8).

OCCASIONAL RECORDS.

Any test made under provisions of Regulation 6 (ii).
Localization and removal of leakage, stating time occupied.
Particulars of any abnormal occurrence affecting the electric working of the tramway.

WOVEN WIRE DYNAMO BRUSH.

The General Electric Company has perfected its woven wire dynamo brushes, and now has

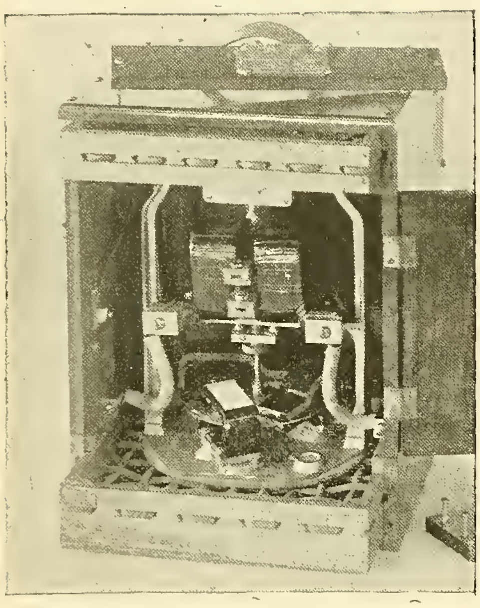


GENERAL ELECTRIC DYNAMO BRUSH.

ready a complete line of them for all of the machines it manufactures, including Edison bipolar, Thomson-Houston bipolar or multipolar, and in fact all, with the exception, of course, of the arc dynamo. The brushes are made of fine wire gauze, which is first wound into rolls, and then shaped into brush form under heavy pressure. They are smooth, and are claimed to give excellent contact.

PORTABLE THOMSON RECORDING WATTMETER FOR STREET CAR TESTING.

It is frequently necessary in electric street railway practice to test the power consumption of the cars, and heretofore the General Electric Company has furnished a voltmeter reading to 500 volts mounted rigidly within a mahogany box for this purpose. This was, however, found not to be without faults some of which were referred to in the last issue in an article by W. Nelson Smith. The mechanism being rigidly mounted, the meter was subjected to violent jars which frequently interfered with its accuracy, shortened its life and rendered it unsatisfactory. Experiments have been going on for sometime past to solve a satisfactory portable recording meter for



PORTABLE WATTMETER.

the purpose named, and the General Electric Company now announces one which according to the statements made will satisfy the requirements of street railway service.

The meter in question consists of a Thomson recording meter mounted on a skeleton metal frame, and having a capacity of 25 amperes at 500 volts. It is mounted within a polished wood carrying case about two-thirds the size of the former type. Instead of being rigidly mounted in the case the meter is suspended between two networks of interlaced rubber cord, or, as it were, between two rubber hammocks. This method of suspension is claimed to preserve the meter from violent agitation or shocks, and render its accuracy reliable. It is the first time that this system has been applied to the recording meter. The meter may be used placed upon the floor of the car with absolute safety and convenience and is said to give perfectly accurate readings.

This portable meter, is normally rated at 25 amperes. In testing street cars, however, the current will frequently, for short intervals very greatly exceed this as when starting, or upon heavy grades, but this meter is so constructed as to record these sudden bursts of current accurately; and heavy overloads may be carried for short intervals without detriment to the instrument or impairment of its accuracy.

Fitchburg, Mass.—The Worcester Construction Company has been awarded the contract for relaying the tracks of the Consolidated Street Railway Company in Fitchburg. The work will last through the season and will employ for the greater part of the time 150 men. About eight miles of track will be laid, and it is possible that the lines may be extended beyond their present limits.

LEGAL NOTES.

Liability for Negligence.—In Washington, a city constructed a temporary roadway, about 120 feet long, near a street car track, and persons driving along the street were compelled to cross the street car track when they reached the temporary roadway, and again when they left it. The Supreme Court decides that a driver of a wagon, who, with full knowledge of the dangerous character of the place, crossed the car tracks onto the temporary roadway without looking for an approaching car, which struck him as he was attempting to cross back at the end of the temporary roadway, was guilty of contributory negligence, and could not recover from the street car company. (*Christensen v. Union Trunk Line*, 32 Pacific Reporter—1018.)

The Supreme Court of Pennsylvania holds, that where a boy attempts to get on the front platform of a horse car, which has stopped to let off a passenger, without giving any indication to either the driver or conductor of his intention to become a passenger, and is not seen by either of them, the street railway company is not liable for injuries to such boy, caused by starting the car, in the ordinary manner, just at the time of making such attempt.—(*Pitcher v. People's St. Ry. Co. of Luzerne*, 26 Atlantic Reporter—559.)

It is held by the Supreme Court of Pennsylvania, that it is not contributory negligence, as a matter of law, for a person to drive on a street occupied by an electric railway, even though the cars cause noise calculated to frighten horses, and the space between the track and the retaining wall is narrow.—(*Gibbons v. Wilkesbarre & S St. Ry. Co.*, 26 Atlantic Reporter—417.)

Collision With Vehicle.—The New York City Court rules, that a person who has driven a heavily loaded team so that the horses are on the track of a street railway, before seeing an approaching car 60 or 80 feet distant, has the right to cross before the car, which must be stopped if necessary to avoid collision. (*Witzel v. 3rd Ave. Ry Co.*, 23 New York Supplement—317.)

In Massachusetts, in an action against a street car company for personal injuries caused by an electric car colliding with a heavily loaded wagon which plaintiff was driving across the tracks from one cross street to another, there was evidence that plaintiff saw the car nearly 400 feet away when he started to drive across; that it was daylight; that when he saw the car was getting close to him he "stirred up" his horses to get over the tracks; and that the driver of the car put on brakes only when the front of the car was about 20 feet from plaintiff. The Supreme Court lays it down, that the question of due care by both parties was for the jury. (*Driscoll v. West End St. Ry. Co.*; 34 Northeastern Reporter—171.)

Persons on Track.—In Pennsylvania, plaintiff was in the employ of a city, working in a ditch at a point where it crossed the street under defendant's track; defendant's employes, in charge of a car which struck plaintiff, omitted to give any warning of the approach of such car; previously they had given such warning each time that a car approached such point. The supreme court decides, that the question of defendant's negligence was for the jury, though such employes moved the car very slowly, and excused the omission of the warning on the ground that they looked ahead and saw the way was clear. The court also rules, that in an action against a street railway company for personal injuries, it is not error to admit evidence showing that plaintiff was in the service of the city, working in a ditch in the street, at the time of the injury. (*Owens v. People's Pass. Ry. Co.*, 26 Atlantic Reporter—748.)

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street correspondent.)

Street Railway Securities in Demand.—In keeping with the sudden demand that has arisen for chances for investment, street railway securities, that have always been prime favorites for such purposes, have made swift and sudden advances within the last two or three weeks. As an instance how eagerly investors are watching their opportunities it may be well to cite the course of the quotations for the new Broadway consolidated 5 per cent. bonds. When the issue was made some six weeks ago, the bonds were sold to insiders at 97½ and interest. True the company was then in need of funds and sold the bonds to the underwriting syndicate at a price hardly commensurate with the security attached to the bonds. In fact less than 97½ was secured for the bonds, for the New York Guarantee and Indemnity Company and the other subscribers to the underwriting syndicate received a substantial commission for giving the company the money needed. The bonds to-day sell for 104½ to 105, thus netting a neat profit to the money lenders.

Advance in Stocks and Bonds.—In illustration of the buying tendency of street railway stocks and bonds that has recently developed in local financial circles, further comparisons of a similar nature are of value. Thus Eighth avenue shares have advanced between March 13 and April 3, an interval of three weeks, 5 points, Ninth avenue stock has gained 4 points, Second avenue 10 points, Metropolitan Traction 10 points. Bonds also have made gains, not quite so large but none the less gratifying to security holders; thus Broadway and Seventh avenue 5s are up three points, Union Railway 5s 3 points, Westchester Electric first mortgage 5s 2 points. These gains point out clearly how much the small investor, who after all gives the real value to securities, appreciates the merits of the securities of well organized and well managed street railway companies.

Securities of Long Island Companies—While the securities of New York City companies have thus been appreciating in value, the stocks and bonds of the Long Island street railways have been steadily losing favor. The trouble with the traction companies on Long Island is due to the terrific watering of capital that they have recently indulged in. Investors are scared at the rapidity with which the Brooklyn Traction Company the Long Island Traction Company and others are adding to their capital. Here is the Brooklyn Traction Company that recently put out a big bond issue with a deal of trouble and some expense, and now it is made known on the best of authority that another issue of capital stock is to be made within the month. The company claims that all the money it is asking for from bond and stockholders and the general public is absolutely required for construction and equipment purposes. Others of the hugely capitalized Long Island companies have no such excuse to offer for their watering processes. They resort to the explanation that so much money has been saved by the substitution of electricity for horses as a motor power. Inasmuch as the last report of the railroad commissioners of the state of Massachusetts presented statistics showing that trolley lines were dearer, not cheaper, to operate than horse-propelled cars the claim of tremendous savings to represent which new issues of capital stock are being continually authorized does not appear well founded. The people who have bonds to sell say that the trolley saves 50 per cent. and the cable 20 per cent. in operating expenses. The people to whom the bonds are offered discover no such immediate gains when comparisons of earnings are made. There is no attempt or design here to decry the introduction of cable or trolley systems; such methods of street car propulsion are far preferable to horses if good sense is shown in their management, but no excuse can be had for the unlimited swelling of capital that the traction companies across the East river are indulging in.

Philadelphia Stocks.—Philadelphia has been devoting itself a good deal more to the stocks of traction companies than to the bonds. Metropolitan, Electric People's and Baltimore have all been freely purchased and quotations in consequence have gained considerably. Metropolitan has been the center of attraction. P. A. B. Widener, in speaking of its affairs, says that, "after paying a quarterly dividend of 1¾ per cent., the company had enough money in the treasury to pay fully as much more. In fact, the company has a surplus of $700,000 in its treasury, exclusive of the $2,000,000 required for construction purposes." Horse cars are to be run during the latter part of this week on the completed portion of the company's new cable line on Columbus avenue (this city), and this policy will also be followed on such portions of the Lexington avenue line, which was begun this week, as are completed. The company has entered into negotiations with Mr. George Westinghouse relative to the introduction on some of the company's lines in this city of Mr. Westinghouse's new third rail system. A third rail between the two wheel rails supplies the current to a trolley under the car, and the construction of the road is such that no danger will be met with by persons coming in contact with any of the three ground rails, as the circuit cannot be completed except through the battery on board the car. Mr. Westinghouse is perfectly sanguine regarding the success of the system and prophesies that it will entirely revolutionize present methods of street car propulsion.

Consolidation in New Haven.—There are indications that the recent death of Millionaire Hoadley B. Ives, of New Haven, will hasten the consolidation, or rather, concentration of street railway interests at New Haven. Mr. Ives was a man of strong individuality and was always opposed to all schemes where his interests could not be dominant. There are big opportunities for economy through the joint operation if not joint ownership of the New Haven street railroads. It is expected that a pronounced move in the direction of consolidation will be speedily brought about. The properties directly under the management of Mr. Ives are owned locally; the other street railroad properties of New Haven have passed into the hands of outsiders. The syndicate endeavoring to secure consolidated control is mainly composed of Providence people, though one or two New York interests are in the deal. It may be stated here that at least three of the New Haven roads will extend their lines into the suburbs this year.

South Norwalk Bonds.—New York bankers have recently brought out $60,000 first mortgage 5 per cent. gold bonds of the Norwalk Tramway Company, of South Norwalk, Conn. The bonds are offered at 95 and accrued interest. The charter of this company is exceedingly broad and liberal and puts no limit to the company's right to purchase, lease or consolidate any street railway in the state of Connecticut. Arrangements have already been made to purchase the Stamford Street Railway of seven miles which will be equipped electrically and made a part of the tramway system. In six months the net earnings of the company were a little over $5,000 more than the interest charges for the entire year; on this basis for the year, the net earnings will be more than 5 times its total interest charges.

West End Affairs.—Boston advices are to the effect that West End Street Railway has not proved a bonanza for the bears. The demand for this stock improves whenever dullness prevails in the railway list and recent stock exchange history has been such as to promote the interest in West End. The stock holds the advance and above par very strongly and it is now whispered that the recent attempt to throw the stockholders into a panic was for the ultimate purpose of securing control of the road. The Massachusetts Legislative Committee on street railways is at present conducting an investigation into the company's affairs and the severe probing of ex-congressman George Fred Williams in behalf of the people is giving the bears some ammunition, but they have not as yet accomplished much with it. Mr. Williams charges that the company has issued bonds to the amount of $5,000,000 within two years, and avers that the corporation realized only 90 per cent. on their value. He charges that the whole system is one of inflation from beginning to end. The company's reply has not yet been made.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, Chicago said yesterday: Cable stocks have been active and strong at higher prices. There has been some liquidation but market has absorbed all stock readily. We cannot advise buying now but think when a reaction comes should buy. The movement that we predicted in the traction stocks came during the past week. Philadelphia Traction has advanced $10, Metropolitan $12 and Electric $18 and the others to a less extent Insiders in Philadelphia traction have figured great increases from the business of their two lines already running and based on that and talk of increased dividends buying has started in all along the line. To our mind the movement has not culminated and we expect still higher prices. Quotations at 2 P. M. to-day were Met., 116¼; Phila., 111¼; Elec., 68½.

Receiver of New Albany Railway.—John McLeod of Louisville has been appointed receiver of the New Albany (Ind.) Railway Company. In 1888 it executed to the Louisville Safety Vault & Trust Company bonds amounting to $150,000, to secure which a mortgage was given to the trust company and Samuel A. Culbertson, trustee, upon the franchises and property belonging to the railway company. The bill of complaint filed by the attorney for the trustees sets forth that the weekly interest has not been paid since October 14, 1893, and that the state and county taxes for 1892 and 1893 are still unpaid; that the company is now insolvent and has been so for six months, and has neither money nor credit to provide for the proper operation of its property. The court fixed Receiver McLeod's bond at $25,000.

Sioux City, Ia.—The Consolidation Company has filed a trust deed conveying the cable railway property to William Stewart Todd as security for a loan of $400 000 made by him to the company. By the terms of the deed the Consolidation Company purchases D. T. Hedges' interest in the road and takes up his notes secured on the bonds of the road. It is authorized to equip the road for an electric line, and to take all necessary steps for a consolidation with the other street railway lines in the city. Officers of the road say that this arrangement will enable them to keep the cable property intact until the road can be put on a paying basis. It also enables them to put in the electrical equipment at once, and the work of changing the systems will begin as soon as the necessary materials are received. It is hoped to have the change made by the early part of June.

Brush Electric Co's Election.—At the annual meeting of the Brush Electric Company, in Cleveland, March 26, the old board of directors was elected. The directors elected the following officers: President, W. H. Lawrence; first vice-president, C. A. Coffin; second vice-president (vice John S. Bartlett resigned), and general manager, S. M. Hamill; treasurer, B. F. Miles; general counsel, Wm. B. Bolton; assistant general manager, L. H. Rogers; secretary, A. H. Hough; superintendent, C. W. Phipps; assistant superintendent, C. N. Black.

Minneapolis, Minn.—J. C. O'Gorman was appointed receiver of the Union Depot Street Railway & Transfer Co. of Stillwater in 1888, and in this capacity sold the property for $100,000 to the highest bidder, Frank M. Prince. The receiver now claims that Prince has paid but $74,395.13 of the amount, and that he now owes $25,604.87, for which latter sum suit has been brought in the Hennepin county district court.

Rochester (N. Y.) Railway Earnings.—The quarterly report of the Rochester (N. Y.) Railway Company for the quarter ending December 31 last ,has just been filed at Albany. The report contains these figures: Gross earnings, $185,139; operating expenses, $101,957; other income, $1,482; fixed charges, $58,250; net income, $26,413; cash on hand, $19,373; surplus, $428,236.

Short Electric Co's Election.—The annual meeting of the Short Electric Railway Company was held March 27. The old board of directors was re-elected. The following officers were elected: President, B. F. Miles; secretary and treasurer, Bethune Duffield, Detroit, Mich.; general manager, S. M. Hamill.

Troy, Pa.—An electric road is projected between Troy, Pa., and Wellsboro, Pa., via Sylvania and Mansfield. The necessary stock, $250,000, is reported to have been subscribed.

New Incorporations.

Chicago, Ill.—Articles of incorporation of the Chicago & Morgan Park Electric Street Railway Company, which proposes to construct an electric railway from a point in Englewood to the villages of Morgan Park and Blue Island, have been filed with the Secretary of State. The capital stock is $500,000. The incorporators and first board of directors are: B. Frank Deacon, Charles S. McCoy, Samuel H. Hubbard, Frank Foster and Ralph F. Bogle, all of Chicago.

NEWS OF THE WEEK.

Detroit, Mich.—Those interested in the electric railway to Toledo state that the construction of the line is practically assured. At a town meeting held in the Flat Rock town hall last week the company was granted all the franchise and right of way asked for in that locality, and the company that is to build the section from Detroit to Dearborn has filed a $1,000 bond with the town board for the completion of the road within six months. It is understood that the Huron river water power at Flat Rock will be utilized for the generation of the power. Ties for the road were distributed along the line last summer, but present indications are that the work of constructing the road will begin soon.

Chicago, Ill.—The Metropolitan West Side Elevated Railroad Company held its annual meeting on April 3. It was merely a formal meeting held in accordance with the law providing for annual sessions. The old directors and officers were re-elected. No action was taken in regard to the operation of the road as that matter is in the hands of the construction company. It is understood that the road will at first be operated by steam locomotives. Within the last few weeks 5,000 persons have made applications for employment. About six miles of road have been built from the river west, at a cost for right of way and construction of approximately $4,000,000. The right of way and construction (including bridge) from west side of the river to Franklin street on the South Side will take nearly another $1,000,000.

Woodbury, N. J.—The board of freeholders of Gloucester county, has given the Camden, Gloucester & Woodbury Electric Railroad Company a franchise to use certain bridges, and this action ends a long and hard fought contest between the company and the governing bodies of the city and county. The company has for the past year been making every effort to get through Gloucester county, and only succeeded in getting the right of way through Woodbury a few days ago. The franchise just granted clears away all obstacles, and the company can now go ahead with the extensions throughout Woodbury and Gloucester county.

Cleveland, O.—Since it has been decided to build the Johnson Steel Works at Lorain, there has been considerable talk of an electric railway between Cleveland and that place. It is said a number of capitalists have conferred on the subject and will take action in the near future. There is a probability they could secure a right of way along the old Lorain wagon road, but they prefer to follow a line nearer the lake shore, believing it will be built up with summer residences in the course of time.

Chicago, Ill.—The directors of the Lake Street Elevated Railroad Company have made reductions of from 50 to 60 per cent. in the salaries of the managing officers. President Roche's salary has been decreased from $12,000 to $5,000. The offices have been removed from a downtown business block to a building which the company owns at Rockwell street. All these changes are made in the interest of economy and it is stated that the revenue will now meet the fixed charges and the interest on the bonds.

Chicago, Ill.—The attorneys for the West & South Towns Street Railway Company have filed specifications of the damages which the company has sustained as a result of the injunction restraining it from the construction of its line on West Twenty-second street. Its loss, it is claimed, was over half a million dollars, and it is trying to fasten the liability on the West Chicago Street Railroad Company, which, it is alleged, was behind the injunction proceedings.

Denison, Tex.—The Denison street railway line was tied up for a short time on March 27 by a strike of the men, who left their work because the receiver had failed to pay their wages. The places of the men were filled within an hour and the public was not inconvenienced. The receiver did not pay the men because of certain instructions of the court.

Toledo Consolidated Changes.—Albion E. Lang was elected president of the Toledo Consolidated Street Railway Company at the annual meeting last Monday. N. B. Ream was elected vice-president and W. S. Jewell was appointed manager to succeed Mr. Lang. Mr. Jewell until a few months ago was electrician of the Citizens' Street Railroad Company, of Indianapolis.

Cincinnati, O.—The Cincinnati Street Railway Company has purchased a lot 119 by 196 feet on the southwest corner of Depot and South streets, and will erect on it a power station. The structure and its equipment will cost about $200,000. The plant will supply power for the Price Hill and Sedamsville lines.

Toronto, Ont.—The council of East Toronto last week granted the Toronto Railway Company power to extend its line up Walter street to Garrard street and west to Main street, thus giving a service through the more thickly populated part of the village. .

Vermillion, O.—It is considered probable that the proposed electric line from Vermillion to Wakeman by way of Oberlin will be built. The estimated cost of the road is $200,000. Lewis Wells and Dr. Quigley are the committee on right of way.

Camden, N. J.—The West Deptford township committee, of Gloucester county, has granted the application of the Camden, Gloucester & Woodbury Electric Railroad Company for the privilege of laying tracks through the township.

Chicago, Ill.—If the weather is favorable for work within the next two weeks the West Chicago Street Railway Co. will run cars through its Van Buren street tunnel under the Chicago river about April 20.

Brooklyn, N. Y.—The state board of railroad commissioners has approved the application of the Brooklyn, Queens County & Suburban Railroad Company to change its motive power from horses to electricity on certain parts of its line.

Toledo, O.—The street railway strike has been adjusted by the arbitration committee. All the discharged men on whose account the strike was ordered were reinstated, with one exception.

Adrian, Mich.—The cars of the Adrian Electric Railway are not in operation, as the Electric Light Company has cut off the power, because its bill for current has not been paid.

Albion, N. Y.—About $50,000 stock has been subscribed for the Albion & Oak Orchard Railroad Company, and it is now stated that the railway will be constructed.

Harrisburg, Pa.—The East Harrisburg Passenger Railway Company has recently made a test of the Robins life guard and has been well satisfied with the results.

Philadelphia, Pa.—The Philadelphia Traction Company has recently tested with considerable success the Wright automatic wheel guard and pick-up fender.

Leavenworth, Kan.—Work has been begun on equipping the Fifth street line for electrical operation

PERSONAL.

George O. Manchester, formerly of the Atchison, Topeka & Santa Fe Railroad Company, has been elected vice-president and treasurer of the Sargent Company, Chicago.

Frank X. Cicott has been appointed manager of the railway department of Pettingell, Andrews & Co., Boston.

Hon. Tom L. Johnson, of Cleveland, delivered an address on "Free Trade" before the Iroquois Club of Chicago on April 2.

W. C. Groetzinger, of the Chas. Munson Belting Company, made a flying visit to New York last week.

W. S. Loutit, of the Pullman Company, Chicago, is absent on a trip to California.

TRADE NOTES.

The General Electric Company has just placed upon the market a new rubber covered wire, which is claimed to be superior to anything of the kind yet offered This is known as the double rubber core wire. It has three coverings. Next to the wire is an inner core of soft rubber, free from sulphur and protected by a second heavy covering of pure vulcanized rubber. Over this is a braided sheath, finished with weather-proof compound which serves to protect the rubber from the attacks of acids, alkalies and from mechanical injury. Before applying the first covering the copper wire is thoroughly tinned to protect it from corrosion. The rubber coverings are made of the best grade of fine Para rubber. The wire is made with three standard thicknesses of insulation, although it can be of any thickness desired. The lightest is intended for ordinary electric light wiring and for use on circuits not exceeding 500 volts; the second for use on circuits not exceeding 2,000 volts, such as street railway, primary circuit alternating and arc light circuits up to forty lamps. The thickest insulation is for circuits up to 5,000 volts and is devised for high tension work. Wire with the last two insulations may be armored for any class of submarine work.

Berlin Iron Bridge Company's Catalogue.—The Berlin Iron Bridge Company of East Berlin, Conn., has paid special attention to the design of modern manufacturing buildings and structure of a similar character. It has undertaken more work of this class than any company in the country and nearly as much as all other companies combined. For street railway and electric light companies it has constructed a great many buildings, the excellence of which has shown that the company stands at the head in this class of work. The catalogue which the company has just issued is worthy of special mention, and it will prove of the greatest value and interest to all those contemplating the construction of manufacturing buildings or power stations. The catalogue is a volume of over 300 pages, and contains over 150 large illustrations showing the various kinds of work undertaken by the company.

The Sterling Supply and Manufacturing Company, of New York, has removed its factory to the Ross Building, corner Bank and Hudson streets, where it has largely increased facilities in new and commodious quarters. The offices of the company have also been established at the same address. This company since its reorganization has met with great success, and among recent orders may be mentioned, sandboxes for the entire equipment of the Consolidated Traction Company, Jersey City, and over two hundred Sterling Registers for the Third Avenue Cable Road, New York. The company has also received an additional order for sixty registers from the Citizens' Street Railroad Company, Indianapolis.

The Gennett Air Brake Company, of Chicago, is equipping cars of the Chicago & North Shore Street Railway Company, of Chicago, and of the Buffalo Railway Company, of Buffalo, with air brakes. The company is also sending equipments to the King-Ocean Streets Cable Tramway Company, Sidney, N. S. W. Mr. Rothschild, manager of the company, reports that the business outlook is now decidedly brighter than for a long time.

Cushing & Morse, western agents for Day's kerite wire, say that April business has started in with a rush far exceeding their expectations, and bids fair to exceed that of the month of March, which was one of the best months they have had.

The Lehigh Valley Construction Company, H. O. Duerr, manager, has been awarded the contract, by the Easton Transit Company, of Easton, Pa., for the extension of five miles of electric road.

Edward Lasell & Company, 225 Dearborn street, Chicago, report large sales of their Monarch incandescent lamp. Users of the Monarch express themselves very strongly in its favor.

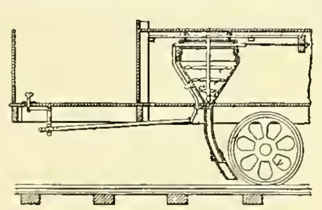
The J. G. Brill Company, of Philadelphia, has received an order for forty-eight trucks from the Winchester Avenue Electric Railway Company of New Haven, Conn.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued March 27, 1894.

517,028. Electric Railway Trolley. Frank S. Church, Detroit, Mich., assignor of one-half to William F. H. Edwards, same place. Filed April 17, 1893.

This is a trolley formed of two grooved wheels having the flanges on one side of the groove adapted to make con-



NO. 517,044.

tact beneath the conductor, and the other flanges adapted to approach each other above the conductor.

517,044. Sanding Device for Cars. Clarence E. Holbert, St. Joseph, Mo. Filed March 27, 1893.

In a device for sanding rails, a funnel-shaped sandbox, combined with a vertical rotatable shaft having a series of transverse blades of graduated lengths adapted to the form of the funnel, such blades having their ends made with twists or propellers to propel the sand downward. (See illustrations.)

517,075. Railroad Rail and Chair and Process of Uniting Same. Maxmilian M. Suppes, Johnstown, Pa., assignor by mesne assignments to the Johnson Company of Pennsylvania. Filed January 26, 1892.

This patent covers the combination of a railroad rail and support, each having a single vertical web, the web in one terminating in a pocket, or jaws, fitted to receive the web of the other and said parts, connected together only by the jaws, being molded by pressure against the web. (See illustration.)

517,134. Apparatus for Supplying or Removing Storage Batteries. William E. Worthen, New York, N. Y. Filed August 5th, 1893.

This consists of the combination with a main track and railway car, supported upon wheels, of a battery truck supported upon wheels and supporting a battery and a motor

NO. 517,075.

or motors, and connected detachably with the body of the car, a movable track section, and a support for the track section whereby the same with the truck can be moved to and from the body of the car.

517,162. Electrical Measuring Instrument. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed March 24, 1893.

The combination of a fixed frame, movable support pivoted or movably connected to the fixed frame, an expansible body connected between the fixed frame and movable support over which an electric current passes to be measured, and a compensating pointer device moved by the movable support and carried by it whereby the free end of the pointer may have a compensating movement independent of the movement of the movable frame.

517,163. Electrical Indicator. Andrew E. Kennelly, Orange, assignor to Thomas A. Edison, Llewellyn Park, N. J. Filed October 26, 1892.

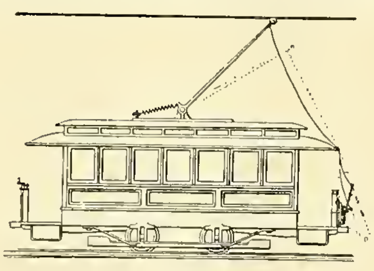
The first claim reads as follows: "The combination, in an electrical indicator, of a magnet, a disk armature situated flatwise between the poles of said magnet and having a winding adapted to carry the current to be measured, and an indicating device moved by said disk armature."

517,166. Trolley Catcher. Levi G. Mowry, Buffalo, N. Y. Filed December 11, 1893.

This is the combination with a swinging depressor rod, of a holder for retaining the depressor rod in its normal position, and a trip or releasing device operating on said holder and connected with the trolley. (See illustration).

517,212. Car Brake. Lloyd H. Cole, Pawtucket, R. I. Filed August 24, 1893.

In a car brake, the combination with car wheels, the axle on which the wheels are mounted, and a cam operated by



NO. 517,166.

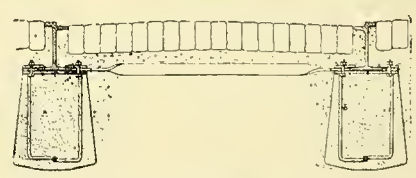
the rotation of the wheels, of a shaft rotatable in bearings, brake shoes carried by the shaft and adapted to be applied to the wheels by the rotation of the shaft, and a device carried by the shaft and adapted to be acted upon by the cam.

517,236. Rail Clamping or Fastening Device. Minard A Possons, Cleveland, Ohio. Filed November 20, 1893.

This is a rail clamping or fastening device consisting of two arms adapted to clamp the base of the rail and connected by a web, the free ends of the arms terminating in clamping jaws and the connecting web being adapted to engage the under side of the rail-supporting tie or member, the device being composed of such material as will accommodate the twisting of the arms and the web being separated a suitable distance from the arms to accommodate the twisting of the latter.

517,258. Electric Railway. Benson Bidwell, Philadelphia, Pa., assignor of one-half to Charles F. Bidwell, Indianapolis, Ind. Filed January 8, 1885.

The first claim of this patent reads as follows: "In an electric railway having a line of conductors in connection with a generator located at a station along the line of way, a branch or loop in said generator circuit having tele-



NO. 517,277.

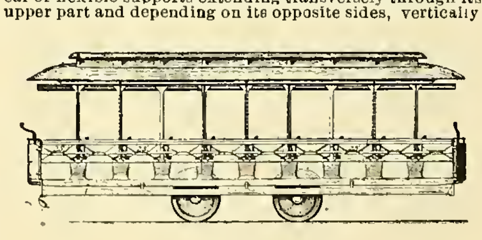
phonic instruments and resistance coils, in combination with a car having traveling circuit connector, a motor circuit and a loop or branch from the motor circuit or loop, and including a telephonic instrument and resistance coils."

517,277. Railway Truck Structure. Peter Hevner, Philadelphia, Pa. Filed October 13, 1893.

This is the combination in a road bed for railways, of the opposite rails, foundation blocks of artificial stone or cement, clamping devices for securing the rails to said blocks, securing bolts immovably confined to said blocks and tie bars adapted to the inner clamp bolts and serving as a means of spacing both the foundation blocks and the rails. (See illustration.)

517,339. Safety Guard for Open Cars. William H. Hart, Chelsea, Mass. Filed December 13, 1893.

This patent covers the combination with an open street car of flexible supports extending transversely through its upper part and depending on its opposite sides, vertically



NO. 517,339.

sliding gates extending along the sides of the car and attached to the opposite ends of said supports, guides for said supports, and means for locking each gate in lowered position when closed. (See illustration.)

517,405. Rachet for Car Brake Staffs. August D. Gerbig, St. Louis, Mo., assignor to the Laclede Car Company, same place. Filed October 23, 1893.

This is a ratchet for a brake staff, comprising a ratchet wheel having a sleeve connected thereto, staff mounted in said sleeve, and a ratchet wheel rigidly connected to said staff, and engaged by pawls connected to the upper side of the first mentioned ratchet wheel.

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CONTENTS.

More Money for Street Railways. In our financial letter from our Wall Street correspondent this week are given the details of a big deal just completed for a transfer of the present ownership of the New Orleans street railways to a syndicate of bankers in New York City. The new owners will expend a large amount of additional money in the extension and improvement of the system. This is to be taken as another indication that street railways are coming to be considered by bankers and investors a much more attractive property, even in these times of depression, than they were formerly. Preference is frequently shown for this class of securities rather than for steam road stocks and bonds.

Engineers' Services. In a letter printed elsewhere in this issue, Mr. J. H. Bickford again calls attention to the remarkable fact that many street railway companies do not realize the importance of securing the services of the very best engineering talent available in designing extensions to their plants. The fact that so much shiftless work has been done in the construction of plants will make the work of the engineer for the next ten years a particularly difficult one; for he must not only be able to design a new plant with new material but he must be ready to reconstruct a badly designed and uneconomical plant using whatever second-hand material is considered of value and not hesitating to throw away such apparatus as has been instrumental in making the plant uneconomical. For the next few years the work of the real engineer will be as much one of reconstruction of existing plants as the building of new ones.

Good Chance for Debate. The paper to be presented at the next meeting of the American Institute of Electrical Engineers is one that will afford an excellent opportunity for discussion. It will treat of the electrolytic effects of return railway currents on underground pipes and cables and will be read at the Chicago meeting on the evening of April 25, at the rooms of the Armour Institute. As there are a number of electric roads in this city and vicinity that have had more or less experience with troubles of the kind mentioned, and it is to be hoped that those who can will attend and contribute to the discussion such material as they have gathered. The paper will be accompanied by a large number of lantern slides and many specimens will be exhibited, showing the effects of electrolysis. Considered simply as a question of commercial operation this is a matter of the greatest importance, even if no account is taken of the resulting annoyance to other interests.

State Railway Associations. For a variety of reasons the formation of state street railway associations is desirable, and companies should give to organizations of this character far more encouragement than they have done up to the present time. Not alone is the interchange of opinions and experiences oftentimes invaluable to the active manager, but occasions may at any time arise when by its action the association may defeat pending legislation of a character injurious to street railway interests. Eight state associations of this character have now been formed; the last one to be organized was the Connecticut Street Railway Association, which is referred to elsewhere in this issue. It is certainly high time that Connecticut possessed an association of this kind, for its legislature has had before it a considerable number of measures relating to street railways. Such a body can make it its business to organize the opposition to the measures which, if passed, are calculated to be injurious to the business. The Connecticut association is formed on rather broader lines than most state organizations, and we trust that its plan of furnishing information of various kinds to its members will prove successful.

Construction of Roads by Counties. The suggestion has recently been made in Omaha that half a million dollars be raised by bonding the county and be expended in improving roads and in constructing suburban tramways. It might be thought that the plan was of populist origin, but we believe it is fathered by a paper which has no populist leanings. The project as it is outlined by this journal is attractive, although its practicability may well be questioned. Such improvements, it is said, would tend to bring into the market a vast amount of real estate, it would stimulate the cultivation of small tracts of land by making it possible to transport the products cheaply and quickly into the city, would vastly increase the trade of Omaha merchants, and, in fact, the adoption of the plan "would be pointed to all over the United States as an evidence of advanced western civilization." Even if it be assumed that all these benefits are possible, it may be doubted whether the contemplated improvements could be made for any such sum as half a million dollars. In building good roads in the county, in the construction of even a score of miles of electric railway and in the purchase of equipment for them, half a million dollars would not go very far. On the other hand, if the territory lying about Omaha is such that the construction of suburban electric roads is warranted, local companies will soon discover the fact and will make the improvements and render unnecessary any bond issue by the county for such a purpose.

Injunctions and Strikes. In the report of the Toledo strike which appeared in these columns two weeks ago mention was made of the fact that the street railway company had obtained an injunction restraining the strikers from interfering with the operation of the road. This resort to an injunction was unusual in a street railway strike, but it was in line with the recent practice, which has created so much stir, of invoking the aid of courts to prevent labor disturbances. It does not appear that the injunction order proved efficacious at Toledo or that the men, fearful of penalties for contempt, regarded the mandate of the court with any great degree of respect. Certainly no one was taken into custody for failure to obey the order. It is interesting to note that in the decision of Judge Caldwell at Omaha, which has excited such a vast amount of discussion within the last week, this resort to the injunction is unqualifiedly condemned. He refers specifically to the issuance of the restraining order on the application of receivers but the court's objections are broad enough to cover all injunctions of this general class. He condemns this use of an enjoining order because of its probable moral effect on strikers. If it is issued restraining them from the commission of unlawful acts the impression may be created that it is not an offense to interfere with property or to intimidate employes, but that the wrongful act is disobedience to the court's mandate.

Worthless Census Statistics. It would be hard to find a more useless lot of figures than those just issued by the government census department relating to the electrical industries in the state of New York. The publication is a part of the eleventh census, and the material of which it is composed was collected and arranged under the direction of Allen R. Foote and is based upon returns made for the year ended May 31, 1890. The publication may have a certain small value as an historical document or because it has assisted in the reduction of a troublesome treasury surplus, but it is certainly of no real commercial value to those who are directly interested in the electrical and street railway industries, and who by their coöperation and assistance made it possible for the census department to obtain the figures they have so tardily presented. The figures would have been of great interest had they been published, say not later than the end of the year 1890, allowing even then six months for their collection and presentation; but to base any calculations of importance upon the returns here given would be absurd. To do so would be like basing one's calculations of the capacity and capabilities of an athlete upon his physical measurements of ten years ago. The dimensions of the whole electrical and street railway business have so changed that the publication of these statistics is most unfortunate, for we are sure to find them widely quoted and referred to as unbiased authority to prove all sorts of ridiculous propositions. And yet these figures are only for the state of New York; for those relating to the electrical industries in the country at large nothing has yet been heard, and indeed if they have as little value as those before us the less we hear of them the better.

CONNECTICUT STREET RAILWAY ASSOCIATION.

Representatives of almost all the street railway companies of Connecticut met in New Haven, April 3, and organized the Connecticut Street Railway Association. It is intended that meetings shall be held from time to time to advance the interests of the business. The purpose of the organization is formally stated in these terms:

"The object of this association shall be the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways, and the diffusion of knowledge among members of this association, with the view of increasing the accommodation of passengers and improving the service; also the establishment and maintenance of a spirit of fraternity among the members of the association by social intercourse and the encouragement of cordial and friendly relations between the roads and the public; to harmonize the interests of the street railway companies of Connecticut and to secure uniformity in regulating the construction and operation of such companies."

The association will establish in New Haven a a bureau of information for the benefit of the members.

The annual meeting will be held in New Haven on the third Wednesday in November.

The following officers were elected:

President, H. Holton Wood, Derby; Vice-president, Henry Parmelee, Hew Haven; Treasurer, E. L. Goodrich, Hartford; Secretary, Robert A. Fosdick, Stamford. Executive Committee, George A. W. Dodge, New Haven; A. M. Young, Waterbury; Israel Kelsey, West Haven and the officers.

NEW AGREEMENT BETWEEN THE LYNN & BOSTON RAILWAY AND ITS EMPLOYES.

The termination of a long standing dispute between this company and its employes has been effected by the signing of the following agreement:

That conductors, motormen, drivers and night men receive not less than $2 per day or night.

That snow plow drivers shall receive for all time detained at stable or while on duty on snow work 25 cents per hour, and that helpers on snow plow shall receive for all time detained at stable or while on duty on snow work 20 cents per hour.

That all track laborers shall receive $2 per day and for all work done on Sundays or nights 30 cents per hour; nine hours shall constitute a day's work. The pay of all transient men to be discretionary with the management.

The track oilers shall receive $1.50 per day.

That all trips for chartered cars be paid for at the rate of 20 cents per hour until 12 p. m., 22 cents per hour until dismissed.

That a man on being discharged or leaving the service of the company shall have written on his license "resigned" in such a way as not to injure his future prospects.

That the company recognize agents to be appointed by this organization to adjust all grievances that may arise between the company and employes, said agents to have supervision of the interests of the employes.

That all misses be blotted out at the end of the year.

That no deduction be made in a man's pay when two or less trips are taken off his day's work.

That all employes when called into the office shall have a full and impartial hearing, and if found innocent of charges preferred shall be paid in full for all time lost.

That conductors and motormen shall receive 30 cents per trip for all extra trips to all entertainments and places of amusement; if more than 1½ hours, 20 cents per hour.

That hostlers shall be paid $1.60 per day for their work, and hours to remain the same as they are at present.

That all employes shall be listed according to rank and date of employment.

That all spare men be given the preference to all kinds of spare work, including snow work, if capable.

That when a conductor or motorman wishes to be absent from duty, and a spare man is not available at the station at which he works, the foreman shall apply to some other station for a man.

That this agreement shall remain in force from the date of acceptance to January 1, 1895.

Knoxville, Tenn.—The Street Railway system is to be reorganized.

CONSPIRACY IN A STREET RAILWAY STRIKE.

In Philadelphia last week Judge Gordon sentenced James Bradley to thirty days imprisonment on his conviction on the charge of conspiracy. It was proved that he had violated the law at the time of a strike of laborers of the Traction Company. It was in evidence that the defendant and a number of other "ditchmen" employed in laying trolley tracks on Nineteenth street, near Washington avenue, struck for higher wages. After trying to induce all of the workmen to join in the strike, without success, a band of 50 of them went up Nineteenth street to a point where another gang was at work, and insisted that they should also strike, and those who refused were forcibly driven out of the ditch, and their tools were taken from them. The defendant, it was said, was the leader in the affair. He admitted that he had taken a shovel from one of the men, and said he did not see any harm in what he had done.

"You were attempting, by force, to prevent other workmen from earning their bread," said Judge Gordon, in sentencing the prisoner. "You, a single man, and a recent arrival in this country, undertake to say what other American citizens should do. You thought that if you did not get the wages you desired you would not permit others to work for a less sum. In times like the present, when all work is scarce, your act was even more culpable because it was calculated to spread dissension among other honest workmen, and prevent also the progress of an important public work. It might just as well be judicially ascertained, as it has been in this case, that all acts like yours are criminal violations of the law. Laborers have a right by all proper means to raise their wages, as all other men have in the struggle of life, but as soon as you use force you transgress the law. It is time it was understood that such proceedings will be punished. I do not intend to punish you severely. Nevertheless I think it is needful that something should be done to substantially indicate to you that your act was a violation of law, and should be punished in order to deter others from imitating your conduct."

CHICAGO TROLLEY ORDINANCES.

Mayor Hopkins of Chicago has vetoed the ordinances passed at the April 4th meeting of the city council, giving the Chicago City Railway Company the right to introduce electricity as a motive power on most of its lines now traversed by horse cars. The mayor takes exception to the fact that amendments which he had recommended had not been incorporated in the ordinances, that the company was given the right to erect wooden poles and lease them to other companies, and that the principle of compensation for franchises had been entirely ignored. He remarked in this connection:

"When the City of Philadelphia on the 30th day of March last year granted a trolley franchise to the Citizens' Passenger Railway Company, it did so upon the condition that the company shall at its expense pave from curb to curb, with improved pavement, all streets upon which its trolley lines may be operated, and furthermore embodied into the ordinance a condition compelling the company to take down and remove the overhead wires whenever so directed by the council. To require the Chicago City Railway Company to light its right of way is an infinitely smaller compensation than that secured by the paving clause of the Philadelphia ordinance. I hope that in the exercise of your duties as representatives of the people you may so amend the ordinance as to make it possible for me to give them my executive approval."

The ordinances were reconsidered and referred to the committee on railroads.

TWO-STORY CARS.

John A. Tackaberry, of the John Stephenson Company of New York, was recently asked if it would be practicable to operate two-story cars on the elevated roads or Broadway cable road of New York City. He answered:

"There are no two-story cars in use anywhere. Cars with top seats are used in many foreign countries but I know of no cars with upper tiers of seats enclosed in a permanent structure.

"On the elevated road they are now running trains of five cars. Doubling the number of passengers would of course add materially to the weight to be hauled, necessitating more power and heavier rolling stock, and perhaps a heavier elevated structure. And there would be no advantage in it unless the passengers could be moved quickly. One of the great problems of transportation in cities is how to handle people quickly. Two-story cars might, of course, be built, and it would be quite possible to get people in and out of them, but they would be worse than useless if passengers had to go to and from the upper seats by means of stairs, as in the ordinary top-seat cars. The only way to handle them would be to and from station platforms on a level with the floors of the cars. This would necessitate the building of two-story stations. Stairs to climb are an objection, of course, but I don't think the second flight would be so great an objection as at first it might seem to be, for I think that the younger and more active would naturally seek the upper story, and so the convenient distribution of the passengers would in large measure settle itself. Of course there would be other questions to settle, the possible danger, in more ways than one, arising from adding so much to the exposed surface of the cars and to the weight in the air if carried on the same wheel base; and there would be many minor details of operation to settle.

"I do not believe that it would be practicable to operate two-story or top-seat cars on the Broadway cable road. The power is there, but Broadway is comparatively a narrow street and greatly crowded, and doubling the number of people getting on and off in a street so narrow and so crowded would, I believe, so hinder the movement of the cars as practically to block them. There may be something in the idea of two-story cars for the elevated road, but not unless we could have second-story stations."

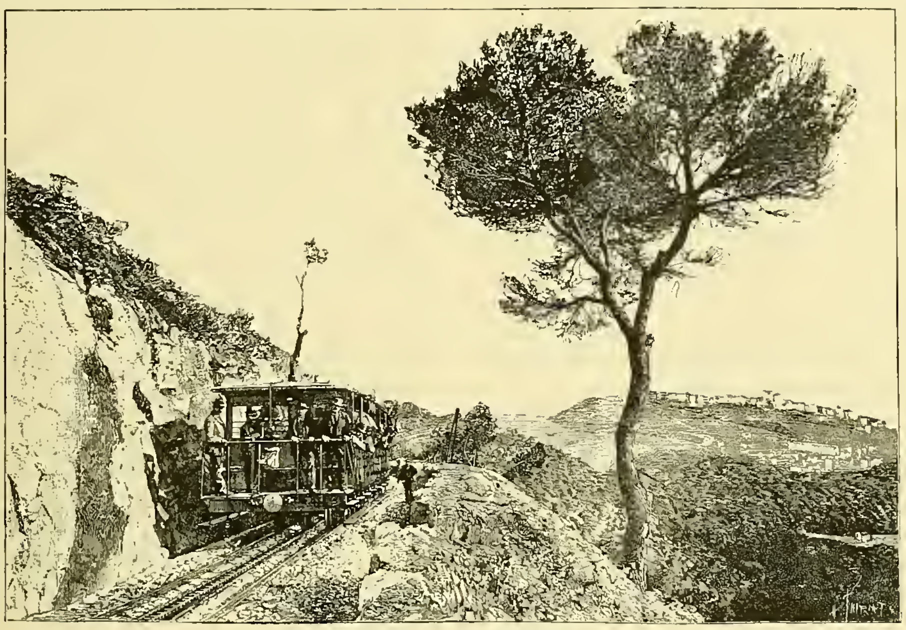
GENERAL ELECTRIC ANNUAL MEETING.

The annual meeting of the General Electric Company was held on Tuesday of this week. The report of the year's business, which was circulated in advance of the meeting, was printed in our last issue. President Coffin said, in answer to a question, that no action had been taken or was contemplated looking to a reduction of capital to make good impairment of the capital stock. Director Coster moved that the matter of reducing capital be referred to the new board, and this was agreed to. It was voted to increase the number of directors from 11 to 13, the vacancies to be filled by the board at some future time. The date of holding the annual meeting was changed from the second Tuesday of April to second Tuesday of May "in order to give more time for making up the annual report and inventories." At the meeting 210,436 shares were represented. The old board of directors was reëlected, and the present officers, with the exception of E. I. Garfield, secretary, were reëlected. F. Westover was chosen to the office of secretary. The list of stockholders showed a total of 4,800, of which number 2,800 are in Boston and 2,000 in New York. No very large holdings were credited to any one individual.

Increased Earnings.—The Atlantic Avenue street railroad (Brooklyn) earnings for the first week in April were $17,129, an increase of $2,667.

MONTE CARLO RACK RAILWAY.

Since the latter part of February a rack railway has connected Monte Carlo in Monaco and Turbie. From the latter place a magnificent view of the surrounding territory can be gained, and in the immediate vicinity Roman ruins of no little interest can be seen, but till the construction of the cog line few tourists journeyed from Monte Carlo to Turbie as the roadway was roundabout, and the trip fatiguing. The projectors of the railway after long periods of delay obtained from the French authorities the right to construct the road which is built entirely on French soil but extends to the boundary line of the principality of Monaco. The line is a short one; the trip from terminal to terminal occupies only 20 minutes. The road is single-tracked with one turn-out at Bordina which is the only station



MONTE CARLO RACK RAILWAY.

When the railway was opened a few weeks ago a French general took part in the inaugural exercises. His participation was explained by the fact that the railway is considered of no small importance from a military point of view. By the rack road soldiers can be carried to Fort Tete de Chien in a quarter of an hour, while if they tramped up the hill they could not make the trip in less than three hours. In order that the French should always be able to control the road the builders were very careful to construct the Monte Carlo station entirely on French soil.

THE MODERN PROMOTER.

Idle money, and those who have more of it than they can carry or know how best to use, have evolutionized the modern promoter. He has risen to his opportunities, and in his methods is equally dignified and expensive. He handles towns as peddlers manipulate socks, develops mines and furnaces with equal facility, and by the aid of ink and eloquence he floats corporations that, like the rest of paper boats, make longer voyages beneath the water than on its surface. He humps the spine of the mail carrier with his circulars, maps of cities as yet invisible are covered with boulevards, and public squares are not wanting for streams and groves made for the occasion. Statistics blossom in arithmetical roses, and prophecies in rainbow splendor depict the future wealth and greatness of localities where at present and for years to come the gopher makes his hole and the blackbird follows the plowman. Enterprises are invited to migrate where taxes are low, and trade, like a mushroom, will spring up in a night.

Of these artistic creations the promoter too often makes his net, into which the golden fish enter on their way to the pan. The fisherman fattens and the victims fry. Men unload their cash; widows with nest eggs in the bank vacate the ark and tempt the flood, and thrifty crowds in honest confidence cast their bread on the waters, to search for it with lanterns after many days.

It may be a reflection on average intelligence that credulity should be so common, and that men and women otherwise prudent and thrifty, should in this case pay for chickens that are as yet without parents or feathers. It may also be as much an anomaly that where the law puts an iron hand on felons and forgers, it is sometimes a velvet convenience to men who trade on public confidence and issue their invitations in legal forms to such flies as would be acceptable to the spider. We do not include in this class of sinners those men who are integral parts of the necessary machinery of enterprise and industrial development. Without such there would be a missing wheel in the mechanism of prosperity. In many instances they represent vital and important interests, which, without the promoter as a pioneer and missionary, would only be possibilities and never realized facts. It is also possible that even where integrity and sagacity are unquestionable, that mistakes may be made, and enterprises with every reasonable prospect of success may, from causes beyond provision or prevention, prove abortive and ruinous. Examples are numerous. There is hardly a state in the west or south where the bones of such failures have not been picked by the buzzards of time.

There are mines missing miners, furnaces without fires, mills with idle wheels and towns containing more rats than men, that tell the story of speculative folly, and booms that labored with child but brought forth a mouse. The fact is the whole thing has been over done, and it has more to do with the idle money kept in stockings and piled up in vaults than is generally supposed. If enterprise is in its nightcap, and so-called capital is hesitant and timid, it is not without its reasons. One burnt finger warns the rest. The European digit has been badly scorched, and if it hesitates at a hot chestnut, who can say nay? It has unloaded its millions on booms, where all that is left is repentance and a troubled memory, and it is not to be denied that mismanagement and unlaundered rascality have had all the rope needed to strangle foreign faith, even in honest and reasonable schemes. The promoter has, in too many instances, fried his steak in foreign fat—the probabilities being he will have to wait some time for his next dinner. The evil might be curtailed by legislation, but its real cure lies in the public being as prudent in buying shares as it generally is in the purchase of a horse or a coat.
—Fred Woodrow in *Age of Steel.*

A GOOD ELECTRIC GROUND.

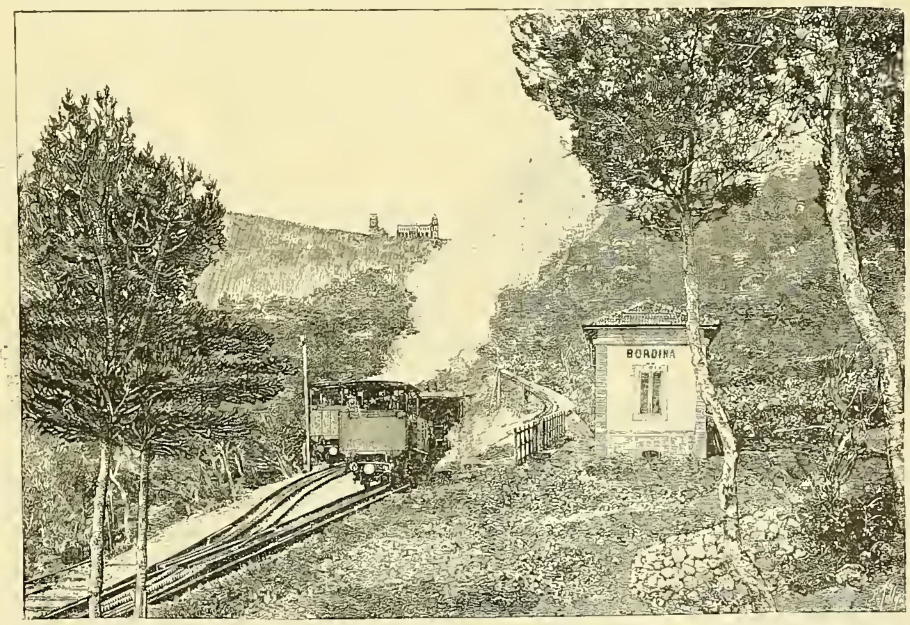
BY CHAS. DESMOND.

Grounds on electric circuits, cause more annoyance than anything else, unless it be the expense account of the plant. Grounds are most likely to appear where we do not want them and where we try to form them it is most difficult to obtain one of sufficiently low resistance to serve our purpose and not annoy our electrical neighbors.

By the methods commonly employed, electric grounds are difficult to establish and maintain in a manner that is satisfactory and at the same time with reasonable economy of current. This is particularly the case in electric railway work and it has also been found a difficult thing to maintain good grounds in telephone plants. In the latter class of work corrosion and high resistance have been the cause of considerable expense and more annoyance. Since the advent of the electric roads the telephone ground has been so good that it has gathered up nearly all of the sound made by the electric roads and has distributed it, impartially, to all the telephone customers.

The currents from the roads have also caused much injury and annoyance from the electrolytic effects produced on all kinds of metals employed underground, especially gas and water pipes; so much so that the poor trolley has been terribly abused for sins that are but partially its own, most of which, like the runaway horse are due to improper control.

The more common methods of making grounds for carrying heavy currents consist in making the



MONTE CARLO RACK RAILWAY.

earth contact as large as possible—or as large as thought necessary—without due consideration for the conductivity that could be obtained.

The electric resistance of moist earth is, at best, a very indefinite factor, but so long as simple moist earth or running water can be obtained it has been thought all that would be required—until it was tried, when it would be found far from what was desired. On some of these permanent grounds much time and money have been expended to make them as perfect as possible, but nearly all, if not all, have been disappointing in the results obtained, for they have been of too high resistance to be economical to maintain and that resistance has been the cause of injury to other property in the immediate vicinity.

Just why coke has been so favorably considered as a proper material for use in making permanent grounds has never been explained in a satisfactory manner and yet nearly all directions given for making such grounds have provided for the use of this material. Coke is useful for many electrical purposes, but is not suitable for a good ground connection, principally on account of its porosity and also because there are more suitable materials that have less resistance and can be more cheaply applied and with better results, as a ground of much less resistance can be obtained at less cost and one which will last much longer without attention and can be renewed at trifling expense.

In establishing a telephone exchange, in one of the southern states, a few years since, the writer was very much annoyed at finding that the water in that section was so free from conducting salts that it was sometimes impossible to ring a Post magneto through the water, even though the magneto would ring a bell through 50 miles of No. 14 iron telephone wire. The subject of suitable grounds then became an interesting one, as this point was the one which had given the most trouble in other sections. Copper plates, iron rods and moist earth became terribly mixed while being considered.

The site of the town had been filled in, quite extensively, with furnace slag and ore screenings which made the matter more difficult to settle, as this filling was of very high resistance, and in some places it was found impossible to get the magneto to ring through the earth, even when one pole was grounded in the swamp.

With these conditions to contend with, each of the usual methods of making permanent grounds was considered from electrical, mechanical and chemical standpoints, with the result that chemical considerations furnished a satisfactory solution of the problem and the grounds obtained were, one and all, perfectly satisfactory and gave no trouble whatever from corrosion, high resistance or mechanical injury.

The difficulties were overcome and satisfactory results obtained, in every way, by the use of common salt. Salt, chemically sodium chloride, is hygroscopic; that is, it will absorb moisture. Electrically considered in solution, it is a good electric conductor. Chemically considered, it will attack iron; so iron, the usual material, could not be used for the ground connections. Its action on copper is very slight and unless the current is very strong the action on even a small section would be practically negligible. So copper wire, the same size that was used for the inside connections, was used for the ground, and about four feet in length was put into the earth.

The method employed was as follows: A hole was made by driving down a rod of iron about ¾ inch in diameter, as far as it could be easily driven, or the length of the rod, which was four feet. The hole was then filled with a handful of salt and a basinful of water poured in to dissolve and spread the salt. The wire was then put into the hole as far as it could be pushed, another small handful of salt was added and the hole was then filled with earth, after which a sort of basin was formed in the earth around the wire, another handful of salt was placed in the basin and more water added. That was all, but it made an electric ground that was all that was required and no trouble was experienced with it during the year and a half that the writer remained there.

To protect the small wire from mechanical injury it was run through a short piece of gas pipe that was left projecting a few inches above the ground, but this formed no part of the electric circuit.

The electric resistance of one cubic foot of water, from the average city supply, is about 100 ohms. The addition of one per cent. of common salt will reduce its resistance to less than 2 ohms. Salt will penetrate through the earth until many hundreds of cubic feet are saturated and by its affinity for moisture the whole ground, where the salt has penetrated, will become a conductor of comparatively low resistance and the electric ground will be as lasting as the material used in making the electric contact.

The electrolysis of a solution of salt will give, besides the oxygen and hydrogen from the water, chlorine and sodium, but even with the heavy currents used by the electric roads the electrolytic action will cause but slight deterioration of the ground connection if large surfaces are connected to the return wire at suitable intervals, or the bare return is laid in a trench freely supplied with salt which will practically increase the capacity of the return circuit. These can be provided at slight expense and will be more satisfactory than the methods now employed. Renewal of the ground connection will not often be necessary and, when it is, the cost of material and the time required will be but a small fraction of that required for producing and maintaining the grounds commonly employed.

The grounds at present in use where coke, copper and moist earth are employed can be greatly improved by the addition of a barrel of salt and a couple of hogsheads of water.

IS THE "CUTTING" OF LINES OF FORCE A NECESSITY?

EDITOR STREET RAILWAY GAZETTE:—In your issue for March 3, I find in Mr. Perry's article on "Street Railway Motors," page 100, referring to the experiment, figure 19, this statement: "In

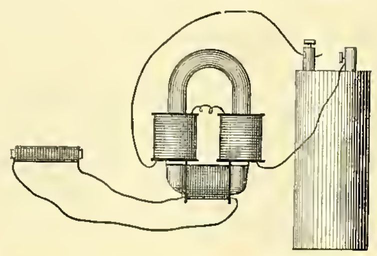


FIG. 19. (FROM MR PERRY'S ARTICLE).

this case there was absolutely no cutting of lines." As every magnetic line is a closed curve, and as the coil in the figure is a closed circuit, I would like it explained how the lines get in and out of the coil without cutting.

Vineland, N. J. WM. A. ANTHONY.

EDITOR STREET RAILWAY GAZETTE:—I have received Prof. Anthony's letter, a copy of which you were kind enough to send me, and note his criticism on my statement that "In this case (Fig. 19, p. 100) there was absolutely no cutting of lines."

I am very glad that Prof. Anthony has raised this question as it is one that has considerable theoretical interest. The method of explaining the generation of electromotive force by moving a wire or coil in a magnetic field by saying that it is dependent upon the rapidity with which that wire *cuts* the lines of force is a very convenient one, but I have never been able to make myself believe that the *cutting* of the lines of force had anything to do with the generation of electromotive force.

Where the loop or coil is revolving in a uniform field as is the case with armature coils, there would seem to be some foundation for the theory of cutting but in the case of a transformer, (which by the way Fig. 19 really is) where there is no motion of any kind of the secondary coil or its core, the idea of *cutting* does not appeal to me at all. When the primary current is turned on, the lines of force rush out from the N pole, *thread* themselves *through* the solenoid and enter the south pole just as a stream of water might do were this path limited by a pipe and when the primary current is broken, these lines of force which had been threading the secondary coil disappear from the coil in the opposite direction from that by which they entered it, as would so many elastic strings in tension between the N and S poles when their attachment to the south pole was suddenly released. In the water analogy the coil would not be wetted by the entering stream, and therefore could not have cut the pipe—at least it would not be necessary that the coil should cut the pipe in order that the stream should enter the coil. Perhaps my analogies are not good ones, but they fairly represent what I conceive to take place in the secondary coil of a stationary transformer.

The E. M. F. generated is due, in my opinion, rather to the rapidity of change of the number of lines of force embraced by a coil, than to any cutting. This view explains the action of the revolving armature coil quite as well as it does that of the transformer, for as the coil revolves from its neutral position to that of maximum effect, it is constantly presenting a less and less effective area through which the lines may thread themselves and the *rate* at which this effective area decreases is increasing until the coil has arrived at 90 degrees from its neutral position, when the coil suddenly reverses its plane to the poles and the lines of force change their direction with regard to the coil, or as mathematicians would say, the direction or number passes through zero. Again, in the case of the revolving armature coil, when its plane is at right angles to the lines of force and when, according to the *cutting* theory, the coil is for the moment cutting *no* lines of force, and therefore generating *no* electromotive force; it can be made to generate a maximum electromotive force by simply reversing the direction of the lines of force. I cannot see why, if in the one case it is *admitted* that the coil is cutting no lines of force, it can be claimed that it cuts them in the other.

As before stated, I am glad this question has been raised by Prof. Anthony, and hope that it may be further discussed in the columns of the GAZETTE. NELSON W. PERRY, E. M.

Brooklyn, N. Y.

INVESTMENT IN ENGINEERS' SERVICES.

EDITOR STREET RAILWAY GAZETTE:—My views are fully in accord with the editorial in your issue of March 24 on "A Profitable Investment." There is no doubt in my mind that this one thing alone is responsible for the precipitation of several roads into the hands of receivers. Heretofore they have rushed madly into construction regardless of engineering advice and even at this late date millions of dollars are being spent for apparatus, which, from an economical standpoint may be totally inadequate for the the purpose for which it is to be used.

I find in talking with many managers and officials that they are of the opinion that there is no secret in the construction of an electric road, and that expensive engineers are not necessary. I cannot understand why this should be so; such men would not hesitate a moment to employ an architect if they wished to build a business block notwithstanding the fact that some carpenter might say to them that it was not necessary. Why then, should they hesitate to employ an engineer, when they wish to invest half a million dollars in an electric road?

The points set forth in your editorial are very opportune, and I shall be pleased to see you follow them up with other remarks of a similar character until investors and capitalists are brought to realize that if they wish any return on their investments they must construct their railways on an economical basis, and that this can only be done by advice of those thoroughly experienced in the construction of all details, especially those of the power house.

Salem, Mass. J. H. BICKFORD.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Fourteenth Article.*)

IN TRANSLATING DEVICES.

When there are no cars on the line or the trolley wire is not otherwise connected with the rails or the ground, the resistance between the two is infinitely great and no current will pass from one to the other. If one car be now put into operation one path will be opened to the current from the trolley wire to the rails. If now a second car and a third be placed in operation, a second and a third path will be opened, and if the resistances of all three of these paths be the same the resistance between the trolley wire and the rail when two cars are in operation will only be one-half, and when three cars are going one-third what it was when but one car was receiving current, the pressure will remain the same with the addition of cars in multiple, but as each car put into service opens a new path for the current between the trolley wire and the rail, the number of amperes of current that will flow will increase with the number of cars—will be twice as much for two and three times as much for three cars as for one.

A parallel case is found in the consumption of water. Supposing we have a line of water mains connected with a reservoir five hundred feet high. The pressure of water in the mains at their lowest point would be that due to 500 feet of head. Now, suppose we have a number of small faucets tapped into the main at its lowest point. When they are all turned off, the strength of the main or its resistance, while not infinitely great as in the illustration of the trolley wire, is still sufficiently great so that no water can flow ont at any point. Open one faucet and a single path of, we will say, unknown resistance is opened and a stream of so many quarts or gallons per minute will flow out onto the ground. Open a second faucet and another path of equal resistance will be opened and double the quantity of water will flow. The same quantity would flow if instead of opening a second faucet of the same resistance as the other, the first one were closed and another one of double the capacity or offering half the resistance were turned on in its stead. Therefore, while by opening one small faucet we have decreased the resistance of the pipe from something more than sufficient to keep back water under 500 feet pressure to some definite quantity which is less than that, by opening two of the same size we have divided the resistance remaining by two, and by turning on a third it will be reduced to one-third what it was when but one was turned on. But no matter how many faucets we open, nor how much water runs out (provided of course it does not exceed the capacity of the main or the reservoir is not emptied) our reservoir remains 500 feet above us and the pressure will remain the same at the faucets.

We may make the resemblance between the electric flow and the flow of water still more striking by supposing that each faucet connects with a little water motor which, when working to its fullest capacity, requires a stream of water as large as that which can run out of the faucet when turned on full under 500 feet head.

By turning on the faucet part way, with 500 feet head of water behind it, enough water will flow to enable the motor to do a fraction of its maximum work, turn it further it will do more, and finally turn it on full and it will do the most that it is capable of doing. A second and a third water motor may be attached to other similar faucets and be caused to do varying amounts of work by turning on more and more water, but whether the motors are doing little or much work, using little or much water, the pressure in the main will not decrease until so many motors are attached as to require for their operation more water than the main can carry. If the capacity of the main be exceeded it will be necessary to lay a larger main, and if this be fed by two pipes of the same size, the original pipe from the same reservoir and another one from another reservoir at the same height, the pressure on the main will not be increased, but its capacity for running water motors will be doubled.

While there will have been no water consumed by the water motors, for the reason that just as many gallons will flow away from the motor as was delivered to it, that which flows away has lost its pressure. If, for example, it required just ten gallons per minute under 450 feet of pressure to drive each motor at its fullest capacity, and the motor received that amount of water at 500 feet pressure, it may be said to absorb the pressure due to 450 feet, and the water will flow away from the wheel at the rate of ten gallons per minute, but having a head of but fifty feet. That is to say, a pressure equivalent to that exerted by a column of water 450 feet high will have disappeared in operating the water wheel. A second wheel requiring a pressure of 450 feet head placed below the first wheel could not be operated, because the remaining head would not be sufficient, and if the two were placed together in this manner—in series—neither of them could be operated to their full capacity, because when thus placed their combined resistances would be opposed to the water—that is to say, the resistance of both would be double that of one, and the amount of water that would pass through either would be only half as much as when there was but one. If we increase our pressure, however, more water will flow through our faucet and from one motor to the other until when we have doubled our pressure, or connected our main to a reservoir 900 feet high, both motors will be operated at their maximum capacity. The water running away from our last motor will then have no pressure—each motor having absorbed a head of 450 feet—the same amount of water, ten gallons per minute, will, however, be found to have passed through, but it is no longer capable of doing any work.

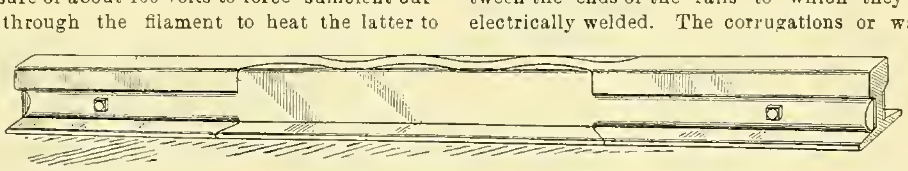
Thus we see that by operating translating devices in series, we *consume* pressure (volts) and not current (amperes), which is just the reverse of what takes place in the generating station where we connect generators in series—thereby increasing the volts with the number of machines but gaining nothing in the way of amperes.

Take the case of an incandescent dynamo giving current at about 100 volts. Each 16 C. P. lamp consumes when working at its normal rate about ½ ampere of current at 100 volts. That is to say, its resistance is such that it requires a pressure of about 100 volts to force sufficient current through the filament to heat the latter to such a white heat. If our dynamo had a maximum capacity of 100 amperes at 100 volts, and our lamps required ½ ampere each, 200 lamps could be fully supplied by the circuit if placed in multiple arc with one another, because there would be enough current to go round and it will be delivered to each lamp under the same pressure. Its capacity, however, would then be exhausted. If we connect up a second dynamo of equal capacity to the same circuit in multiple arc with the other, 200 additional lamps could be supplied in the same way. But supposing we place two lamps in series across the circuit, their resistances would be added and at 100 volts pressure but half as much current could flow, viz. ¼ ampere. The lamps, we have stated required ½ ampere each, hence if two were placed in series, neither would be heated sufficiently to give much light. If, however, we connect our dynamos in series so as to double the electromotive force or pressure of the circuit, the required quantity, ½ ampere, will be forced through the combined resistance of the two lamps and both will burn at their normal candle power. A single lamp, unless of double the resistance of those heretofore used, could not be used on this 200 volt circuit, as the pressure would be so great as to immediately break it. For the same reason, we cannot put 100 volt lamps in our cars in multiple arc arrangement for they would all be destroyed as fast as they could be placed in their sockets by the 500 volt pressure. But if each lamp absorbs 100 volts of pressure and each added to a series consumes the same number of volts, if we place five lamps in series on the usual 500 volt circuit there will be just enough pressure to give each of them what is required to operate it at normal candle power. We are thus limited on street cars operating on the usual 500 volt circuits to five lamps placed in series. If we want more, we must arrange another series of five, for if we placed six or seven on the first series each would only receive ⅙ or ⅐ of 500 volts which would not be sufficient to illuminate them to full candle power, and if placed but one or two on the second circuit, in the case of the single lamps, it would receive the full pressure of 500 volts and in the case of two lamps, each would receive 250 volts, which in both cases would be entirely too much. We might of course, make up the second series of one or two lamps and dead resistances equivalent to the resistance that would be offered by the additional lamps required to make up the series of five, but these dead resistances would consume as much energy as the lamps they replaced and give no useful return, so that it would be much better to complete the second series with lamps than with dead resistances. If we had a second series of five lamps this second series would be in multiple with the first.

The same reason which compels us when using 100 volt lamps on a 500 volt circuit to place five of them in series, would compel us in case our circuit was at 1,000 volts to use ten lamps in series.

EXPANSION JOINT FOR CONTINUOUS RAILS.

The accompanying illustration shows an automatic expansion rail joint recently invented by Thomas J. Gilmartin, of Ogden, Utah, who claims that it solves the problem of a perfectly smooth track and continuous rail. The expansion part of the device consists of a set of corrugated steel plates about two feet long and set upon edge between the ends of the rails to which they are electrically welded. The corrugations or waves



JOINT FOR CONTINUOUS RAILS.

in these expansion plates extending lengthwise of the rail are weaker longitudinally than the rail, and being welded to and integral with the rail must respond automatically to all movement thereof due to expansion or contraction.

These expansion plates are confined laterally by two peculiar fish plates which are longer than the expansion or corrugated plates and are bolted in the ordinary way to the rails beyond the points at which the expansion plates are welded to the rail ends, says the *Railway Review*. The fishplates serve the double purpose of holding the expansion plates in position laterally, and at the same time form part of the top of the rail with which the wheels come in contact. They also form a guide for the flange of the wheel and fill out the openings in the top of the rail caused by the irregular form of the corrugated or expansion plates, so that the general contour of the top of the joint is identically the same as that of the rail, except that instead of the ordinary and objectionable lateral spaces between the rails there appears two or more waving or corrugated lines running lengthwise for about two feet in the top of the rail. The sides of the fish plates coming in contact with and confining the expansion plates laterally are formed to fit into the corrugations or recesses in the expansion plates, but vary in form sufficiently from that of the expansion plates to admit of the necessary longitudinal movement in the expansion plates to take up and absorb expansion and contraction. The joint complete presents a uniformly smooth and continuous surface for the wheels to ride upon, and is made stronger laterally and vertically than the rail itself.

EQUIPMENT AND OPERATION OF THE LIVERPOOL OVERHEAD RAILWAY.—III.

Power at Generating Station.—The efficiency of I. H. P. to E. H. P. on the line is very high, and results are given of special tests taken with carefully calibrated instruments. For this purpose No. 1 engine and dynamo were used. This engine had been running for some weeks, and was in thorough working order, the valves being carefully adjusted to give the best diagrams. The tests were taken after the engine had been running the traffic all day, when the load was transferred to a water-resistance tank. They lasted over three hours and a half, volts, amperes and speed being kept constant, and readings and diagrams taken every half hour.

The results of the tests are:

Diameter of high-pressure cylinder, 15½ inches.
Diameter of low-pressure cylinder, 31 inches.
Length of stroke, 36 inches.
Mean efficiency (E. H. P. to I. H. P.), 88 per cent.
Coal consumed, 4,032 pounds.
Total E. H. P. hours, 1,195.
Coal per E. H. P. hour, 3 37 pounds.
Coal per I. H. P. hour (efficiency 88 per cent.) 2.96 pounds.

These results are eminently satisfactory, and are borne out by the low coal consumption in practice, of which mention will be made later.

Curves are given (8 and 9) showing the power absorbed by a train during an experimental run covering the length of line at present open (5⅛ miles) in 24 minutes and 57 seconds, with intervals of 25 seconds stoppage at stations, or an average running speed of 15.1 miles per hour. Also during one journey performed in 23 minutes 47 seconds, or at the rate of 16.1 miles per hour.

The particulars of these trials are:

MARCH 5, 1893. FIRST JOURNEY.
Herculaneum to Alexandra (return). One train on line.
Loaded with 8 tons (iron weights).
Total time on journey, 24 minutes 57 seconds.
Total time current is on car, 17 minutes 7 seconds.
Total time train is standing, 4 minutes 37 seconds.
Total distance run, 9,030.4 yards=5 miles 230 yards, say 5½ miles.
Average speed while running, 15 miles per hour.
Average speed, including stops, 12.3 miles per hour.
Average current per train while running, 82.7 amperes, including stop, 67.3 amperes.
Average electrical horse power per train while running, 54 4 H. P., including stops, 44.4 electrical H. P.
Average electromotive force, 485.2 volts on car.

MARCH 5, 1893. SECOND JOURNEY.
Herculaneum to Alexandra (return). One train on line.
Loaded with 8 tons (iron weights).
Total time on journey, 23 minutes 47 seconds.
Total time current is on car, 15 min. 18 sec.
Total time train is standing, 4 min. 40 sec
Total distance run. 9,030 4 yards, say 5⅛ miles.
Average speed while running, 16.1 miles per hour.
Average speed, including stops, 13 miles per hour.
Average current per train while running, 90.8 amperes; including stops, 73 amperes.
Average electrical horse power per train while running, 57.1 electrical H. P.; including stops, 46 electrical H. P.
Average electromotive force on car, 484 volts.

The weight of the car complete without passengers is 15½ tons. For the test each car was loaded with 4 tons, making the total weight of the train 39 tons. The average power absorbed was 44.4 E. H. P. at 15 1 miles per hour, and 46 E. H. P. at 16 1 miles per hour.

A comparison of the consumption of coal when the number of trains is varied is interesting. During the month of April and part of May there were seven trains on the line, giving a 10-minutes service from 5:10 a. m. to 6:40 p. m. During this period the coal burned was 22.55 lbs. per train mile. This includes coal for all purposes, no deductions being made for charging the station batteries, etc.

From June to the beginning of October the train service has been as follows:

5:00 A. M. to 9:00 A. M., 8 trains in service.
9:00 A. M. to 5:30 P. M., 12 " " "
5:30 P. M. to 7:00 P. M., 6 " " "
7.00 P. M. to 8:30 P. M., 4 " " "
giving a five minutes' service from 9:00 A. M. to 5:30 P. M.

The coal used for all purposes per train mile has been—

	Lbs.
April	25.16
May	20.03
June	18.97
July	18 27
August	16 95
September	17.20

The figures show a continual steady decrease in fuel consumption. That for August is abnormally low, due to extra traffic during the holiday week, the car mileage on the 7th of that month being 21 per cent. greater than usual. On that day the trains carried 48,000 passengers, each train during the middle part of the day being loaded with over three hundred people. The average weight of slack burned during the four months of June, July, August and September, inclusive of all battery charging and power at the central station and car-shed, was slightly less than 17.8 lbs., or, allowing for energy expended otherwise than on the trains, it may be taken at 17 lbs. per train mile.

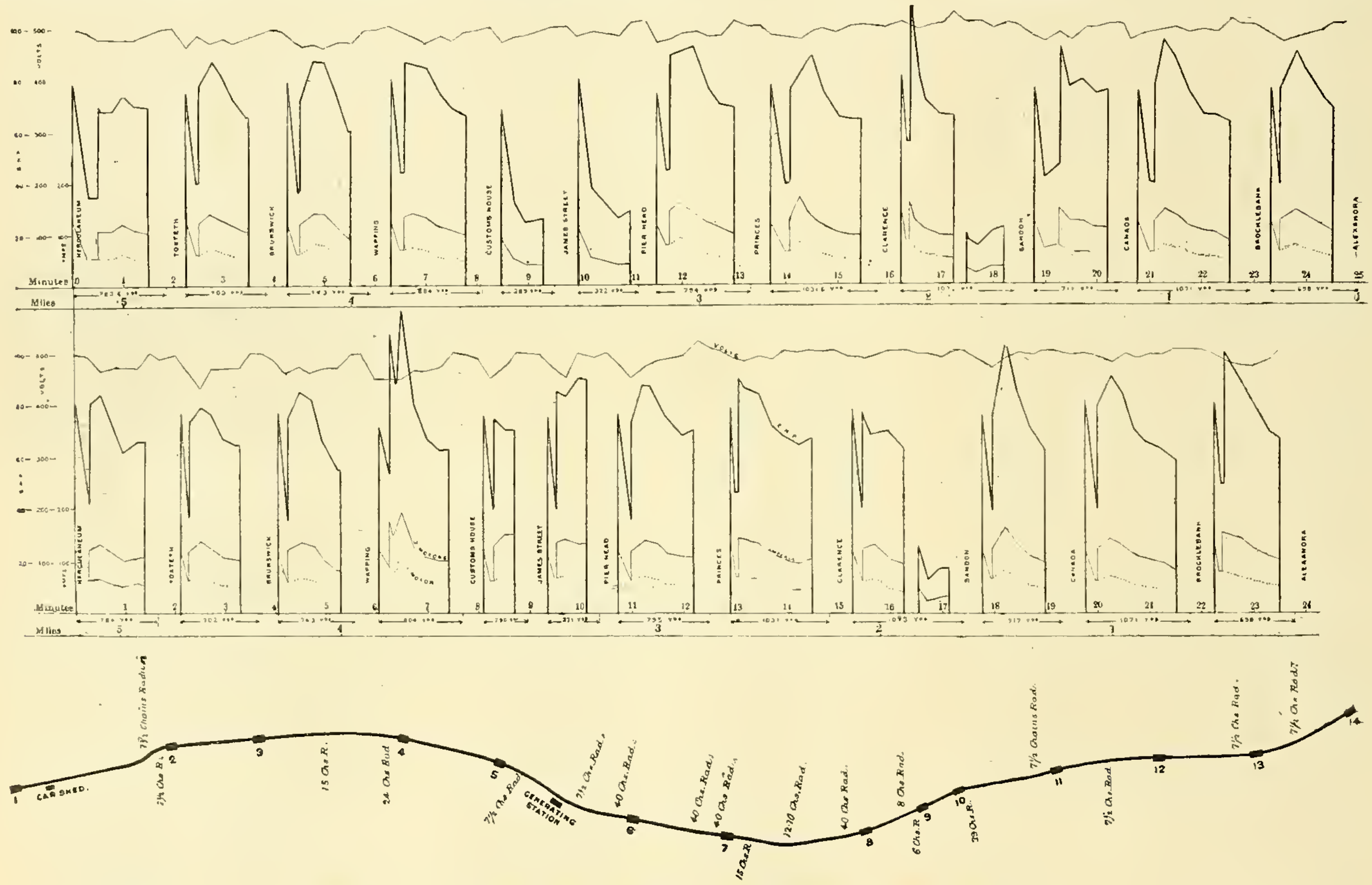
TABLE SHOWING COAL CONSUMED PER KILOWATT-HOUR, ETC.

	Kilowatts generated.	Pounds per kilowatt-hour.	Pounds per E. H. P. hour.
April	69,954	8.40	6.32
May	86 627	6.90	5.17
June	97,789	7 10	5.30
July	109,909	6.70	5.00
August	117.843	5.95	4.44
September	119,328	5.81	4.34

During four days in June, owing to the dock from which condensing water is drawn being emptied, the engines ran non-condensing, and an additional boiler was required.

The coal used is small Lancashire slack, having the following composition:

	Per cent.
Fixed carbon	70.08
Volatile hydrocarbon	16.47
Sulphur	1.92
Moisture	3.01
Ash	8.51



FIGS. 8, 9 AND 10. TRACTION DIAGRAMS OF THE LIVERPOOL OVERHEAD RAILWAY.

Its calorific value is approximately 75 per cent. of that of best Welsh coal. The price of the slack which was used until the latter part of August was 5s. 10d. per ton, but since that date, owing to the strike in the coal trade, coal has been procured from various sources at price ranging up to 17s. 6d. per ton.

Cost of Working.—Under their agreement, the contractors engaged to run the service of trains for the Liverpool Overhead Railway Company, and to supply all power, maintenance, drivers, superintendence, etc., if required, for a period of two years, for the sum of 3½d. per train mile, which was estimated upon an average daily running of 2,400 miles. At the present time only 5⅛ miles of line have been opened for traffic, and the contractors have received 4d. per train-mile, as, with a five-minutes' service the total train-mileage is necessarily decreased on the shorter line. For current to charge the station batteries 7d. per unit is received, which includes the maintenance of lighting and signal plant. In the table are given figures analyzed from the actual working costs during the months of July, August and September.

The increased cost of running during August and September is fully accounted for by the item of coal; and, taking into consideration the fact that the Overhead Railway Company has not employed so rapid a service as was at first anticipated, the average running per day being only about 1,350 train-miles, the figures indicate most favorable results; as, even with this mileage, the trains were run at a fair profit for July and August, and it is evident that with coal at a normal value, the line can be run at a cost within that guaranteed by the contractors.

COST OF WORKING, INCLUDING THE LIGHTING OF STATIONS AND THE SIGNALS.

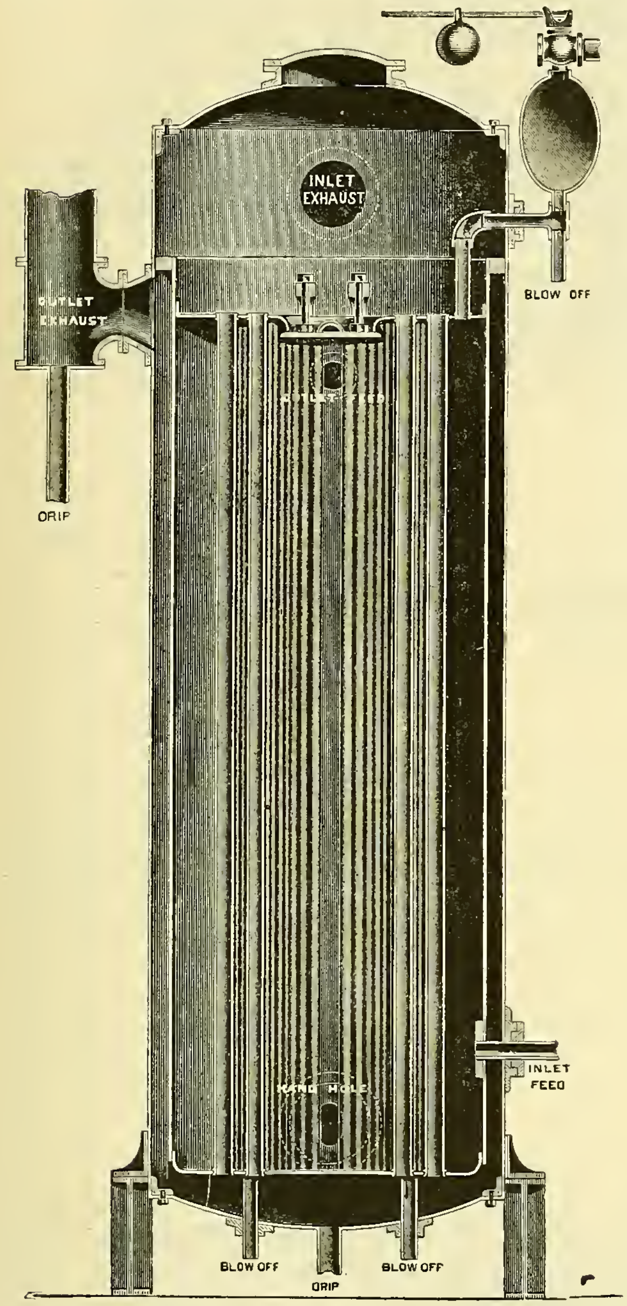
	Pence per train-mile.		
	July.	August.	September.
Supervision	0.416	0.416	0.416
Generating station, wages	0.618	0.590	0.628
Drivers' wages	1.076	1.043	1.058
Coal	0.589	0.718	1.230
Oil, waste, grease	0.140	0.139	0 129
Water	0.010	0.013	0 015
Stores and sundries	0.049	0.105	0.115
Cleaning and repairs, etc., at the car shed — Wages	0.545	0.521	0.539
Cleaning and repairs, etc., at the car shed — Material	0.284	0.430	0.221
Total	3.727	3.975	4 351
Allowance for signals and lighting	0.286	0 271	0.276
Cost of running	3.441	3.704	4.075
Train-mileage	39,250	41,430	40,640

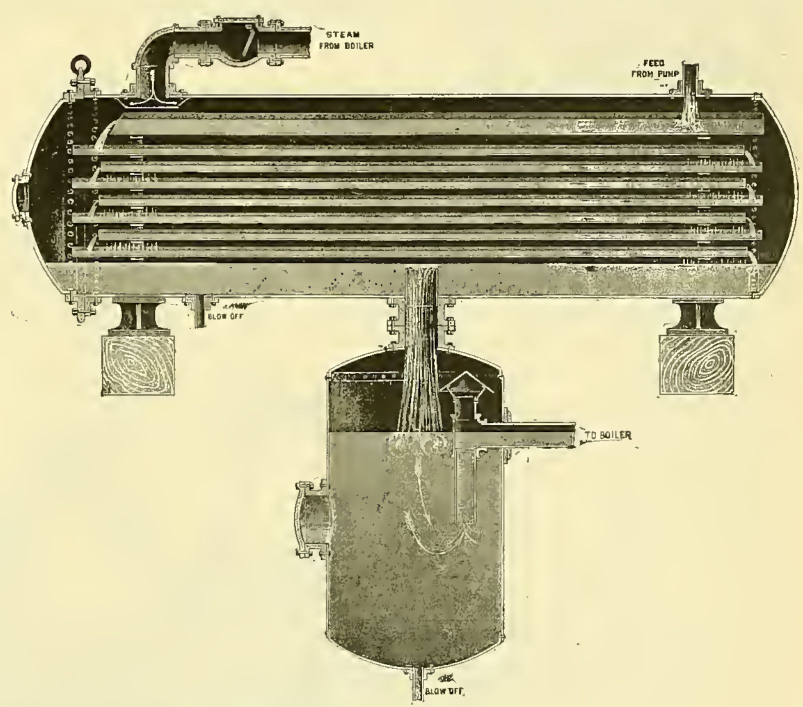
New York, N. Y.—The Metropolitan Traction Company's dividend of 1¼ per cent. is payable April 16.

NEW BARAGWANATH FEED WATER HEATERS.

The feed water heating and purifying apparatus illustrated herewith was recently brought out by William Baragwanath & Son of Chicago. Several new features distinguish the new type from the older apparatus of the firm. The steam jacketed upright heater is made in large sizes, 500 horse power and upward. It is provided with a manhole at the center of the tubes, so that every part of the interior is rendered accessible. It is specially intended for use where the feed water is very hard and the liability of the tubes to scale is consequently great. The water enters at the right near the bottom, circulates around and between the steam tubes, and passes out through the outlet near the top. The water chamber is provided with blow-offs at top and bottom, a scum chamber, and a safety valve. The exhaust steam enters near the top, passes down through the tubes in the water chamber, and up around the outside, acting as a complete steam jacket for the water chamber. In the horizontal heater live steam is used, it being termed a feed water "superheater" as well as a purifier. It is not designed to do away with the exhaust steam heater, but rather to act as an auxiliary to it in certain cases, as, for instance, where the heater is inadequate to do the work, where water is used which contains impurities which cannot be removed by boiling, or where no exhaust is available. Briefly stated, it heats the water up to the temperature of that in the boiler, and precipitates the scale on readily accessible and removable shelves before passing the water into the boiler at all. It consists of a heavy boiler iron shell, with removable heads, and contains a series of slightly inclined shelves or pans over which the water flows in direct contact with the live steam from the boiler. The water is heated to nearly the same temperature as that in the boiler, and when thus heated precipitates its impurities in the form of scale on the shelves. After thus flowing backward and forward the full length of the superheater several times, the water falls to the bottom of the superheater, which is arranged to act as a settling chamber, and retain the heavier particles of scale, mud, or sand, which may be carried over the shelves by the flow of water. The water then flows into the the lower settling chamber, which is so arranged that the water is drawn from a point half way between the surface and the bottom, thus retaining both the scum and any mud which may have passed through the first settling chamber. Suitable blow-offs and hand plates are provided.

The heads are provided with nozzles through which the interior may be easily examined. When the shelves have become coated with scale so as to interfere with the flow of water, the heads are taken off, and the shelves drawn out and cleaned. The bottom and the settling chamber should be washed out at same time.





FIGS. 1 AND 2. THE BARAGWANATH FEED WATER HEATER.

OPERATING EXPENSES OF THE LAKE STREET ELEVATED, CHICAGO.

A statement of car and train mileage has been compiled by the Lake Street Elevated company for the month of March. Administration expenses are not given. During the month salaries were paid, not by the Lake Street Railroad Company, but by the contractors, Underwood & Green, and so the figures given for March include operating expenses only. The total cost per car mile is shown to have been a trifle less than 6c. The operating expense of the Manhattan road in New York per car mile, according to Mr. Roche, is 18½c. This is in the face of the fact that the Manhattan road pays $4.06 per ton of 2,240 lbs. for coal, while the Lake Street road is paying $5.78 per ton of 2,000 pounds. The train mileage for March was 67,080, and the car mileage 241,785. Operating expenses are given as follows:

Engineers	$ 2,763
Firemen	1,635
Conductors	1,493
Guards	1.586
Fuel, coal, and wood	6,551
Stores, oil, and waste	90
Repairs, labor, and materials	276
Total	$14,408

The cost per mile run is as follows:

Wages per car mile	.0310
Fuel per car mile	.0271
Stores per car mile	.0004
Repairs per car mile	.0011
Total cost	.0596

A summary of car and train mileage for the month is given as follows:

Train run.		Mileage.
Five-car	1.252	34,265
Four-car	2,824	61,765
Three-car	8,502	131,927
Two-car	7,572	13,828
Totals	20,150	241,785

Sioux City, Ia.—The date for the sale of the Sioux City Street Railway has been postponed from April 25 to May 3.

THE NEW AMERICAN ENGINE.

We present herewith illustrations and description of a high grade automatic engine built by the American Engine Company of 75 Raritan avenue, Bound Brook, N. J. This company was organized in 1893 with a capital of $200,000 and purchased from the American High Speed Engine Company its fine plant.

The claims made for the new engine by the manufacturers are that it possesses the remarkable features of retaining all the simplicity of the single valve engine while distributing the steam as in the Corliss and other similar engines which give the highest attainable steam economy. Simplicity is always desirable in machinery, but is often sacrificed for complication to secure better results. Heretofore the consumer of steam power has had to choose between two evils, viz: the evil of complication for steam economy, or the evil of poor steam economy for simplicity.

Fig. 1 is a view looking at crank side of the engine, and shows a massive bed-plate with a square base to rest upon the foundation. The foundation is protected from oil and water by a bead which extends around the outer edge of the base and conducts the oil, etc., to a pit under the crank dish from which it is drawn out through a pipe and saved for filtering to be used again. The bed-plate from cylinder to main bearing extends above the center line of strains, ensuring rigidity and freedom from springing.

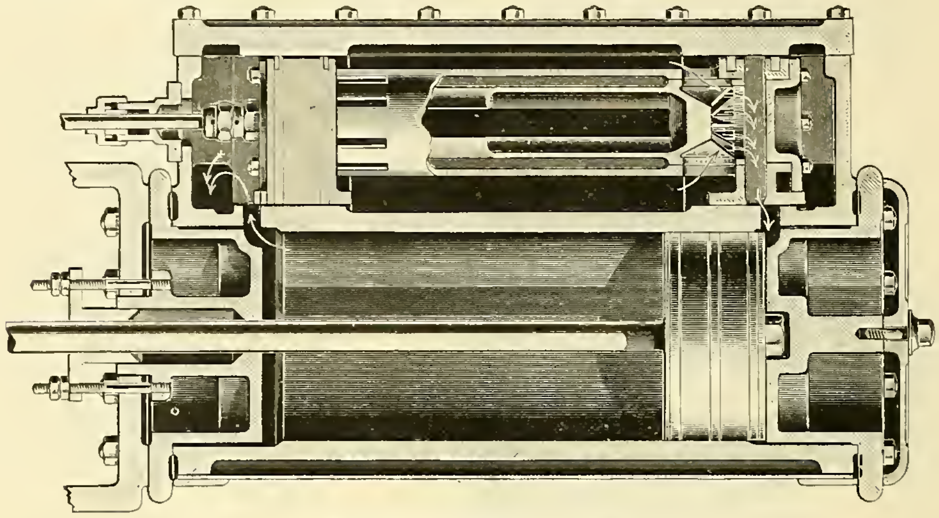


FIG. 3. SECTION THROUGH CYLINDER OF AMERICAN ENGINE.

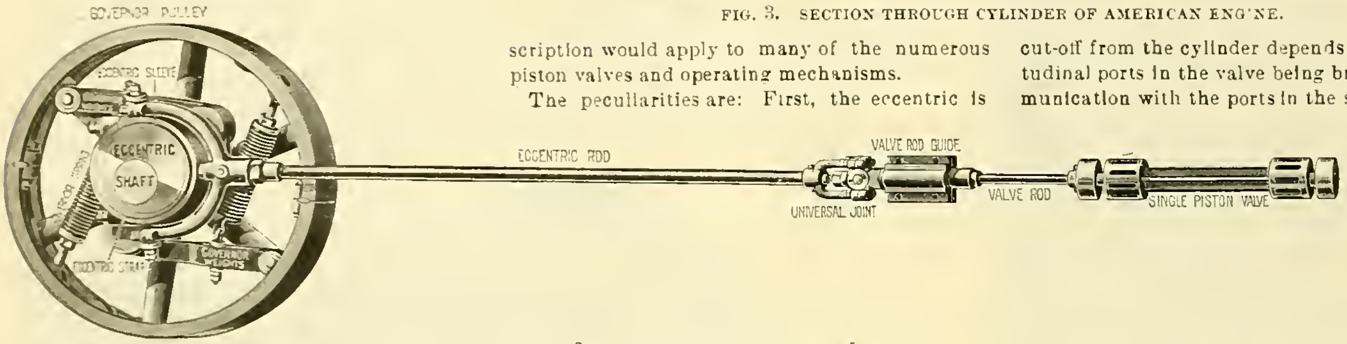


FIG 2. VALVE GEAR OF AMERICAN ENGINE.

Fig. 2 is a view of the valve gear and single piston valve having the usual annular ports, one at each end, which control the admission of steam to the cylinder—the release and compression being controlled by the ends of the valve. Thus the movement of the valve to control these actions is reciprocating, and is produced by the eccentric shown as it revolves around the shaft; the motion being transmitted to the valve by means of the eccentric rod and valve rod. So far this description would apply to many of the numerous piston valves and operating mechanisms.

The peculiarities are: First, the eccentric is fixed to the shaft, which makes the reciprocations of the valve invariable, thereby giving a constant admission, constant release, and constant compression: second, the automatically variable cut-off is produced as follows: In addition to the annular ports this valve is provided with longitudinal ports and corresponding ports are cast in the stationary sleeve which is within the steam chest. As the inner ends of the valve are closed, steam, in order to get into the cylinder, must pass through these longitudinal ports, and will so pass when the ports in the valve coincide with the ports in the stationary sleeve; and the flow of steam to the cylinder will be cut off when these ports do not coincide.

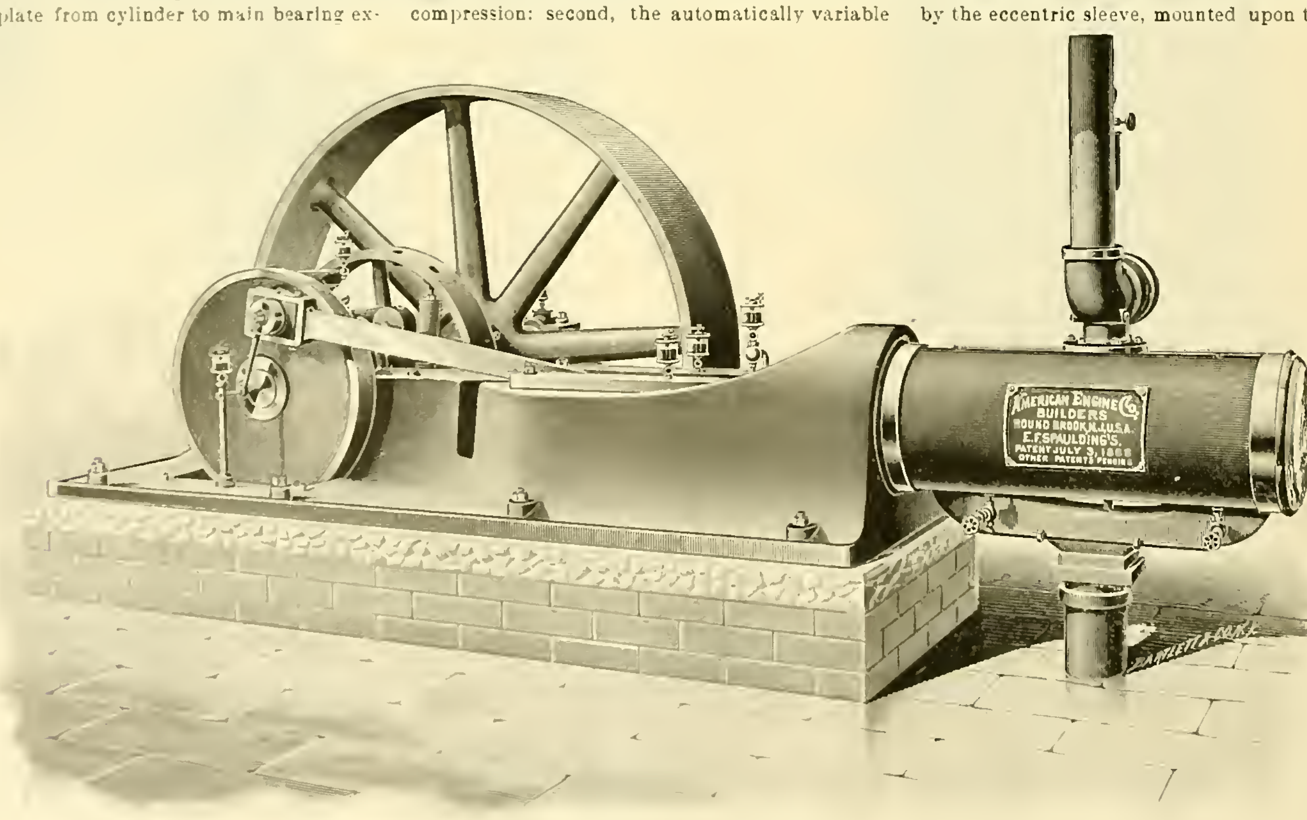


FIG. 1. SIDE VIEW OF AMERICAN ENGINE.

Therefore the admission of steam to, and the cut-off from the cylinder depends upon the longitudinal ports in the valve being brought into communication with the ports in the stationary sleeve and vice versa. This opening and closing of these longitudinal ports calls for a twisting motion to be imparted to the valve. This is accomplished by the eccentric sleeve, mounted upon the eccentric having a diagonal V-shaped groove turned in its periphery to which is fitted the eccentric strap. This sleeve is connected with the governor weights by links in the usual way of connecting eccentrics. As the sleeve revolves with the eccentric, being carried around by the governor weights, a twisting motion is imparted to the eccentric strap and through the eccentric rod and valve rod to the valve.

It will therefore be seen that the valve has two motions: one, an invariable reciprocating motion; the other, a twisting motion, which is invariable in degree, but variable relative to the reciprocating motion. This variation is accomplished by the rolling of the sleeve on the eccentric, whenever the governor weights change their position as a result of a change in speed.

Fig. 3. is a horizontal section through cylinder, and illustrates the construction of valve used in the horizontal engines. It consists of a flat face slide valve bearing upon a flat seat, against which it is held by the steam pressure. The valve travel is invariable, hence the wear upon its seat is uniform, and therefore the valve always remains tight. This valve controls the admission, release and compression, maintaining them constant; while the cut-off is variably controlled by a small cylinder valve within the slide valve as shown. This valve is provided with longitudinal ports, and corresponding ports are cast through the shell of the slide valve surrounding it; and the cutting off of the steam is accomplished by twisting or rotating the valve which opens and closes the longitudinal ports. No change whatever is required in the valve gear to actuate this valve.

The exhaust steam passes directly to an exhaust pipe cast on the under side of the steam chest, the ends only being joined to the steam chest so that the exhaust does not come into contact with any live steam surfaces except the ends of the main valve. The live steam is conveyed by a pipe into the steam chest through the top at the center, and is prevented from passing the ends of the valve to the exhaust by packing strips, one bearing against the steam chest cover, the other against the top of the steam chest, being kept in contact with these surfaces by the steam or by small springs when the steam is turned off. A corner piece is so constructed as to effectually close the joint where the packing strips meet at the corner. These strips are made of the same material as the valve, and are secured from moving away from the valve seat proper by a pin, but are free to move out of the groove in the valve (as wear may occur) against their bearing surfaces. The economy of small clearance space is fully realized in this engine, having but one short port at each end of the cylinder for the admission and eduction of steam.

Comments and Views of Contemporaries.

ACCIDENTS IN BROOKLYN DECREASING.—The number of trolley accidents has been lessened in some degree in the last two or three months from various causes. The motormen have become more expert, the cars are not run quite as rapidly as formerly, and the public has become educated to the point where they run no needless risks in front of cars. Safety appliances and new brakes, enabling motormen to have better control over the cars, also add to the safety of trolley operation in the streets of the city.—*New York Evening Post.*

CHICAGO STREET RAILWAYS.—Track enough to reach from Chicago to Manitoba; cars, which, if joined together, would make a train twenty miles long, with cables long enough to wind five times around it, and power enough to operate twenty such trains; 8,500 men whose lives are subserved completely to the necessity of being on time, yet who continually are late, who, as a body, are ruled and swayed by a scanty half dozen of other men, yet who, when taken individually, are autocrats themselves without exception, who are each one the king of an absolute, if small, monarchy, although at the same time obliged to obey the will of billions of their fellow citizens; 51,000 horses that labor all day and far into the night to reach a certain destination merely that when there they may turn round and plod back again; machinery enough to run the great water works of the city, with half a dozen locomotives thrown in; ropes sufficiently heavy and strong to relieve Atlas of his load, and enough oil to blow men, horses, cars, and all into the smallest possible fragments, if by any chance it should become ignited, not to mention the deadly currents of electricity which are controlled so easily by means of the insignificant-looking switchboard—all these things and personalities are needed, all are put into active use continuously by the various street car companies of the city that the people of Chicago may ride from their homes to the business districts and back again.—*Chicago Tribune.*

VESTIBULE LAW.—A judge in Springfield has decided that the law passed last year which required street railroad companies to inclose the front platforms of motor cars with vestibules, is unconstitutional. His reason is that he considers the law special and class legislation. We suppose that the case will be carried up to the court of last resort, and it would be premature, therefore, to regard this decision as settling anything in regard to the legal questions involved. The vestibule law is so similar to the laws requiring the placing of fire escapes on buildings and many other acts passed to protect persons employed in factories, on railroads, in mines, and elsewhere that the blow struck at the statute devised for the protection of street railroad employes can hardly be abandoned at the word of a single judge. If the street railroad companies are wise they will obey the law so loyally and fully, however, that there will be no occasion for further litigation. They can ill afford to win such victories as the Springfield judge has given them. Suppose that it were possible to overthrow in the courts, not only the present vestibule law, but any and all others which might be passed to take its place; would not the natural result be the punishment of the corporations which should rebel against humane and reasonable laws? Is it not in the power of the municipalities of Ohio to so deal with the companies enjoying special privileges in the public highways that they would be very glad to cry for peace? All of them ask for favors, from time to time, and none can afford to incur the well-grounded hatred of the public.—*Cleveland Leader.*

PROPOSED REDUCTION OF CAR SPEEDS.—The Senate Committee on Railroads is now considering a bill requiring surface roads operated by electric power in cities of less than 1,000,000 and more than 300,000 population to restrict their speed to six miles an hour or less. Brooklyn is not designated, but the proposed legislation under these limitations of population is meant to apply to that city. It is an open secret that this legislative project has been introduced in the interest of New York capitalists, who have obtained franchises and are operating elevated railways in Brooklyn. Their object is to reduce the speed of the electric cars now running on over four hundred miles of track in the city, and thereby to divert traffic to the elevated railways. With trolleys slower than horse cars, these capitalists and speculators would increase the value of their elevated railway stock and franchises. That is the main motive of this legislative raid against the surface railways in Brooklyn. Honest legislators ought to have nothing whatever to do with this measure. It ought never to be reported from the Railroad Committee.—*New York Tribune.*

INTERURBAN RAILWAYS.—The day has gone when a city can depend solely on steam railways as feeders. The possession of light electric lines also will soon be an absolute essential to continued prosperity.—*Toronto News.*

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

VACCINATION FOR WEST END EMPLOYES.—One of the largest corporations in the city to issue a compulsory vaccination order is the West End Street Railway Company and its appearance has created quite a little flurry among the men, especially the motormen and a few anti-vaccination cranks who are always ready to object. The road, as is well known, employs several thousand men, and quite a staff of doctors will be required to operate on the arms of so large a force. The work is to begin the present week and arrangements have been made to meet the contingency of many men being temporarily incapacitated. On one division of the road the men have made a little demonstration against the order by posting a big cartoon in one of the car stables showing a conductor held down by a policeman and doctor while the vaccine is being applied. Several of the men have talked of vacating their positions rather than be vaccinated.

LABOR TROUBLES SETTLED.—At last the trouble between the Lynn and Boston Railroad Company and its employes has been amicably settled, and the agreement that has been signed will be operative throughout the present year. Mutual concessions were made, the employes withdrawing their demand for $2.25 per diem as wages and accept $2. [The full text of the agreement is given elsewhere in this issue.]

NO WIRES TO GO UNDERGROUND.—The bill for compelling the placing of all electric wires underground in Boston and other cities of the state of Massachusetts has been adversely reported upon as "ought not to pass" by the legislative committee appointed to take charge of the matter. Many public hearings have been given; some personalities have been indulged in between counsel engaged, and a committee has made a tour of the country to make inquiries and examine the merits of various existing underground conduits for wires. The evidence they obtained in this way induced them to decide that it is not best to place electric wires underground. The West End Street Railway Company has made the most determined fight against the movement which is again in temporary abeyance. Public opinion, however, has been aroused on the subject and it is not likely things will long be permitted to remain as they were before the agitation.

BOSTON NOW WANTS A CONDUIT SYSTEM.—The subject of an underground conduit trolley system for electric street railways is engaging more and more attention in this territory, by reason of the fact that there is such a diversity of opinion as to whether Boston shall have an elevated railway or a subway. There are about half a dozen underground trolley systems being talked of already.

REVIVAL OF AN OLD PROJECT.—The building of a Trans-Connecticut electric railway is a movement of considerable importance that is engaging the attention of the directors of the Boston & New York Inland Railway, who meet this week at Middletown, Conn., to consider plans for the construction of an electric road across the Nutmeg state, a road that is to have neither grade crossings nor drawbridges. The bridges, where it would be necessary to cross rivers, would be built so high that vessels could pass under them. The company was organized some ten or fifteen years ago, but never did anything further in the way of development. At the time of the company's incorporation it went to the state legislature backed by the influence of the late governor, Marshall Jewell, and asked for a charter of a special character. The charter was not granted for the reason that the legislature regarded the undertaking as purely speculative. It was rumored about that time that a similar company was about to build a road in Massachusetts and connect with the projected road in Connecticut. Neither of the plans came to anything then, nor has anything further been done until now. The proposal is engaging a good deal of public attention.

MORE ADVERSE LEGISLATION.—As an outcome to the persistent opposition which street railway companies are too frequently encountering throughout this state, the following brief act relating to street railways has been introduced in the state legislature: "No board of aldermen or selectmen shall hereafter grant authority to any street railway company to locate its tracks upon any street, lane or highway of any city or town, or to operate its cars thereon by electricity, the cable system or by any other mechanical power, until such street railway company has filed with the clerk of such board of aldermen or selectmen the written consent, acknowledged in each instance as are deeds entitled to be recorded, of the owners of at least one-half of the land fronting on that portion of the street, lane or highway through which such location is granted."

STEAM ROAD CROSSINGS.—To obviate accidents a petition was recently presented to the Massachusetts state legislature in favor of a law to prevent the construction of any street railway operated by electric power across the tracks of any steam railway without the consent of the board of railroad commissioners or some other disinterested board. The petition was finally withdrawn to make way for a bill to be introduced by one of the representatives for Boston.

REMOVAL.—Since the electrical supply firm, the Pettengill-Andrews Company, organized a special department for handling every kind of railway supplies, they have found business expanding so rapidly that they are compelled to vacate their present quarters. They have leased the handsome brown stone block known as the Channing Building, corner of Franklin and Federal streets, and are having it altered to suit their requirements. They expect to move in a month or so.

Baltimore, Md.—Baltimore capitalists have formed a company to build an extensive electric railway system on the Eastern Shore of Maryland. The plans as outlined by the directors include the construction of nearly 40 miles of standard gauge electric road from Chestertown through Church Hill, Centreville and Queenstown, with a further extension to Wye Mills, Denton and Easton. The country through which the electric line will run is a great peach-growing section, but has been seriously affected by lack of transportation facilities.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

THE LOCAL MARKET for street railway stocks and bonds has chiefly been confined to the continued buying of the new Broadway consolidated 5 per cent. bonds, which now rule around 104¾ to 105. The demand for these securities comes from the best of investment sources. The buying is really a good indication of the favor with which the general investment public regards the securities of street railway companies. Only Broadway 5's are being liberally traded in, for the very good reason that these are the only securities that can be obtained. As an instance of how closely street railway stocks and bonds are held it may be noted here that Eighth Avenue Railroad shares within a week rose five points on the fulfillment of a single buying order. In the same way Dry Dock shares advanced when it became known that the investment brokerage houses had orders to purchase a block of the stock of this company.

A GENERAL ADVANCE.—The strength marking the quotation of these stocks has been participated in by the shares of all the local street railroads. Third Avenue Railroad shares are in particular demand; the new cable cars are earning from $40 to $60 per car a day, and the receipts are justifying the action of the management in substituting cable for horses. Work on the Lexington Avenue cable road of the Metropolitan Traction Company is makin: rapid progress; labor is plentiful and consequently cheap and the work is being pushed forward with astonishing rapidity. The same can be said of the Columbus Avenue cable line which is now nearing completion. How profitable the Ninth Avenue line will be when in operation can be appreciated when it is stated that the transfers to such of the Sixth Avenue cars of the same company as run above Fifty-ninth street number over 2,500 a day. This will give an indication of how great the traffic will be, when the Broadway cable connects with the new Ninth Avenue line.

BROOKLYN STOCKS have been somewhat depressed on the introduction into the Legislature at Albany of a bill restricting the speeds of street railways in cities of this state with a population between 250,000 and 1,000,000 to six miles an hour. This is aimed particularly at the trolley lines in Brooklyn and in favor of the elevated roads, as six miles an hour is practically less than the ordinary speed of horse cars. Long Island Traction stock has been particularly weak. The chief trouble with this stock is that there is too much. By reason of the over capitalization, whenever an attempt is made to move the price upward, reams of long stock are poured on the market, and the movement generally results in a net loss. The management, however, insists that earnings are not correctly diagnosed by the quotations, and they say that a quarterly statement to be presented next week by the Brooklyn City railroad, which is controlled by the Long Island Traction Company, will be the best in the history of the road.

PHILADELPHIA SPECULATION.—New York operators have taken a deal of interest in the tremendous speculation that has been going on in Philadelphia in traction stocks. The craze for the local passenger railway stocks has been growing for the last ten days, and as a result stocks like Electric Traction and Philadelphia are advanced $6 and $3 a share a day. Much gossip is current relative to the latter company. The market supply of this stock at present is very small, but it will soon be increased, as an early issue of several millions of stock is contemplated. The money is to be used in "trolleying" the various lines of the system. It is said $3,500,000 cash will be required. There is good authority for the statement that the dividend on Philadelphia Traction will be increased next month from 6 to 8 per cent. Metropolitan Traction also has scored a big advance to 116; the rise is mainly due to the scarcity of the stock and the great demand for it.

WEST END STREET RAILWAY COMPANY shares in Boston hold the rise to 50 remarkably well. The good statement of earnings helps the bull crowd a good deal. In March the gross earnings made a gain of about $23,000. The net increase, however, was considerably larger than that, because of reduced expenses. In answer to certain questions put by the street railway committee of the Massachusetts Legislature, the company has replied that all the stock of the company, amounting to $9,000,000, was issued to the stockholders at par, except $3,000,000, which was sold at $70, the par being $50. The premium amounted to $800,000, and this sum went to pay the cost of the change in motive power. Last year the company negotiated $3 000,000 5 per cent. bonds at par. A commission of ¼ of 1 per cent. or $7,500 was paid to the brokers. This year the company has negotiated $2,000,000 4½ per cent. 20-year debenture bonds. The price was from 91 to 94, the syndicate which took them getting them at enough under 94 to give them their profit. The company figured these bonds on a 5 per cent. basis, and the returns amounted to about the same as if the bonds had been sold at that price.

BALTIMORE TRACTION.—Hambleton & Co., the big Baltimore bankers, who are closely identified with the management of the Baltimore Traction Company, say that notwithstanding the severe competition now existing and which did not exist last year, the net earnings of the company for March were in excess of those of last year. Travel is beginning to increase and the daily receipts of the company are increasing. When the new lines now being pushed to completion are finished the receipts must be largely augmented.

WILL PAY A DIVIDEND.—It comes from Philadelphia that a dividend will be paid on Duquesne Traction stock in July. This is a Pittsburgh road.

A THREE PER CENT. DIVIDEND.—The Quincy and Boston Street Railway Company has declared a semi-annual dividend of 3 per cent. payable May 2.

A BIG DEAL.—Much the most interest in New York, however, has been taken in the reports current of a deal whereby the control of the greater part of the New Orleans street railways, which are now in the hands of a syndicate headed by the New York banking house of J. & W. Seligman & Co., is again to pass into other hands. It will be remembered that the system referred to was consolidated some time ago, and that it includes about three-quarters of the mileage of all the street railways in that city. It is now to pass into the hands of another large banking house, whose name it is not yet permitted to make public. The house is, however, one of the most prominent in Wall Street, and is connected by family and business ties with the largest capitalistic interest in the United States. This banking house has an interest in the present syndicate, but, becoming dissatisfied with the course of events, has arranged to obtain exclusive control of the New Orleans Traction Company, and will reconstruct it financially and also in regard to the *operation* of its finances. The reorganized company will have $2,500,000 preferred 8 per cent. stock and $15,000,000 common stock. The New Orleans Traction Company controls 16,171 shares out of the 20,000 shares of the capital stock of the New Orleans City and Lake Railroad Company. This company has issued $3,000,000 bonds, of which $2,583,500 have been turned over to the New Orleans Traction Company. The $416,500 bonds outstanding will be redeemed by salvage arising from sale of old cars, rails, etc. A sinking fund is to be established, which, after January, 1898, is to retire the bonds at the rate of $30,000 per annum. On the 3,829 shares of stock outstanding 8 per cent. will be guaranteed. The New Orleans Traction Company next owns 16,297 out of 20,000 shares capital stock of the Crescent City Railroad Company. This company has $120,000 bonds outstanding which mature between now and 1900. All the salvage from this road goes to the parent company, which guarantees 6 per cent. on the 3,753 shares of stock not owned by it. In addition to the above capitalization $3,000,000 bonds have been issued, and these are to be floated here in New York. The syndicate expects to secure control of the roads operating under the so-called Judah Hart franchises; it already controls 120 miles of street railways in New Orleans. The securities are to be listed on the New York Stock Exchange.

Financial Notes.

Earnings of Brooklyn Traction Company.—The quarterly reports of the companies comprised in the Brooklyn Traction Company will probably be ready next week. This will be of particular interest, as the quarter was the first in which the entire system was operated by electricity. A local paper has obtained information that the system will show a surplus over expenses, fixed charges and payments of every kind of about $25,000. For the same quarter a year ago the system showed a deficit of $25,000. This then shows an increase of about $50,000 for the last quarter. The earnings of the Atlantic Avenue Company for March were $17,182 greater than for the same month in 1893. This is the largest increase since the complete installation of the trolley. When it is considered that the past quarter is regarded by railroad men the worst in the year, this showing is admirable. Unofficial figures of the earnings of the Atlantic Avenue Railroad Company for the quarter are as follows:

	1894.	1893.	Changes.
Gross earnings	$204,514	$159,104	Inc.... $45,440
Operating expenses	144,224	170,909	Dec ... 26,684
Net earnings	60,320	*11,804	Inc.... 72,124

*Deficiency.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, of Chicago, said yesterday: "There has been a recession from the high prices of last week, but the movement has been healthy and we look now for another upward turn. There are evidences of good buying in the market. Street railway bonds are scarce and hard to buy but we look upon them as the cheapest and best investment in the market. Philadelphia and Metropolitan Traction have continued the upward movement this week both advancing about four points. There has never been any large amount of stock offered and the price has been advanced with comparative ease in both stocks. The Ridge Avenue line of the Philadelphia Company is expected to be running by the trolley next week. There has been a strong demand for People's Traction since the last payment of $3, making the stock now $17 paid in, but without any disposition to advance the price. Electric Traction, after an advance of 18 points to 70, has been rather neglected but around 66 there is some demand. The last call of $15 on this stock is payable April 15, which makes the stock full paid (par fifty). Any disposition in the general market to advance, will, no doubt, see the Tractions participate."

Westinghouse Business Increasing.—The Boston *News Bureau* says that the Westinghouse Electric and Manufacturing Company has been obliged to increase its night force on account of its large orders for railway apparatus. Work on the Niagara Falls machines is progressing rapidly, and that department has been running on double time the past two months. The same authority states that the Westinghouse Company has just closed contracts with the Consolidated Railway Company, of New Jersey, for all its equipment for the year 1894. It is believed that between 300 and 500 cars will have to be fitted this year for this company. A test of about 300 feet on the Westinghouse underground system for operating street cars has thus far met with gratifying results. It will be about three weeks before all of the apparatus is completed for all of the track.

Sale of the Washington (Pa.) Railway.—The Washington (Pa.) Electric Street Railway was sold to John W. Webster for $10,900 last week. The company went into the hands of receivers about a year ago and for the last six months the road has not been operated. Mr Webster, it is stated, is merely the nominal purchaser. The owners will be men of means in Washington. It is stated that one or two extensions will be built and at the small price for which the property was bought it can be made to pay. The old stockholders lose $39,000, the total amount of subscriptions; the directors lose $10,000 in addition to their losses as stockholders.

Earnings of the New England Company.—The New England Street Railway Company has declared its regular 1 per cent. quarterly dividend, payable April 16. Transfer books close April 13 and open April 17. The earnings of the company, while far below those of last year in gross amount, owing to the withdrawal of some of the companies in the combine, show, it is said, a larger percentage of increase now than then on the capital stock, and are on every road increasing month by month as compared with the corresponding months last year.

Traffic on Brooklyn Elevated.—During March of last year the daily average number of passengers carried by the Union Elevated railroad of Brooklyn was 600 greater than the average for February. In March, this year, the increase over the previous month was a little over 5,000 per day. This increase in the company's business is attributed partly to an improvement in its facilities, but is more especially due to a moderate revival of local manufacturing industries.

Kansas City Consolidation.—Articles of consolidation have been filed in the office of the secretary of state at Jefferson City, Mo., by the Kansas City Railway Company, of Kansas City; capital, $4,300,000. The consolidation includes the 9th Street, Independent Avenue, Troost Avenue and Summit Street cable companies, having a mileage of ten and a half miles, double track, and the Kansas City Independence Rapid Transit Railway, with a mileage of ten miles, double track. English capitalists are said to be interested.

Chicago & North Shore Trust Deed.—The Chicago & North Shore Street Railway Company of Chicago, has filed a trust deed on first mortgage gold bonds for $650,000, dated March 15, and expiring April 1, 1912. The deed is to cover bonds already issued amounting to $650,000 and future issues to aggregate not more than $1,500,000.

General Electric January Business.—The *Journal of Finance* says: "It is learned that the New York office of this company has done $23,845 worth of cash business per week since January 1, a total for the fourteen weeks of $313,830, or at that rate for the year $1,317,940. The railway department, it is said, took one order last week of $116,000."

New Incorporations.

Freeport, Ill.—R. S. Brown, of Easton, Pa., this week purchased the Freeport Street Railway in behalf of a syndicate composed of himself, Congressman Haines, of New York, and Congressmen Mutchler and Sibley, of Pennsylvania. They propose to convert the line into an electric road.

Green Bay, Wis.—The Fox River Electric Railway Company has been incorporated to operate an electric railway in Green Bay, Fort Howard, De-Pere and the town of Allouez; capital, $100,000; incorporators: Jas. H. Elmore, Adam Spuhler and F. A. Hollman.

The St. Louis Electric Brake Company, of East St. Louis, has been incorporated; capital stock, $2,-000,000; incorporators, J. L. Black, Samuel Rosh and W. V. Wolcott.

Akron, O.—The Akron Street Railway Company has been incorporated with a capital stock of $700,000.

NEWS OF THE WEEK.

Philadelphia, Pa.—The Suburban Railway Company of West Chester intends to construct an electric railway between Philadelphia and West Chester, which promises to be one of the most important of the several suburban electric roads which are planned to start from this city. A party of surveyors is out now selecting a route, and negotiations are going on with a construction company in reference to the building of the road. The company intends to construct a road in as direct a line as possible from a point near Market on the Western city line to West Chester, upon its own private property. In the view of the projectors of the road the use of turnpikes and country roads is objectionable because there is a limit to speed upon a road used in common by electric cars and teams. In order to be successful, an electric road between West Chester and Philadelphia must compete with the steam railroads, and to do this the line must be shorter than those of the steam roads. The proposed electric road, it is said, will be about 23 miles in length, and it is hoped to avoid grade crossings. The distance by the Central Division of the Philadelphia, Wilmington & Baltimore railroad to West Chester is about 27½ miles from Broad Street station, and by the Pennsylvania Railroad's main line, via Frazier, the distance is 30½ miles.

Lancaster, Pa.—The stockholders of the Lancaster & Philadelphia Electric Railway Company have elected the following officers: President, W. S. North, Mifflintown; secretary and treasurer, John J. Patterson, Jr., Mifflintown; directors, Dr. L. Banks and John J. Patterson, Mifflintown, and C. F. Espenshade and John S. Graybill, Lancaster. The work of building this line will be commenced within two months, starting at the Philadelphia end. The Lancaster & Littiz Electric Railway Company and the Lancaster & New Holland Electric Railway Company have just received their charters and will begin building operations without delay. The former line will be seven miles in length and the other will be thirteen miles long.

Toledo, O.—In his application to the town board of Carleton, Mich., for a franchise for the Toledo, Monroe & Detroit Electric Company, Dr. Gardner, president of the company, made the following statement: "The road will go through from the Boody House, Toledo, to the city hall, Detroit. It will be almost an air line, passing in the order named through La Salle, Vienna, Monroe, Frenchtown, Ash, Berlin, Brownstone, Taylortown, Dearborn, and then to Detroit, entering there on Fort street It will surely go, reports to the contrary notwithstanding, and will start with not less than ten daily trips. Tickets will be issued at one cent and a half per mile. Stops will be made anywhere when signaled, and it is expected to make the trip in two hours." The board postponed action on the franchise.

Gettysburg, Pa.—A bill in equity was last Monday filed before Judge McClean by the Gettysburg Battlefield Memorial Association asking for an injunction to restrain the Gettysburg Electric Railway Company from appropriating the Round Top extension of the Gettysburg and Harrisburg Railroad to form its continuous route and complete its circuits. The bill asks the court to enjoin said electric railway company from crossing with its tracks Hancock avenue, the property of the association. The time fixed by the court for a hearing is Wednesday, May 9. It was developed that this application was made by the Battlefield Association with the knowledge and approval of the United States Commission.

Pittsburg, Pa.—The Allegheny & Kiskiminetas Railroad Company has petitioned the council for a right of way from the borough line along Noble, North Canal, Clay, Sixth, South Main and North Main streets. If the right be granted work will commence within a year, and the line will be completed and in operation twelve months later. The company intends running the line from Tarentum to Pittsburg, and has already secured the right of way from Tarentum to Sharpsburg.

Toledo, O.—J. K. Tillotson, president of the Toledo, Maumee & Perrysburg Electric railroad, states that cars will be running on the line by June 1. All contracts have been let, and large gangs of men are now grading the roadbed. The Westinghouse Electric Company will furnish the motors and the electric apparatus. The Craighead Engineering Company of Cincinnati has secured the contract for overhead construction.

Tiffin, O.—Work has been resumed on the construction of the electric railway between Tiffin and Fostoria, which was stopped by the panic last fall. Twenty-five workmen commenced this morning grading the track at a point where operations ceased five months ago. The company will work from Tiffin westward, completing the track and trolley wire together, and will thus be enabled to run a construction train. An effort will be made to have the line in operation by Memorial Day.

Minneapolis, Minn.—President Lowry, of the Twin City Rapid Transit Company, addressed a letter to the common council a few days ago stating that the company was ready to comply with the terms of the Harvey ordinance, which provides that transfer tickets shall be issued at all intersecting points by conductors of cars. The council voted to discontinue the mandamus proceedings.

Boston, Mass.—Osborne Howes, a former member of the rapid transit commission of Boston, has recently published a long article describing his plan for solving the rapid transit problem. He discards the subway scheme and the elevated railroad plan and urges the advantages attending the construction of six double track underground roads centering at Music Hall. The tunnels would be built on the Greathead system.

Transfer Legislation in Massachusetts.—The committee on street railways of the Massachusetts legislature has reported a bill prohibiting street railways from withdrawing free transfer checks without the consent of the railroad commissioners. The whole question relative to transfer checks has been referred, by the same committee, to the railroad commissioners.

Dayton (O.) Contracts.—The City Railway Company of Dayton, O., has awarded contracts as follows: Fifteen car equipments to the General Electric Company; iron poles to the Electrical Railway Equipment Company of Cincinnati; trolley and feed wire to the Washburn & Moen Company; wooden poles, Brownlee & Co., Detroit.

Philadelphia, Pa.—It is announced that the Electric Traction Company will start the trolley cars running regularly on Tenth and Eleventh streets next week. It is the intention to run about 20 cars at first, and they will probably be started at night in order to give the motormen practice.

PERSONAL.

W. H. Bone, manager of the Walker Manufacturing Company of Cleveland, and H. McL. Harding, manager of the New York office of the company, were in Chicago this week.

TRADE NOTES.

The R. A. Crawford Manufacturing Company, of Pittsburgh, Pa., reports an active demand for its automatic wheel guards and pick-up fenders, for electric and cable cars. The company has secured contracts, among others, to equip all the cars of the Philadelphia (Pa.) Traction Company, the Williamsport (Pa.) Passenger Railway Company, the Citizens' Street Railway Company, Indianapolis, Ind., New Orleans (La.) Traction Company, Pittsburgh (Pa.) Traction Company, Duquesne Traction Company, Pittsburgh, Pa., Central Traction Company, Pittsburgh, Pa., the Citizens' Electric Traction Company, and the Pittsburgh & Birmingham Traction Company, of Pittsburgh, Pa. It is reported that since February 1 seven lives have been saved by the wheel guard, and three by the pick-up fender. Of these ten, three were children of four, five and nine years old, respectively, one a boy, one a man, and the other five, a party of boys on a sled. For the first quarter of 1894, ending April 1, about 1,100 machines were made and delivered; for the second quarter of 1894, the company expects to double this number. Outside of the United States, inquiries have been received from France, Belgium, Australia, Switzerland, New Zealand and England.

The Purity Oil Filter Manufacturing Company, of Pittsburg, Pa., shipped on February 28 and March 15, to the Market Street Railway Company of San Francisco, its Ideal steam oil refiner. These orders make four sales to the same company in twelve months. The Ideal refiner is used on ever street railway in San Francisco. The company's business since January 1 has improved very much. Four of the largest sized refiners were sold recently to the Carnegie Steel Company for its different works. On the third of this month, the company had received as many orders during April as in some entire months between June, 1893 and January, 1894. Inquiries are coming in more rapidly than they have for many months. Many unsolicited testimonials have been received, among them, one of special interest from the Metropolitan Street Railway Company of Macon, Ga.

The United States Projectile Co., of Brooklyn, N. Y., is meeting with considerable success in the introduction of its patent hot pressed steel motor pinions. Thousands of these are now running, and they are used exclusively on some of the largest roads in the country. They are also being adopted by some of the largest manufacturers of electric motors. The Brooklyn City Street Railway Company recently purchased a large number of new motors, specifying in the order that only the hot pressed pinion should be used. This road has over a thousand of these pinions in use, and will use no other. Mr. C. S. Knowles, of 7 Arch Street, Boston, is the selling agent, and to him all inquiries should be addressed. The General Electric Company has decided to adopt the hot pressed pinion, and last month an order was placed with the company for 1,000 pinions.

Warren Webster & Co., of Camden, N. J., manufacturers of vacuum feed water heaters and purifiers and oil and steam separators, report that the number of orders they received for the above-named specialties, during the month of March, was very satisfactory and showed a marked improvement over the few former months. They say that the reason that their specialties sell during these hard times is on account of their goods being fuel saving devices. Rapid progress is being made upon the extension of their wrought iron department, connected with the new works, which they just built last year. They visit steam plants at their own expense, and back their guarantees by cash indemnity.

The Campbell & Zell Company, of Baltimore, Md., has recently closed a number of important contracts, among which may be mentioned Citizens Street Railway Company, Indianapolis, Ind., 1,500 H. P.; Kent & Stanley Company, Providence, R. I., 400 H. P.; Val. Blatz Brewery, Milwaukee, Wis., 1,164 H. P.; T. Marshall Smith & Co., 100 H. P.; Baltimore Water Department, Baltimore, Md., 430 H. P.; Wm. Henderson, New Orleans, 317 H. P.; Keiffer Bros., New Orleans, La., 50 H. P. The company has in preparation a new catalogue which it is expected will be ready for distribution in a very short time.

The White-Crosby Company has been organized for the purpose of broadening the scope of the business formerly conducted by J. G. White & Co. The main office of the new organization will be in the Equitable Building, Baltimore, Md., while other offices will be maintained at 29 Broadway, New York city, and in The Rookery, Chicago. O. T. Crosby, formerly head of the railway department of the General Electric Company, is president of the new organization; J. G. White, vice-president; G. H. Wallbridge, secretary and treasurer, and A. G. Greenburg, manager of the New York office. The company will do a general consulting and contracting engineering business.

The International Register Company of Chicago is now located in its new quarters at 195 and 197 South Canal street, its business having completely outgrown the shop room and facilities of its former location on Dearborn street. The company's new quarters are perfectly arranged, the shop being equipped with first-class machinery adapted to its special line of work, thus giving the company unsurpassed facilities for turning out work of the highest standard. Mr. A. H. Englund, the enterprising manager, reports having secured some nice contracts for registers and is preparing for a large business this season.

The New Castle Car Manufacturing Company, of New Castle, Pa., since its machinery building was destroyed by fire, has not only constructed a new building for the machinery plant, but also a new brick and iron boiler and engine house, and a new painting and finishing room, 150x40 feet. A new boiler and a new M. A. Green engine have been put in place, and the new machinery building is equipped with a complete line of new woodworking machinery of the latest designs. The shops are again running under full headway, and the company's officials report a good outlook for the work of the coming season.

The Page Belting Company, of Concord, N. H., suffered a severe loss early in the month by the burning of its tannery. The curry shop and new belt factory, however, were unharmed, and as the company has sufficient stock on hand to enable it to keep the manufacturing department running, the business will not be interrupted. All orders will be filled promptly. Steps have already been taken towards rebuilding, and as soon as plans and specifications can be secured, new buildings will be erected.

The Dorner & Dutton Manufacturing Company, Cleveland, Ohio, has recently received a number of good orders for electric motor trucks. The officers of the company are of the opinion that the street railway business is rapidly improving. They expect soon to be as busy as they were at this time last year. In fact, at the present time, they are doing a larger business in electric motor wheels than they did a year ago. A special design has been made, which is reported to be giving excellent results.

The Buckeye Engine Company, of New York City, has removed its office from 18 Cortlandt street to 39-41 Cortlandt street, where larger and more commodious offices will be at its disposal. In addition to the company's regular line of plain, tandem compound, cross compound and triple expansion horizontal engines, special attention is called to its new vertical compound engines for electric light and railway service, ranging from 150 to 1,200 H. P.

W. H. Fleming has severed his connection with the International Trading & Electric Company. The Manhattan General Construction Company, of 50 Broadway, New York, and 753 Monadnock Building, Chicago, has made arrangements with him to act as selling agent for his patent woven wire gauze dynamo brush. All orders and inquiries relating to prices and sizes of brushes in stock ready for immediate delivery should therefore be addressed to them.

The Safety Brake Shoe Company, of Boston, Mass., contemplates the manufacture of its shoes at a point further west in the near future. Orders are increasing fully as fast as the company can take care of them with its present facilities. A mail order recently received from a western city was for 500 of the company's safety brake shoes, and a number of other western orders for 100 each have been received unsolicited.

A. L. Ide & Co., of Springfield, Ill., report recent sales of twenty-four engines, mostly for electric light and power purposes, for plants in Missouri, Illinois, Minnesota, Michigan, Colorado, Vermont and Arizona. Several of these are equipped with the Ideal power transmitter.

Nellel, O'Connor & Co., of New York City, began work this week on the 135th Street line of the Union Railway Company, the first trolley line in New York City. The construction work on all the Mt. Vernon lines has also been undertaken by the same firm of electrical engineers.

J. Jones & Son, of 39 Vesey street, New York City, have purchased from the receiver for Alexander, Barney & Chapin, the balance of the stock now in his hands at 67 Cortlandt street. The stock was valued at over $10,000.

Pepper & Register, of Philadelphia, are employing a novel form of construction for the Electric Traction Company's work, which consists of staggered brackets throughout the entire route, using oil insulators.

The Brown Electric Company, of Boston, Mass., reports business in good condition. The company has considerable railway business in sight for the immediate future, and considers the general situation greatly improved.

A. Groetzinger & Sons, of Allegheny, Pa., report a brisk and steady demand for Dermaglutine pinions. They have recently taken several large southern and western orders.

The Davis Car Shade Co., of Portland, Me., has secured the contract for equipping 250 cars for the People's Traction Co., of Philadelphia, with its patent shades.

E. F. Plummer, who, for the past eight or ten years, has been manager of the Chicago store of Goodell & Waters, is now manager of the New York store of the Berry & Orton Company, at 114 Liberty street.

RECORD OF STREET RAILWAY PATENTS.

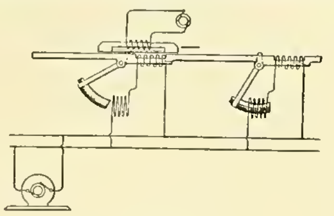
Patents Issued April 3, 1894.

517,531. Induction Electric Railway. Charles E. Roehl, St. Joseph, Mo. Filed May 4, 1893.

In an induction railway system, a road bed provided with a magnetically continuous iron core separated from but extending parallel to the tracks, and a series of primary coils located upon said core, in combination with a moving vehicle carrying a secondary core and coil in inductive relation to said primary core. (See illustration.)

517,535. System of Elevated and Surface Railways. Charles H. Barrows, Willimantic, Conn. Filed May 17, 1893.

In a railway system, an elevated track having the broad girders and central guide rail which accommodate respectively the flangeless traction wheels and flanged central



NO. 517,531.

wheels of a car, and a single surface rail adapted to receive the flanged wheels of a car provided with traction wheels. (See illustration.)

517,549. Conduit Electric Railway. Willie C. Keithly, San Francisco, Cal., assignor of one-half to Jo. Gordon and Herbert F. Dugan, same place. Filed September 17, 1892.

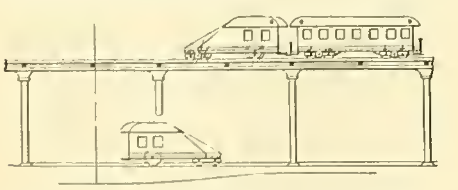
In an electric railway, the combination of underground conduit the wire covering and a hanger for said wire, said hanger consisting of tube wire flange, the upper portion of said tube being made of rubber, spring and means for securing said hanger in said covering.

517,551. Combination Railway Rail and Joint. William H. McCormick, Kalamazoo, Mich., assignor of one-half to Henry A. Klunie, same place. Filed May 26, 1893.

This is the combination of the tread-parts and base-parts provided with their webs and channels and detachably bolted together, the joints between the ends of the tread-parts alternating with the joints between the ends of the base parts, the contiguous ends of said tread parts being provided with the open mortises communicating with the channels of said tread-parts, and the tongues in said mortises resting upon the webs of the base-parts.

517,565. Motor Car Truck. William A. Dutton and Jacob F. Pfetch, Cleveland, Ohio. Filed November 20, 1893.

This comprises the side bars for car trucks having the journaled yokes integral therewith, and the ends of said



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bars bent inclinatorily upward, for supporting the elliptic springs on a higher plane. (See illustration.)

517,571. Car Truck. James L. Hardie, Chester, Pa., assignor of one-half to John J. Leary, same place. Filed May 16, 1893.

In a car truck a frame comprising the side bars composed of two sections with a space between, the cross bars connecting the side bars and supporting the brake mechanism, springs located centrally of the frame, sills located above the side bars, and levers pivoted between the sections of the bars having their outer ends connected with the ends of the sills and their inner ends with the springs. (See illustration.)

517,601. Car Brake. Henry B. Cary, Los Angeles, Cal. Filed June 15, 1893.

In a car brake the combination of shoe frames carrying shoes which are adapted to unitedly engage the track and the wheels, a crank shaft having cranks near the opposite ends thereof, which directly pass through the upper parts of said shoe frames and means for operating said crank shaft.

517,621. Insulator. Louis McCarthy, Boston, Mass. Filed July 15, 1893.

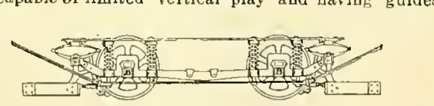
This is an insulator comprising a case, metallic portions placed within said case and separated from each other by an interposed layer of insulating material, a flange on said case extending inwardly therefrom and having a thin or feather edge, a series of sheets of mica outside said flange on one of the insulated metallic portions and in contact around said metallic portion with the insulating material within the case, and a nut or washer on said insulated metallic portion.

517,634. Pin for Insulators. George H. Winslow, Pittsburg, Pa. Filed October 25, 1893.

This comprises the combination of an insulator, a pin, said parts being provided with suitable devices whereby they may be secured together or detached one from the other by a rotation of one of the parts, and a support for the pin, the latter being so secured to the support as to be capable of rotation.

517,638. Car Fender. Carl P. Anderson, Boston, Mass. Filed November 25, 1893.

This is the combination of a substantially horizontal slideway on the car and a fender engaging said slide-way and capable of limited vertical play and having guides



NO. 517,565.

which tilt its forward end downward under a rearward movement of the fender in the slideway. (See illustration.)

517,660. Girder Joint for Railroad Rails. James M. Price, Philadelphia, Pa., assignor of one-half to the Price Railway Appliance Company, of Pennsylvania. Filed March 23, 1893.

This is a girder joint for meeting rails consisting of a vertical plate with a raised center, a horizontal groove forming a jaw, and feet, arches connecting the inner end of the said feet, and a bench depending from said jaw, said parts being combined.

517,664. Electrical Switch. Ernst Ruebel, St. Louis, Mo., assignor to himself, Sherman B. Pike, and William N. Matthews, same place. Filed September 9, 1893.

In an electrical switch, the combination with a swinging contact arm formed with an axle of irregular shape, of a spring contact located in juxtaposition to said axle and adapted to contact therewith when said axle is in certain of its positions, and rigidly mounted contacts with which said swinging arm is adapted to co-operate and make circuit when the spring contacts are in electrical contact with the irregularly shaped axle.

517,692. Conduit Electric Railway. Herbert A. Gorham, Decatur, Ill. Filed August 14, 1893.

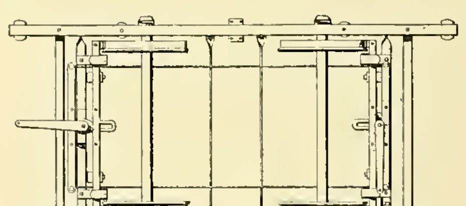
This is a conduit for the trolley wires of electric cars, comprising a trench, a conduit extending along the upper portion of the trench, a central rib, or upward extension, in the conduit, supporting, and insulated from, the trolley wire, slotted grates covering the conduit and communicating with the trench, such grates being separated sufficiently to form a slot for the trolley, and valves in the lower surfaces of the conduit.

517,743. Electrically Operated Railway Switch. William S. Gavey, Brooklyn, N. Y. Filed April 1, 1893.

In an automatic electric switch the combination, with a railroad having a plurality of sidings, of a swinging switch rail at each siding, electromagnets arranged to swing the rails, shunt wires for each switch, the wires being in connection with the switch magnets and in different vertical planes, an overhead wire carrying electricity, trolleys carried by the cars to engage the overhead wires, and contact pulleys which are adjustable along the trolley shafts and thus adapted to contact with different shunt wires.

517,749. Underground Conduit Railway. Wilton F. Jenkins, Richmond, Va. Filed August 8, 1893.

This comprises in an underground railway system, the combination of a conduit, yokes passing under the conduit, longitudinal surface rails resting upon the ends of



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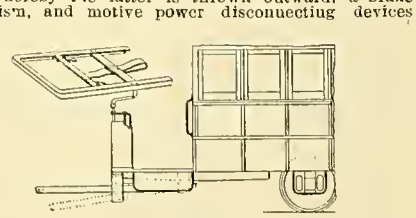
the yokes at right angles and a downwardly drawing screw clamp connection provided with double claws for grasping both sides of the rail base and adapted to be applied laterally to the yoke for fastening the yokes to the rails at any point along their length without the use of bolts.

517,798. Car Fender and Automatic Brake. William L. Fitzhugh, Baltimore, Md., assignor, by direct and mesne assignments, to the Russ Car Fender Company, of West Virginia. Filed December 8, 1893.

The combination of a pilot board adapted to yield when engaged by an obstruction on the track, a lever adapted to be positively operated from an axle of the track, a releasing and clutch mechanism actuated by the yielding of the pilot board to operatively connect the said lever with the axle, connections between the said lever and the pilot board whereby the latter is thrown outward, a brake mechanism, and motive power disconnecting devices



NO. 517,638.

actuated from the said lever, simultaneously with the outward movement of the pilot board.

517,804. Conduit Electric Railway. Wilton F. Jenkins, Richmond, Va. Filed August 10, 1892.

This comprises the combination with a conduit, of a horizontally projecting arm consisting of a metal core having its sides and end completely covered or incased in a non conducting material and bent to form depressions and conducting wires laid loosely upon said arms within the depressions.

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CONTENTS.

Institute Election. The ballots for the annual election of the American Institute of Electrical Engineers have been sent out to members, and as many electric railway men are interested in the society, we desire to call attention to the importance of voting for desirable officers. Scores of names are given from which to select, so that there should be no difficulty in making a suitable choice. The "council ticket" is in no sense an official ticket, but has been arranged to suit the best interests of those who have controlled in a most unsatisfactory and high-handed way the affairs of the Institute and its publications during the past year. This same party or clique—for such it is—came into office one year ago by a trick which savored very strongly of fraud, and have again sought in this "council ticket" to perpetuate their rule. During the year the holding of local meetings has been opposed most bitterly, papers rejected by the proper committee have afterwards been "railroaded" through and passed for publication in the *Transactions*, and in one instance a paper was refused by the Institute, and in spite of this fact, was accepted for publication by the council which now seeks, so far as possible, to perpetuate itself. Let the Institute make such changes at least as will give it a set of officers that are honest and above suspicion.

Maintenance of Pavements. Elsewhere in this issue we publish a brief article dealing with this subject, in which it is sought to prove that the addition of a street car track in the center of a street of itself greatly increases the cost of maintaining the pavement of that street. The figures, however, are based upon the false assumption that the traffic remains constant and continues the same after as before the laying of the street car track. A little reflection will convince anyone that such is not the case. The result of laying a street car track through a street is that more residences and stores are erected along the line and business along the street increases. Traffic therefore increases not only because of these facts, but because teaming that was formerly done on side streets seeks the better facilities for travel along the tracks of the railway company, which afford a much more desirable roadway for vehicle wheels. A case of this kind recently came under our own observation, and doubtless similar cases will occur to many of our readers. In a large western city which has many miles of railway tracks laid through its business streets, it became necessary for the railway company to tear up a short section of its tracks for repairs, at the same time diverting its cars and all vehicular traffic that ordinarily followed its rails to an adjacent street. Although the roadway, aside from the car tracks, was in no way blockaded, the traffic of the street dwindled to an insignificant part of its former volume, and the merchants along the line besought the company to make haste with its repairs so that the normal conditions of vehicular traffic might be restored. That the laying of car tracks in a paved street increases the cost of maintenance of pavement there can be no doubt, but there is plenty of evidence that this is due very largely to the increased vehicular traffic thus attracted to the street, instead of to the mere presence of the rails in the center of the highway.

Underground Feeders. A few weeks ago we directed attention to the contest in Boston between the West End Street Railway Company and certain people of that city who were endeavoring to secure the aid of the legislature to compel the railway company to place its feed wires in underground conduits. At the present time the contest is even more interesting and instructive than it was four weeks ago; interesting, because it is a question that will sooner or later be brought up in all large cities, and instructive because of the unreasonable demands made by ignorant aldermen in their anxiety to force the railway company to comply with their demands. While the proposed bill was under consideration by the legislature, the Boston aldermen took the matter up and passed almost without consideration an order requiring the company to place all of its feed wires and return circuits underground before November 15 of this year. A similar action was proposed for all other wires in the city, but the railway company alone was singled out as the object of aldermanic disfavor while the order relating to other wires was referred to a committee. The West End Company must prepare before May 15 plans for a satisfactory system of burying the wires. When it is considered that the company has about 400 miles of feeder lines and that the order would, if executed, require the construction of 50 miles of conduits at a cost of perhaps $2,000,000, to take President Little's estimate, it will be seen that compliance with the demands of the aldermen is a practical impossibility. All these facts, however, appear to indicate that the order is intended solely for stock jobbing purposes, and this view is strengthened by the statement of President Little that strict compliance with its provisions would mean a cessation of dividends on the common stock for at least three years. In legislation of this kind the Boston aldermen are perhaps not less skillful than those of most large cities where similar opportunities exist. To reasonable legislation of this character the West End Company would offer no serious objection. The bill before the legislature, which will probably be passed, gives the company six years for the performance of the same work which the aldermanic order requires shall be accomplished in about seven months.

Electrolytic Action. No subject dealing with the operation of street railways has been more prominent in the past year than that of the destructive action of electric railway return currents upon gas pipes, water pipes, and lead covered cables, lying underground in the vicinity of the railway company's tracks. A number of excellent papers have appeared treating of this subject, but up to the present time, none has dealt with it more thoroughly than W. Nelson Smith in a series of articles published in the STREET RAILWAY GAZETTE about two months ago, and J. H. Vail in a paper read before the National Electric Light Association at its Washington meeting, and published in full in our columns early in March. Another exhaustive contribution to the subject is presented in our columns this week. This paper has been prepared by a telephone man who has for a number of years taken a commercial interest in the subject, and has made experiments, and collected much valuable data. Mr. Farnham, therefore, has written very largely from the point of view of the opponent of the grounded return for electric railway circuits. His paper presents some very interesting facts and figures, and makes some valuable suggestions. Irrespective of any slight injuries that may occur to the pipes of gas, water and telephone companies through electrolytic action, we believe that by far the most important reason why electric railway companies should give attention to this matter, and in whatever way possible cure the evil, is that it would very materially reduce operating expenses, make the system more efficient, and thus increase the net earnings. It is merely a matter of engineering calculation as to how much current is wasted by failing to provide a proper return circuit for the electric railway currents. One side of the circuit, that is, the feed wires, has been given a great deal of attention and the amount of copper required to produce economical results calculated very accurately; while on the other hand, the return circuit has been allowed to have a very much higher resistance, to say nothing of its *variable* conductivity, and has been generally neglected, on the theory that when a current once reached the earth, it could take care of itself, and could without difficulty find a path of lower resistance than could possibly be provided by artificial means. It is now very generally understood by engineers, however, that such shiftless methods of construction are exceedingly uneconomical, that a return circuit of high conductivity must be provided, and that very great improvements in former methods of bonding must be adopted in order to avoid not only the destructive effects on the property of outside interests, but to prevent the very large waste of current (and therefore coal) which is the necessary result of poor construction. Mr. Farnham's paper, printed in this issue, was read before the American Institute of Electrical engineers at its New York meeting on Wednesday of this week. The same paper will be read before the Chicago meeting of the Institute on Wednesday evening of next week at the Armour Institute. The same lantern slides will be used and the same exhibits of damaged and corroded pipes and cables will be shown, and it is hoped that all street railway men who are interested in this important subject, will take the opportunity of attending the meeting and contributing to the discussion.

THE KANSAS CITY CONSOLIDATION.

In the last issue mention was made of the consolidation of the Kansas City Cable Railway Company, the Grand Avenue Cable Railway Company and the Independence Rapid Transit Company, of Kansas City Mo. The new company which is to be known as the Kansas City Railway Company, is capitalized at $5,000,000. Walton H. Holmes will be president, Daniel B. Holmes secretary, W. B. Clark treasurer and Conway F. Holmes general manager. The directors will be Webster Withers, Frank C. Wornall, G. W. Clawson, R. W. Hocker and Louis C. Krauthoff.

The consolidation was brought about through the efforts of Walton H. Holmes, and the money necessary to purchase the controlling interest in the Kansas City Cable railway was supplied through Robert Fleming of the First, Second and Third Scotch-American Trust companies of Dundee, Scotland, the British Investment Company of Edinburg, and the Investment Trust Corporation of London.

The new company owns and will operate about sixty miles of cable and electric railway. Its tracks weave a network all over the eastern and southern portions of Kansas City, and concentrate in a trunk line on Ninth street, from Ninth and Walnut street to the Union depot and extends to Independence, Mo. It is understood that transfer arrangements will be made so that persons can go from any one part of the system to another by payment of one fare, so far as the city lines are concerned.

The details of the purchase of the properties have not been disclosed. It is stated that the control of the Kansas City Cable Railway Company was obtained by the purchase of the stock of the president, W. J. Smith, and that of several Eastern holders. The price at which it was secured was $105 according to report, and over a million dollars in cash was paid to these gentlemen.

The other holders of stock in the Kansas City Cable were offered bonds and preferred stock of their shares. For each $100 worth of stock each stockholder was to receive $90 in 6 per cent. bonds and $10 in preferred stock, non-cumulative. The bonded indebtedness of the Kansas City Cable, of course, was to be assumed by the new company. In accordance with an agreement with the stockholders of the Grand Avenue Cable company their stock was to be exchanged for preferred stock, 6 per cent. non-cumulative. The stockholders of the Kansas City and Independence Rapid Transit railway, were given common stock in the new company. For every two shares in this road the stockholders were to receive one in the new corporation. The bonds on this line were scaled down to 60 per cent. also. Besides, there was a considerable amount of money to be provided for re-equipping the dummy line with electric cars and for other necessary expenses of reorganization.

ELECTRIC RAILWAY INVESTMENTS.

In regard to the tendency of capitalists to invest in electric railway properties the Philadelphia *Stockholder* has this to say:

"The amount of money that has been invested in electric roads, if it could be accurately computed, would unquestionably reach enormous proportions, more, indeed, than has been invested in new railroad projects. The boom has been as general as it has been protracted, and instead of showing any sign of diminishing, it seems to gather renewed strength every day. New lines are being constantly projected, and there appears to be little difficulty in capitalizing them. The money to build and equip such lines is, in fact, apparently more readily forthcoming than are funds for old established railroads, and investors now give preference to the securities of the former over those of the latter. The cause for this change of sentiment is not difficult to name. The large number of railroads which passed into the hands of receivers last year, and the additions made to that list so far this year, together with the developments in connection with these receiverships form the principal reason for the desertion of capital from railroad companies in this country. And it depends upon the companies themselves how soon confidence shall be restored in their managements. Nothing has developed so far this year to win back the confidence of investors; on the contrary, there has been among the companies continual wrangling, rate-cutting, and other demoralizing factors, all tending to adversely affect earnings. The showing made by earning is the ground on which security holders reckon the efficiency of a management; while this may be unjust in many cases, it is, however, a fact. For the present, therefore, we may expect to see a continuation of the favor in which securities of electric railway companies are held. They are a new departure—large earners apparently—and as long as they shall show favorable net results they are likely to retain their popularity among investors."

PHILADELPHIA-HARRISBURG ELECTRIC RAILWAY.

It has been heretofore announced that the Pennsylvania Traction Company would build an electric railway from Harrisburg to Philadelphia, but up to the present time no details of the project have been furnished. It is now stated that the line which will be 100 miles in length, will be built with four tracks of which the two inner will be for high speed traffic and the other two for the local service. The road will follow a private right of way seventy feet in width and will be stone ballasted throughout. Starting from Harrisburg the line will run through Steelton, Middletown and Mt. Joy, to Lancaster, there to connect with the lines of the Lancaster Traction Company.

From Lancaster the line will run to Coatesville, passing through the numerous small places between those two thriving towns. From Coatesville the route will be direct to West Chester and then to Philadelphia, where connection will be made with one of the Traction systems.

Branches will be constructed from Coatesville to Downingtown, and along the line of the Pennsylvania Railroad near Philadelphia, to the more important places, such as Frazer, Wayne, Bryn Mawr and Ardmore. The branches will be constructed with double track. The through cars will make only one or two stops between Harrisburg and Philadelphia, probably at Lancaster and Coatesville, but the local cars will probably stop in the country districts, at stations placed closely together at convenient points. In the towns they will stop on signal, as is usual.

The cars to be run on the road will be vestibuled, and it is said will be of unusually handsome finish. Those intended for the high speed service will be 68 feet in length and will be provided with smoking room and baggage compartment. The cars for the local service will not be different from those designed for ordinary street railways. The through cars will probably run either every hour or every half hour, and this speed will be from 40 to 50 miles an hour. These cars will be mounted on double trucks and power will be supplied them by four 40 horse power motors.

The question of power has already been very seriously considered, but no decision has yet been reached. It is possible that a polyphase transmission system will be adopted; in that case only one power station will be required. The company has already consulted with the Westinghouse Company regarding the practicability of installing polyphase apparatus. It may be thought that such a departure from existing electric railway practice would scarcely be conservative and if this decision is reached, it will be necessary to construct several power plants along the line.

No time has yet been fixed for the beginning of work, but it is not unlikely that a considerable portion of the road will be ready for operation within a year. A gentleman who is well acquainted with the company's plans said recently:

"The Pennsylvania Traction Company has connected with it some men of very large experience in railroad matters. This scheme, when first talked of, was considered a little wild, but when analyzed it shows how possible and feasible the scheme is, and when built it will demonstrate beyond a question the practicability of long-distance electric roads. It is surprising the number of followers that this company has secured and the amount of encouragement it has received, particularily when, but a short time since, the plan was thought to be inoperative.

"The scheme has attracted wide attention, and while there are other schemes that have been mentioned, nothing has been as yet accomplished by them, while this is a thing of life and is being pushed to its utmost. The surveys have all been made, and some of the contracts awarded, and it will not be surprising that within 18 months it will be possible to step on an electric car in Philadelphia and be in Harrisburg in three hours."

ELECTROLYSIS IN PEORIA, ILL.

One result of electrolytic effects of street railway currents is shown in the following official notification of the Peoria Water Company, to the Ft. Clark Street Railway Company of Peoria. The formal letter of complaint is here given in full:

Peoria Water Company, Peoria, Ill., April 6, 1894.—To the Ft. Clark St. Ry. Co., Peoria, Ill.—*Gentlemen:* You are hereby notified that the Peoria Water Company for a long time past has been, and is now, daily suffering and sustaining great injury and damage to its lead and iron pipes and other underground property in the streets and alleys of Peoria; that it is put to great labor, expense and trouble in making and keeping up repairs on its said pipes by reason of the improper and wrongful use by you of the ground as a return conductor for electrical currents; and by the illegal, careless and improper use of electrical currents generally by you.

You are also notified that by reason of such improper, wrongful and illegal use of electrical currents by you, the Peoria Water Company is not only suffering great loss and expense in connection with its lead and iron pipes and other underground property, but it is greatly hindered, delayed and injured in the conduct of its business, the furnishing of water to the city and citizens of Peoria, Ill.; and if such improper, illegal and wrongful use of electricity and electrical currents is continued by you it is only a question of a short time when this company will, by reason thereof, be so injured, delayed and hindered in its business as to be prevented from conducting and carrying on its said business.

We are informed that you are about to undertake the extension of tracks and the use of electricity in the streets of the city of Peoria beyond the present limits of your street railway lines; and that the construction of the extension and the use of electricity will be the same as is now in use by you; and we wish to protest against all such extensions, and request that you not only do not make such extensions and further use of electricity in the manner above specified, but that you immediately cease and desist from the improper, illegal and wrongful use of electricity and electrical currents as herein before specified.

You are therefore notified that this company and its receiver will hold you responsible for loss, injury and expense suffered, or that may be suffered, by it through the wrongful, improper and illegal use of electricity and electrical currents by you.

Yours truly,

Dabney H. Maury, Jr.,
Supt. for the Receiver.

Philadelphia, Pa.—The Hestonville, Mantua & Fairmount Passenger Railway Company has decided to put down the Lynch-Lake conduit for its feed wires. This conduit is of glazed terra cotta and is pierced by square ducts. The sections are 30 to 36 inches long, and they contain from 2 to 12 ducts, as is needed. They will be laid in concrete and covered with cement, the joints being first wrapped with burlap to keep out the soft cement. The man-holes also will be different from those laid by the other companies.

ARE ELECTRIC ROADS A PUBLIC BENEFIT?

Such a question as this seems an absurdity to those who have followed with any degree of care the development in the last five years of the modern systems of city transportation. In nearly every large city in the country the question has been answered in the affirmative by the granting of the necessary franchises to street railway companies which were ready to introduce the improved service. In conservative Boston other methods of street car propulsion are practically unknown; in Buffalo hundreds of electric cars furnish a highly satisfactory service; in Cleveland the public is well content with its overhead trolley; St. Louis long ago threw away its petty objections and now is furnished with the most improved service that can possibly be desired; Philadelphia is too soon to have hundreds of miles of electrically equipped car lines; Brooklyn, which the daily press would have us believe had turned itself into a howling mob to protest against the further extension of the trolley roads, has just granted the necessary franchises for 100 miles more of line in addition to the hundreds already operating along its busiest and most crowded streets; and Washington, Baltimore, New Orleans, Kansas City, Omaha, Cincinnati, Albany, Denver, Pittsburg, and hundreds of smaller cities from Boston to San Francisco, would much rather surrender their gas service than give up the modern facilities of the electric car and go back to the days of exclusive horse car service. Yet here in Chicago, in a city noted for its progressiveness and its enterprise, we find the mayor when discussing the inadvisability of granting the rights for trolley construction, referring to such a system as something fitted only for suburban towns and calling it an antiquated method of propulsion. It seems incredible that a man who has frequently visited other large cities and must have many times noted their methods of transportation should make such senseless remarks.

It seems tame to say that all the talk of the "deadly trolley" is utter nonsense; but such is the case. One of the electric roads in Baltimore, carrying millions of people annually through crowded thoroughfares, reports but four fatal accidents for the year 1893. In other large cities, where the proper care is exercised, similar records of safety are the result. Not a single well authenticated fatality from electric shock from railway currents has ever been reported. Such accidents as do occur are incidental to *rapid transit* and would be the same no matter what the propelling power of the car.

If the subject is carefully examined it will be found that nothing would contribute so much to the comfort, convenience, health and commercial advancement of the people of Chicago as the further extension in every direction of the rapid and comparatively safe method of transportation by overhead trolley roads. With electrically propelled cars larger and heavier loads are easily handled, the outlying districts are brought into closer contact with the business center of the city, much time is saved in going from one section of the city to another, the streets are more cleanly, the city's healthfulness increased by the removal of so many animals from the crowded streets, property values are increased by means of the increased facilities for transportation, and the business and social interests of the entire community are advanced correspondingly. And what more can be said in favor of electric traction than this? Its safety when proper care is exercised is unquestioned; proper overhead construction is not objectionable to property owners when the corresponding advantages are considered; damage to the property of outside interests is easily guarded against; and the construction may readily be made so that any part of the line can be cut out of circuit in such a way as to protect any fireman or others from danger of shock. An excellent object lesson in the capabilities of electric transportation is shown in the accompanying illustration which is taken from a photograph kindly loaned by Mr. McGuire, of the McGuire Manufacturing Company of this city. It shows what was actually done on "Chicago Day" last year by one of the electric cars of the Chicago City Railway Company. Do the city aldermen think the people who secured transportation on that car would have clamored for the "good old horse car" in its place? The people know what they want and the aldermen who work for the best interests of the city will grant their requests.

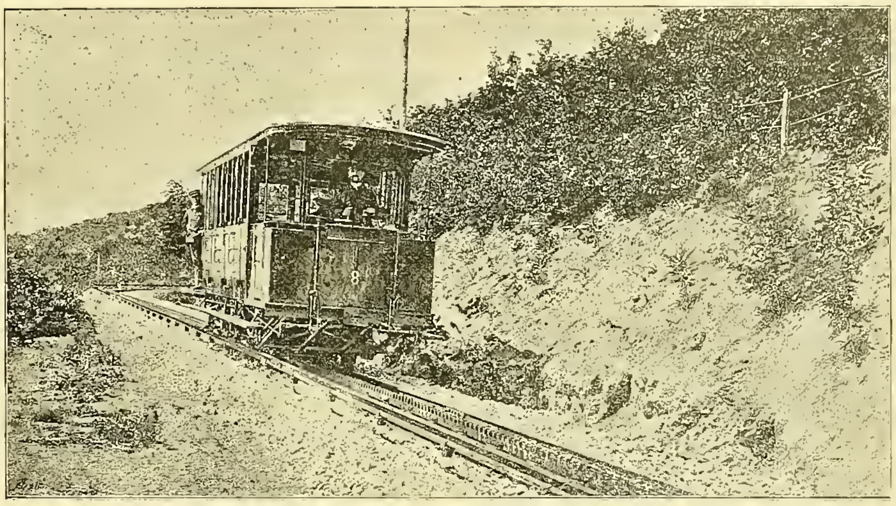
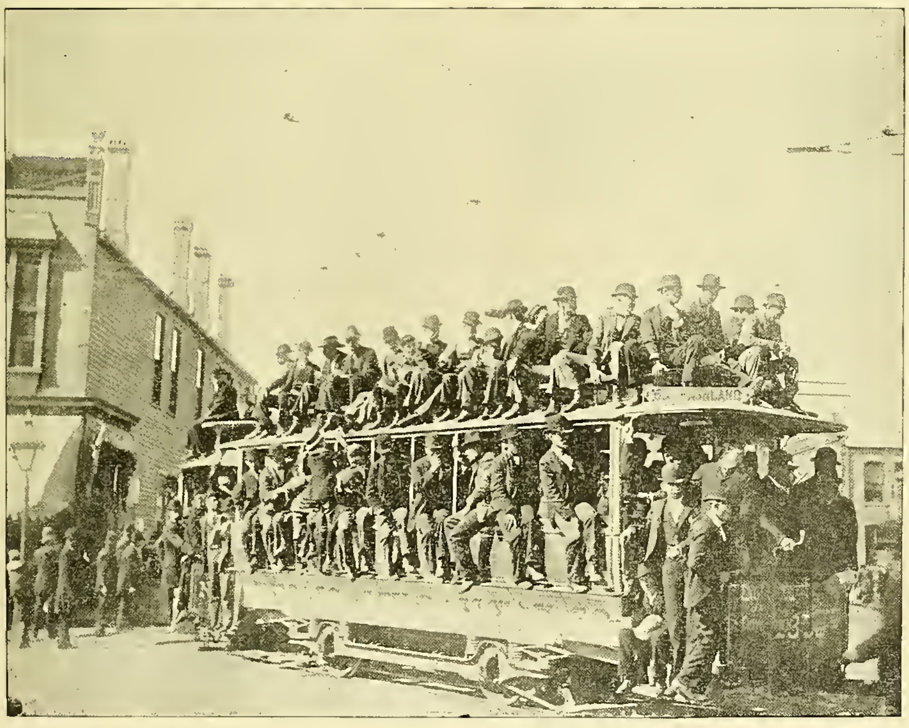


FIG. 1. MONT SALEVE RACK RAILWAY.



ONE ADVANTAGE OF TROLLEY CARS.

MONT SALEVE ELECTRIC RACK RAILWAY.

An addition has recently been made to the extensive system of suburban and district railways which radiate from Geneva, Switzerland. The new road is the electric rack railway to Mont Saleve, the favorite resort of residents of Geneva and tourists, which although situated on French territory is practically a part of Geneva. The line is 5.7 miles in length and the total rise in that distance is 2,400 feet. The grades are as steep as 25 per cent.

The gauge of the line is a meter (39.37 inches) and the rails are of the Vignoles section weighing 30 pounds per yard. The rails are fastened by clamps and bolts to steel sleepers which are laid 3 feet from centers. The road is equipped with Abt single steel rack bars on all grade sections below 10 per cent. and with double defferentiated bars on all sections having grades from 10 to 25 per cent.

The power station is located at Arthaz, about 760 feet below Monnetier Junction, to which point the current is transmitted for the operation of the line. Power for the station is derived from the River Arve. The hydraulic plant consists of two horizontal reaction turbines, whose outer diameter of wheel is about 10 feet, making from 45 to 60 revolutions per minute. It was decided to install dynamos directly on the vertical turbine shafts. These machines, which are multipolar and manufactured by Thury, were designed for 1,000 horse power at 180 revolutions. As the shafts make only about 45 revolutions per minute, the output is 275 amperes at 600 volts or 165 kilowatts, about one fourth of the normal power of the generator. The weight of each machine is 19 tons.

The current is transmitted to Monnetier Junction, a distance of about a mile. The circuit is formed by two insulated cables attached to double porcelain bells on wooden poles. At the terminus wires are let down from the pole line and connect with the terminal of the railway circuit.

The motor cars, Fig. 1, are built to carry 44 passengers, and have open compartments and side doors, as on Swiss mountain railways. The cars, which have "view seats" also on the platform, are 29 feet in length, and are lighted with ten 16-candle incandescent lamps, there being two lamps inside the car, two on each platform, and two at each roof end of the car. The car body rests direct on the frame without spring suspensions, and the load is distributed over three axles with a total wheel base of 10.8 feet, Fig 2. The diameter of wheel is two feet and one of the wheels of each end axle, as well as the two wheels of the center axle, are without flanges, and run loose to facilitate the passing of the sharp curves.

The car wheels do no work at all, the car being propelled entirely by two pairs of rack pinion

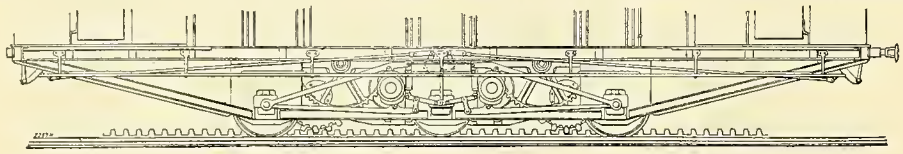


FIG. 2. RACK OF THE MONT SALEVE RAILWAY.

wheels whose diameter of pitch circle is 2.09 feet, and whose teeth are, like those of the double rack bars, differentiated for four-fold grip. The two pairs of pinions are fitted on two separate axles, each of which also carries another toothed wheel only 1.76 feet in diameter, which forms part of the spur gearing by which the rack pinions are actuated from the motors.

The two motors with which each car is fitted are four pole, series wound, of the Thury type, as shown in Fig. 3. They develop normally, viz., at 600 revolutions per minute, 30 horse power, but at 1,200 revolutions are capable of developing up to 50 horse power for a short time and without undue heating, the maximum torque being 3.25 tons. The speed on the steepest (25 per cent.) grade being four miles per hour, the rack pinions make 50 revolutions per minute, so that the motor speed of 600 revolutions involves a reduction of 1 in 12, though the actual reduction is given as 1 in 14, which requires a motor speed of 700 revolutions.

The reduction is obtained by double spur-gearing, of which the intermediate or countershaft pinion is no less than 3 feet in diameter, this pinion and the motor spur being, moreover, in

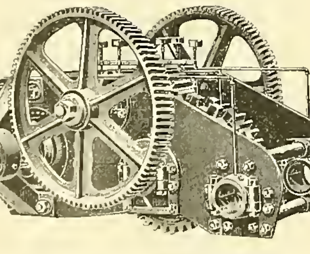


FIG. 3. MOTOR OF MONT SALEVE RAILWAY.

duplicate, viz., one set on each side of the two motors, as shown in Fig. 3. Including the car-wheel axles, there are no less than nine axles to each car frame, of which the separate motor frames carry the motor, intermediate gearing, and rack pinion axles.

In the new cars the motors are always coupled in series, whereas in the first set they are put in parallel, which shows that, with parallel coupling, the motors were somewhat deficient in starting energy. Nor is this surprising in this case, considering the excessive inertia of the ponderous gearing. The combined weight of the two motors *per se* is 2.6 tons, of which 0.6 ton is due to the armatures; but, including gearing and frames, it is no less than 6 tons, which, at their joint maximum output of 100 horse power, or 74 kilowatts, is equal to 174 pounds per kilowatt. The present double gearing and whole arrangement is not only unnecessarily complicated, but produces an exceedingly unpleasant noise when the car is running, particularly on steep grades, the more so as the motors and toothed wheels are not cased in.

The current is taken from the inverted base of the conductor rail by two iron shoes each carrying a bronze slide plate. Besides the electric safety brake constituted by the energy developed by the motors acting as dynamos on the descent, each car is provided with powerful handscrew brakes, two on each platform, viz., one on each side of the latter; these screws, by a series of lever arms and by brake blocks, act on corresponding brake drums, fitted outside the car frame, viz., below the footboards, on a prolongation of the motor axles, as shown in the illustration. Water for cooling the brakes is supplied from a small tank attached to the car frame. The accompanying illustrations are reproduced from *Engineering*, of London.

MAINTENANCE COST OF STREETS INCREASED BY CAR TRACKS.*

BY W. L. DICKENSON.

It is generally acknowledged by men familiar with traffic and its injurious effects upon our streets, that when a car track is laid in any ordinary width street it quickly increases the cost of maintenance and makes it impossible to keep the road in good condition to travel.

Whatever road material you use, be it granite blocks, asphalt, brick or crushed stone, the poorest costs the most for maintenance. With the introduction of electricity as a motive power, the mileage of street car tracks is increasing rapidly and they will soon have the main arteries of our cities and towns girdled with electric railways. I have selected a few macadamized streets under various conditions of traffic in different parts of the city of Springfield, Mass., of which I can get a perfect record from the books of the highway department, for the purpose of illustration and comparison:

COMPARATIVE TABLE OF COST.

BEFORE TRACKS WERE LAID.

Street designation.	Average macadamized width.	Cost of repairs for a term of years.	Years.	Average annual cost per lin. ft.	Average annual cost per sq. yd.	Average annual cost per mile.
1	31.0	$1,499.15	14	$.046	$ 0134	$243.00
2	21.5	386.20	21	.028+	.0119+	148.00
3	24.5	982.37	19	.033	.012	174.00
4	27.7	770.06	23	.055	.018	290.00
5	12.8	374.71	28	.014	.0097+	74.00
6	22.7	360.59	19	.0218+	.0088+	115.00
7	23.7	3,435.82	12	.055+	.021+	290.00
8	23.0	925.70	6	.0386+	.015	204.00
9	23.0	643.67	10	.03	.0115+	158.00

AFTER TRACKS WERE LAID.

Street designation.	Average macadamized width.	Cost of repairs for a term of years.	Years.	Average annual cost per lin. ft.	Average annual cost per sq. yd.	Average annual cost per mile.
8	17.0	$5,332.61	14	$.095	$.051	$502.00
9	16.4	4,105.82	14	.136	.075	718.00
10	28.5	913.01	1	.447	.141+	2,360.00

From the foregoing figures we find that on residential streets with a moderate traffic and driveway of thirty feet from curb to curb, unencumbered with street car tracks so that the traffic is distributed over the entire surface, it is possible to furnish the traveling public with a good surface of macadamized pavement at an average annual cost of .013 per square yard for maintenance. On the other hand, when you put a track in the center and confine the traffic to a narrower space each side, the horses and wagons constantly traveling in the same place will, with the immense pressure per square inch brought to bear, grind the pavement into dust and mud. When you place a car track in the center of a street it occupies a portion that was originally intended, when the pavements were first laid, to carry the bulk of the traffic. Under these conditions it is not at all surprising that on a street which receives but a moderate traffic the cost of maintenance with no track in the center is increased from .013 to .063 with a track in the center. These figures are the average for fourteen years. The average cost of maintenance on Dwight street is .0134, on Water street .021. These streets have no car track in center, are in a business portion of the city and receive a heavy traffic, yet the cost of maintenance is small compared with Maple and Central streets, which are residential streets. These two streets have a car track in center and receive only a moderate traffic, but the average annual cost of maintenance is .063 per square yard, or $610 per mile. Summer street, the approach to the New England freight depot, was macadamized in the summer of 1892, and is subject to a very heavy traffic, though the cost of maintenance annually is only .005 per square yard, while on St. James avenue, macadamized the same year as Summer street, and one of the main arteries in the residential portion of the city, but receiving only an average traffic, has a car track in the center, and costs .141 per square yard.

Of course, it must be understood that these results are obtained by the use of a fine quality of trap rock which comes from the quarries at Westfield and Meriden, Conn., and is as good material for macadamizing streets as there is in the country. Undoubtedly with poorer materials the cost of maintenance would be greatly increased, especially with the traffic confined to a narrow space each side of a car track.

Reviewing the lesson which the past five years have taught, I am most firmly convinced of the great necessity of street superintendents and officials in charge of our highways devoting more time to the careful tabulation and recording of all expenditures, the methods employed in laying the pavements, the foundation, width of street, whether a car track is in the center or not, a record of the traffic or anything pertaining to street work in general. This should be so carefully done that at a very short notice the actual cost of construction and maintenance or any information required about a street, or any part of a street, could be given.

*From *Municipal Engineering*.

STREET RAILWAY EARNINGS IN BUFFALO AND SCRANTON.

It is a significant fact that street railway earnings, which a few months ago showed sharp reductions despite the most rigid economy in operating, are beginning all over the country to make a reverse exhibit. Statements of earnings of the Buffalo Railway and the Scranton Traction companies are especially noteworthy in this regard, as those for March, given below, indicate:

BUFFALO RAILWAY COMPANY

	1894.	1893.		
Gross earnings	$120,009.02	$112,374.81	Inc.	$7,634.18
Operating expenses	71,721.73	76,119 92	Dec.	4,398.19
Net earnings	$ 48,287.29	$ 36,254.92	Inc.	$12,032.37

SCRANTON TRACTION COMPANY.

	1894.	1893.		
Gross earnings	$19,252 72	$15,687.61	Inc.	$3,565.11
Operating expenses	11,436.59	10,227.08	Inc.	1,209.51
Net earnings	$7,816.13	$5,460.53	Inc.	$2,355.60

Baltimore, Md —At the monthly meeting of the board of directors of the City Passenger Railway yesterday Engineer Connett reported that the electric lines of the company would be in readiness for operation about May 1. The work of building the power house, laying new tracks, stretching the wires, etc., has progressed as fast as possible under the delays caused by the weather and other circumstances.

DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.*

BY ISAIAH H. FARNHAM.

For the past year or more, there have been read before water, gas and electrical engineering societies all over this country, papers on the subject of electrolytic corrosion of water pipes, gas pipes and lead cables. In fact, a meeting of such societies is incomplete to-day without some discussion on this subject. It was, therefore, with hesitation and misgivings, that I considered the written invitation from the officers of the Institute, to prepare a paper on the "Electrolytic effect of

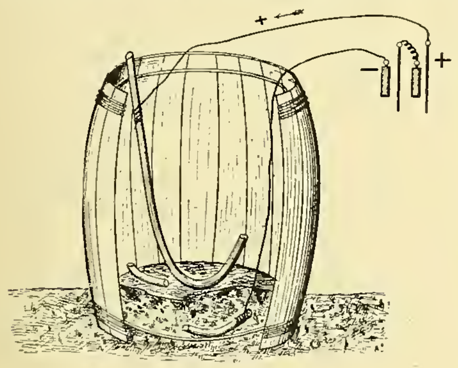


FIG. I.

currents on subterranean gas and water pipes." A prominent officer of the Institute urged that as I was undoubtedly the first to discover and satisfactorily prove that this action was destroying cables, I ought to give the society an account of my investigations and the results. On this suggestion, the promise was made to lay before you such facts as opportunity would allow. If sufficient data may be presented to form a nucleus for the evening's discussion, it will, I am sure, be of some practical value.

Early in the summer of 1891, some lead-covered telephone cable removed from wooden ducts in Boston, showed some very marked yet local spots of corrosion. The cause of the corrosion was generally attributed to acetic acid contained in the wooden conduit, which had, years before, caused corrosion on a few cables in certain sections of the city. In the case just mentioned, the corrosion was so severe, and located in spots only, that it led me to attribute the cause to electrolytic action from the railway currents, and a letter was written to my company to that effect.

A few months later the lead covering of a cable (No. 208), resting upon the ground in manhole chamber No. 76, located at the corner of Berkeley and Newbury streets, was found eaten entirely through at the point of contact with the earth. I then felt certain the cable had been destroyed by the action of the current. With Mr. W. I. Towne, my assistant, I proceeded to prove the theory.

We took measurements between the cable and the earth, the cable having been repaired and raised from the ground, and found 1.5 to 2 volts difference of potential, the cable being positive to the earth. A barrel of earth was procured from an excavation in the street, a metal plate placed beneath the earth in the barrel, and two short pieces of lead cable placed side by side on top of the earth. The plate in the bottom of the barrel was then connected to the negative side of a storage battery giving 4 volts potential, and one piece of the cable lying on the earth, was connected with the positive pole of the storage battery. The second piece of cable in the barrel was left without electrical connections. The earth was then saturated with water and the circuit was closed, allowing the current to pass from battery to cable, to earth, to plate and to battery, for seven consecutive days. The pieces of cable were then removed and the piece which had been connected with the battery was badly pitted, closely resembling the cable which had been destroyed, while the second piece of cable showed no corrosion whatever, proving conclusively that a current such as was found in the manhole, was sufficient to cause the damage that had been found, and that the corrosion was not, in the case of the experiment at least, due to any acid or salts in the earth.

Fig. 1 shows the barrel experiment.

In addition to the experiment just mentioned, we placed in the bottom of manhole chamber No. 76, two short pieces of cable, one of which we connected by a wire to cable No. 208, which had been damaged by electrolysis. (It should be understood that the damaged cable had been repaired, and removed from the bottom of the chamber.) At the end of six weeks, the pieces of cable were removed and examined. The one which had been connected with cable No. 208, was deeply pitted,* while the other piece was free from corrosion.

These experiments, with several others of minor importance, satisfied all who were interested, that electrolytic action was destroying cables, and probably gas and water pipes.

It next became necessary to prove to the electrician of the railway company that the current causing electrolysis was from the railway system, and not from a leak in the Edison or some other electric lighting system.

Measurements were made between the cables in all manholes, and the earth near the cables, for voltage and direction of current. It was found that within a radius of about 2,000 feet from the Albany street power house, cables were negative to the earth, ranging from zero to 2 volts, and that outside of this neutral line, they were positive to the earth from zero to 12 volts. This condition prevailed until a point was reached near the East Cambridge power house, when they again passed a neutral line and became more and more negative as that power house was approached. The same conditions were found as the Allston railway power house was approached. On obtaining sufficient data, maps were drawn, showing voltage between cables and earth throughout all sections of the city. This is shown in map, Fig. 2.

In addition to the figures placed beside the several routes of cable conduits, showing the direc-

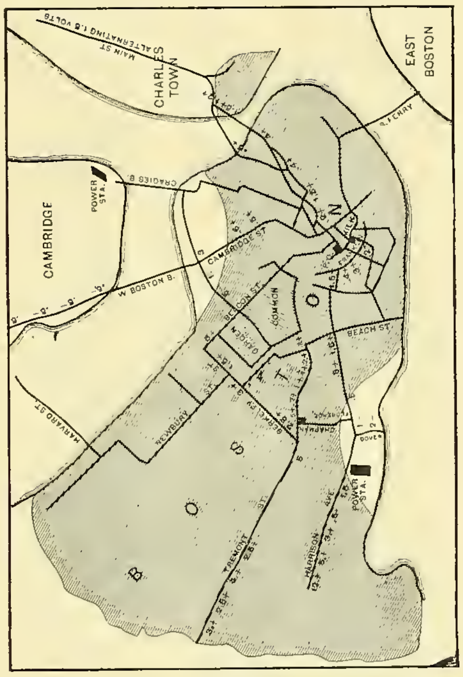


FIG. 2.

tion of current and its pressure, we have colored red, such portion of the map where at that time we found the cables positive to the earth. We may call the red portion of the map, the danger territory. These potential measurements, though taken for other purposes, incidentally furnished all the proof needed to convince one that the railway power was the source of the troublesome currents.

At the time the map was made, and previously, the railway was operating with the negative pole of the dynamo to the trolley, the positive side being to the rails.

Fig. 3 is intended to illustrate this condition. It shows the passage of current from the dynamo to the rails, and the passage of a portion of the current from the rails to the cables within the neutral or zero line, and from cables to rails outside of this zero line. The danger of electrolysis is only where the current is leaving the cable or pipe through the moist earth, hence the dangerous district was at this time outside of the zero, or neutral line, as shown both on the map (Fig. 2) and in this Fig. 3.

Having outlined our early experience in running down this new trouble, we will next mention some of the proposed and applied remedies. Several conferences were held for the purpose of suggesting and discussing means for preventing the destruction of the cables, at which the officers and experts of both the railway and telephone companies were present, and it should be said, that the railway company in Boston has shown a disposition to adopt any promising plan for overcoming the evil, save perhaps, the abandonment of the rails and earth as a part of the circuit.

First: It was proposed to remove all cables from the wet bottom and sides of the so-called manholes. It was found very difficult to place and retain cables free from the wet sides, and even could this have been accomplished, the action at the mouth of the ducts, and within them would still have continued. They were, however, all removed from the bottom of the manholes.

Second: It was suggested that the cables might be connected to ground plates in the manholes, and so transfer the electrolytic action to these plates, and thus save the cables. This experiment was tried on an extended scale, but though many ground plates having a surface of several square

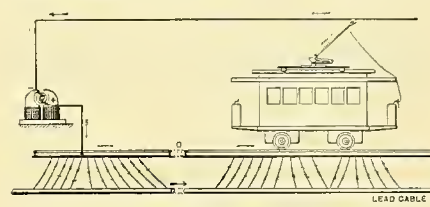


FIG. 3.

feet each, were connected with the cables over a large portion of the city, it was found that voltmeter readings taken between the cables and a point on the earth a short distance removed from the ground plate in any manhole, gave nearly the same pressure as before the ground plates were connected.

In some cases, the voltage between the cables and the earth was reduced 25 per cent; in many others, no noticeable reduction was made. The ground plates were constructed from pieces of old lead cable, 6 to 10 feet in length and embedded in the wet earth at the bottom of the manholes. It was evident from this test, that ordinary ground plates would not prove of material advantage for protecting the cables.

Third: Prof. Elihu Thomson suggested, among other possible remedies, the placing of motor generators at different points along the railway line, wherever the cables and pipes are found to be in danger, the motor generators to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero, with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor generators would, so to speak, pump the current out of the cables and force it into the rails whenever the potential of the former should rise above zero. Fig. 4 illustrates this suggestion. This plan has not yet been put into operation so far as I am aware.

Fourth: Insulating the cables and pipes from the earth was proposed. As some of the worst cases of corrosion of cables by electrolysis occurred where they were painted with asphalt, taped, painted again, and finally covered again with a heavy braiding also saturated with asphalt, it was apparent that to insulate cables sufficiently to protect them would be difficult and expensive,

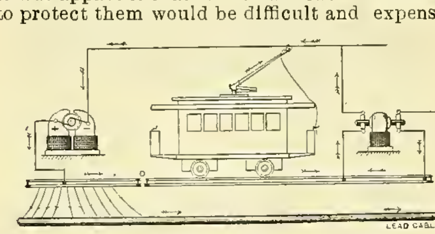


FIG 4.

if indeed practically possible. To protect water and gas pipes by a sufficient insulating jacket was seen at once to be impracticable.

Fifth: Breaking the metallic continuity of the cable sheath and pipes was proposed. From the fact that severe action is frequently found in comparatively isolated spots, where cables and pipes cross each other or pass near or across the rails, it follows that any system of breaking the metallic continuity, would have to be studied with reference to the entire complicated system of pipes, cables and rails ramifying through the streets of a city. There would also be a difference of potential between the several sections of cable or pipe, severed metallically, tending to cause electrolysis at one end of each section, as illustrated in Fig. 5. In case of water pipes, treated in this manner, the action might be expected on the interior as well as on the exterior.

*A paper read before the American Institute of Electrical Engineers.

*The plumbers of Omaha, Neb., apply the name of "small-pox pipe" to that pitted by electrolysis.

There appears to be some evidence of such an action as this in gas and water pipes where the electrical continuity is partially broken by leaded joints. Fig. 6 shows an iron service pipe from the Cambridge gas system. It will be noticed that the action is most severe at points immediately on either side of the coupling. The reason the corrosion appears on both sides of the coupling in this case is not clear; it may be due to reversal of current on the railway system. We have observed other specimens similar to this, which may tend to show that for currents of low pressure, the resistance of joints materially affects the results. I will again refer to this question in connection with potential differences in water mains.

Sixth: My assistant, Mr. Towne, suggested that the railway current might be so frequently alternated, as possibly to prevent serious action

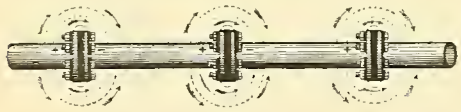


FIG. 5.

on the pipes and cables. The theory was, that before the oxygen gas, liberated by the current, should have time to attack the metal, the reversal of the current would disperse it. A careful experiment was conducted, extending over a period of ten days, employing a pressure of current of from three to seven volts, and alternating its direction at regular periods of one minute, by specially devised apparatus. No material change had taken place in either plate during this period of time. We then considered the practicability of reversing the railway current frequently. It seemed possible to reverse it once each 24 hours, at a given time in the night when the load is comparatively light. To do this in a large system involving several power stations would require either a loss of current for a few minutes in order to guard against one station reversing before some other had opened or reversed its current, or would require some electrical system connecting the several stations together and operating the reversing apparatus simultaneously. We concluded it would be very difficult, if indeed at all practicable, to reverse such heavy currents during regular traffic. We then renewed the reversing experiment, giving 24 hour periods between each alternation, but found at the end of two weeks, to our sorrow, that the plates subjected to the action of the current were seriously electrolyzed. It seemed useless to pursue this line of work further at that time. When alternating current motors become practicable for use on street cars, advantage may be taken of the fact that such currents appear not to cause electrolysis to the extent of injuring pipes and cables exposed to them.

Seventh: At about this stage in the study of the problem, Mr. Fred S. Pearson, then engineer of the West End Street Railway Company, made two suggestions which, though separate in themselves, and presented at different dates, yet carried out in conjunction, have proved exceedingly

FIG. 6.

helpful in overcoming the difficulty, at least so far as relates to telephone cables. It occurred to Mr. Pearson first, that if the railway current should be reversed so that the positive pole would be connected with the trolley, the danger of electrolysis would be removed from the greater and more scattered portion of the city, and be brought near the power stations where it possibly could be more easily dealt with. This reversal was made and the expected potential changes between cables and earth followed. Fig. 7 is a map of Boston, showing the condition after the reversal of current. The red or dangerous portions in this map correspond to the white or safe districts in the map, shown in the first of this paper (Fig. 2) the only variation being, that by the reversal, the neutral or zero line was thrown out a little further from the Albany street power house than it was located before. It was also noted that the cables near the power house which had been from one to two volts negative to earth before the change of current, were now one to nine volts positive to earth; that is, they were raised higher above zero than they had been below zero prior to the reversal. Fig. 8 is a typical representation of the current flowing through trolley, car, rails and cables at this time. It will be readily understood that with the conditions as illustrated in this figure, the electrolytic action would be confined to the territory comparatively near the power stations where the current is leaving the cables to reach the negative or rail side of the dynamo.

Mr. Pearson next suggested the plan of running out large copper conductors from the negative side of the dynamo and extending them through the dangerous district, connecting them at frequent intervals to the cables. Fig. 9 diagrammatically illustrates this plan. On the principle involved in Prof. Thomson's motor generators, this low resistance conductor connected directly to the dynamo, was to pump the current from the cables and so prevent its passage into or through the moist earth. Some of us were skeptical as to the completeness of this proposed remedy. It seemed possible that even with such a good return conductor, some of the current might still pass into and through the earth. Voltage measurements, however, at once dispelled the doubts, for we found that the cables measuring 9 volts positive to earth, gave a reading of 22 positive to the return conductor; that is, the return wire as relating to the cables, was

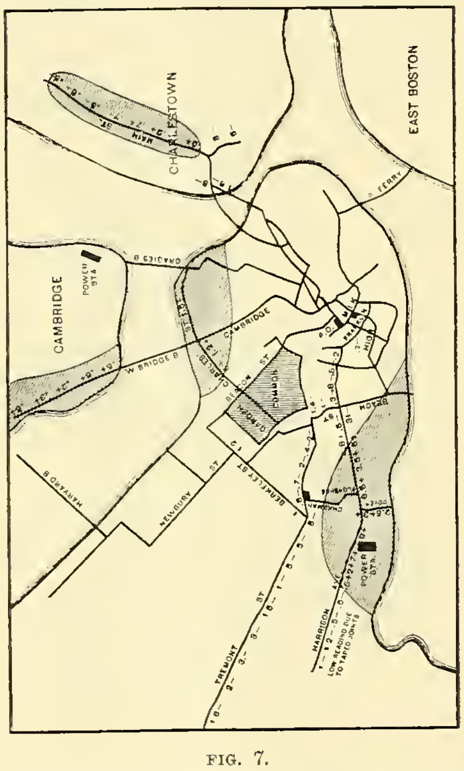


FIG. 7.

at all points, more negative than the earth (if we may be allowed the expression). The return conductors were made up of a large number of No. 18 copper wires formed into cables about one inch in diameter, known as conductors of 500,000 circular mils. These conductors were extended in each direction from Albany street power house entirely through this dangerous district, its longest section being about 4,300 feet. The cables in every manhole within the district, were connected by several No. 12 copper wires to the return conductor and soldered. On first connecting the cables to the return conductor, which took place December 24, 1892, the current was sufficient to melt several stands of No. 12 wire. A measurement for current flowing in the main return conductor which was used for relieving the cables only, gave about 500 amperes.

The map, Fig. 10, illustrates the condition after the installation of the return conductor at the Albany street station. The red patch which existed in that locality is now removed, and the cables are all negative to earth. The remaining red patches or dangerous sections were corrected by taking similar means of reaching the East Cambridge power house. In treating this latter case, many measurements were made to determine whether or not the railway return wires put up to take the current in a measure from the tracks, would answer for a return for the cables instead of using a special return conductor as has been employed at the Albany street district. It was found that they would not answer, since the potential of these track return wires varied constantly and was frequently above that of the earth.

The cables on the Boston side of the draw of West Boston bridge, proved to be positive to both the rail and the water, while on the other side of the narrow draw, the opposite condition existed, showing at once, that it was unsafe to assume any neutral lines or potential difference, without making measurements to determine the absolute facts.

So far, this paper has dealt particularly with the subject of protection of lead covered cables. It might be inferred that water and gas pipes can be treated in precisely the same manner with the same results, or as water pipes have a much greater sectional area of metal, it might be pre-

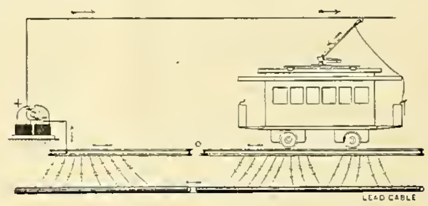


FIG. 8.

sumed that simply a connection of such pipes to the dynamo at the power station would be sufficient to bring their potential down to zero throughout the dangerous district. The facts so far coming to our notice, would materially modify such inferences, and therefore should find a place here.

That iron pipes are as truly subjected to the corrosion as lead, need not be stated to the members of this society, but for the benefit of city officials and others who may read the paper, it should be plainly stated that they are quite as readily destroyed by electrolysis.

The city engineer of Milwaukee, Mr. G. H. Benzenberg, has kindly sent me a photograph of a six-inch iron water main, badly corroded. It is the best specimen of cast-iron pipe I have been able to obtain, although not the most serious case of corrosion.

Mr. Benzenberg writes that the trouble in that city was chiefly noticed upon the six-inch water main extending 100 feet on each side of a point opposite the railway power station. Services entering this main were also destroyed, and all were renewed three times during the past two years. He states further, and I quote his own words, "at other points where power houses were established thereafter, the mains were immediately connected by extra heavy copper wires with the generator; we have had no trouble with them so far."

Mr. O. H. Tripp, engineer at Rockland, Me., recently furnished me with a specimen of wrought-iron pipe destroyed in five months; the fact is of special interest as it comes from a city having but a small railway system.

In Boston, there have been water, as well as gas service pipes corroded through by electrolysis. I have not learned of any mains having burst from this cause. Measurements of water pipes in the city indicate they are still in danger, notwithstanding several thoroughly made connections with the pipes at the power station; the same is true in Cambridge, Mass. This leads me

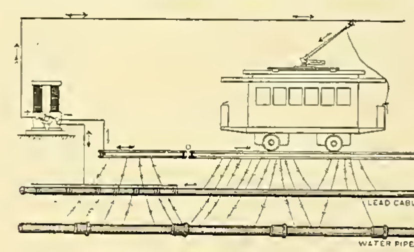


FIG. 9.

to call attention to an interesting series of inquiries.

The engineer of the Water Board at Rochester, N. Y., suggested to me, a short time ago, while looking into the question of electrolytic action upon the pipes in that city, that possibly there might be sufficient resistance in the joints of the water mains to cause an action upon the lead ring which forms the connection between sections of pipe. He stated that not unfrequently there is found a film of moisture between the pipe and this lead ring, and as the pipes are coated with a preparation of tar or asphalt on both the inner and outer surfaces before they are laid, there might be a poor electrical connection. Without having made any inquiries or tests upon this point, it seems to me probable that the careful calking which is given these lead rings, would form in some portion of each joint a good electrical connection; that is, one of very low resistance. Recent measurements, however, made in Boston, and others made in Albany, during the latter part of March, this year, convince me that there is a very appreciable resistance in such joints.

Fig. 11 will illustrate the conditions at Albany. We found the negative side of the dynamo to be connected with the rails, and with ground plates in old wells; no connection had been made with water or other pipes. Directly in front of the power station the voltmeter indicated a pressure of 20 volts between water pipe (an 8-inch cast iron pipe) and the rail, the pipe being positive. A reading taken about 300 feet in either direction, up or down the street, indicated about 18 volts. At a point 1,200 feet north, the reading was lowered to 12 volts. We then connected the rail side of the dynamo to the street hydrant and took new readings, finding 1 volt at the station, 7 volts at 300 feet distant, the same south, and 8 volts at a point 1,200 feet north.

These measurements, with similar indications in Boston, show plainly that there is a very appreciable resistance in the water main joints. At the same time the measurements give fair evidence that the difference of voltage between any two sections of water pipe is very small. The interested parties at Albany have kindly consented to allow any facts or figures obtained there in reference to this subject to be placed in this paper.

Fig. 12 is a photograph of a piece of service pipe at Albany.

A few measurements made through the danger

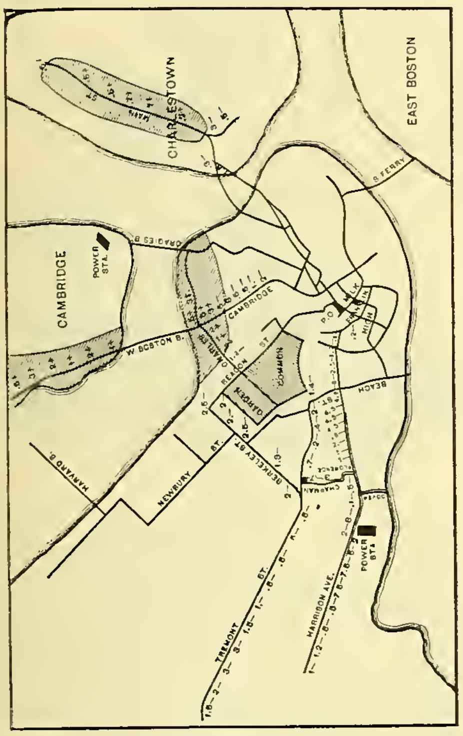


FIG. 10.

district will be of interest. The station is situated near the southern extremity of the city. The danger district extends north about one mile, and over this portion of the district the following figures were obtained. They were taken at nearly uniform distances of about 500 feet, beginning at the station.

MEASUREMENTS IN THE DANGER DISTRICT.

At Station,	Cable to Earth	Positive	12	volts.
" "	" " Rail	"	25	"
" "	Water " "	"	20	"
500 ft. North	Cable " Earth	"	10	"
" "	" " Track	"	22	"
" "	Water " "	"	12	"
1,000 "	Cable " Earth	"	6	"
" "	" " Track	"	18	"
" "	Water " "	"	12	"
1,500 "	Cable " Earth	"	8	"
" "	" " Rail	"	18	"
" "	Water " "	"	18	"
2,000 "	Cable " Earth	"	8	"
" "	" " Rail	"	16	"
2,500 "	" " Earth	"	6	"
" "	" " Rail	"	13	"
" "	Water " "	"	8	"
3,000 "	Cable " Earth	"	4	"
" "	" " Rail	"	11	"
3,500 "	" " Earth	"	3	"
" "	" " Rail	"	12	"
" "	Water " "	"	7	"
4,000 "	Cable " Earth	"	3	"
" "	" " Rail	"	8	"
4,500 "	" " Earth	"	1	"
" "	" " Rail	"	1	"
" "	Water " "	Negative	1	"
5,000 "	Cable " Earth	Positive	½	"
" "	" " Rail	"	½	"

It is proposed at Albany to extend large wires (0000) through the dangerous district, one wire for each system of pipes, connecting the pipes to them at frequent intervals.

It is probable that the remedy which has been applied to telephone cables in some cities, has been the more positive from the very failure, so far, to thoroughly protect the other systems of pipes against electrolytic action. Fig. 9 (already shown) may assist to a clear understanding of this. The cables are here shown connected by a large wire to the dynamo, while water pipes are not so treated. Therefore, the current which enters the water pipes at points outside the danger district passes to the neighborhood of the power station, and, in leaving them there, raises the potential of

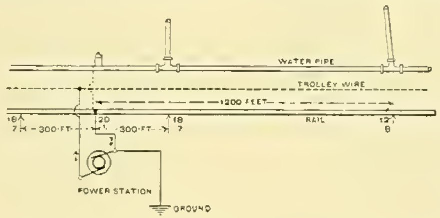


FIG. 11.

the earth about the cables. In other words, the current flows from the water pipes to the ground and thence to the cables in order to reach the dynamo.

Connecting any one system of pipes to the dynamo, will, in measure, protect other systems of pipes, but connecting all systems reduces the certainty or margin of certainty of protection to any one system. This will be apparent from a little study of Fig. 9 just referred to.

When all cables and pipes in the danger district, are connected by sufficiently large conductors to drain them, a careful adjustment in resistances in these several conductors may be found necessary in order to insure a balance between the several systems of pipes. It may lead to the necessity of reducing the carrying capacity of the conductor returning to the dynamo from the rails themselves.

The question has already arisen, and it doubtless will be repeated here,—"How small a difference of potential between pipe and earth will cause electrolytic action?" In reply to this, it may be stated that some of the worst cases of corrosion in Boston, have occurred where the difference was but one and one-half volts. Mr. A. T. Wells, of Chicago, in describing to me an examination of some of the first cases in Cincinnati, states that the "difference of potential between the cables and the rail, was never more than one-half, and usually less than one-quarter volt." Such a difference between cable and rail would mean a much less difference between cable and earth, where electrolysis takes place. Mr. John C. Lee, of Boston, has experimentally caused the corrosion on lead and iron by a difference of potential of $\frac{1}{100}$ volt.

These facts certainly indicate that but a very small pressure is necessary to produce the action and should dispel the numerous statements that well bonded rails or a large amount of rail return wires will alone overcome the trouble. In some cities, where electrolysis is in progress to-day, the return copper nearly equals that of the trolley feed wire system. We cannot force the current to take one path exclusively when others are open to it.

The facts given above, with others similar, though not enumerated, lead me to these conclusions:

1st, All single trolley railways employing the rails as a portion of the circuit, cause electrolytic action and consequent corrosion of pipes in their

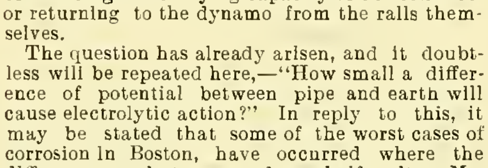


FIG 12.

immediate vicinity, unless special provision is made to prevent it.

2nd, A fraction of a volt difference of potential between pipes and the damp earth surrounding them, is sufficient to induce the action.

3rd, Bonding of rails, or providing a metallic return conductor equal in section area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.

4th, Insulating pipes sufficiently to prevent the trouble is impracticable.

5th, Breaking the metallic continuity of pipes at sufficiently frequent intervals, is impracticable.

6th, It is advisable to connect the positive pole of the dynamo to the trolley lines.

7th, A large conductor extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.

8th, It is better to use a separate conductor for each set of pipes to be protected.

9th, Connection only at the power station, to water or gas pipes, will not insure their safety.

10th. Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.

11th. Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made, as the measurements indicate.

In closing this somewhat rambling paper, I can do no better than use words which will remind you of Patrick Henry: "eternal vigilance" will be the "price" of pipes and cables where conditions favorable to electrolysis exist.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

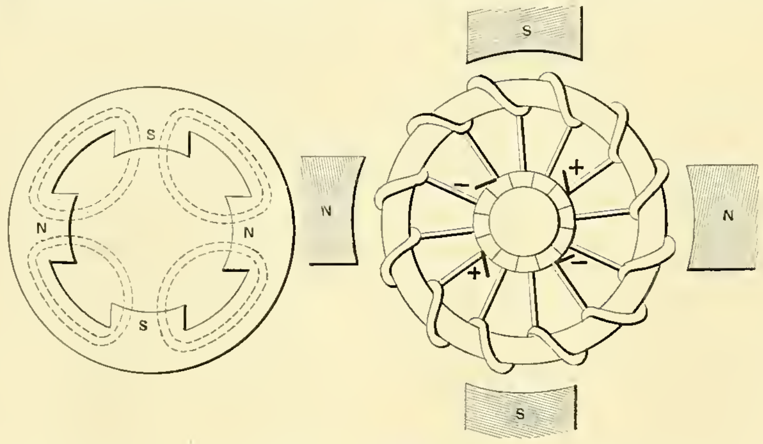
BY NELSON W. PERRY.

(Fifteenth Article.)

MULTIPOLAR FIELDS.

Referring to Fig. 43 we see how an unbroken iron ring may be wound so as to have four distinct poles. In practice, it is desirable to have as little air space between these polar surfaces and the armature as possible and for this purpose, the ring which is to become our multipolar magnet is cast with extensions, called pole pieces, extending inwardly and the magnetizing coils are wound upon these extensions. Fig. 49 shows this arrangement for a four pole field, also the directions taken by the lines of force. It is clear that in a four pole magnet we have the exact equivalent of two simple magnets, and a wire on the surface of an armature revolving in this field will pass in one revolution four poles. As it sweeps by the first north pole it will generate a maximum electromotive force in a given direction. This will decrease until it gets half way between the north and south poles where it will become zero and change its direction. That is, it will come to the point where the currents must be commutated in order to maintain them in the same direction. From this point until it passes the adjacent south pole the generated electromotive force will be increasing. It then decreases until it is zero at a position half way between the south pole and the next north pole where it must be commutated again and so on until the armature has made a complete revolution. Thus in a four pole field the currents in the armature wires in every revolution reach a maximum four times, instead of twice as in the two pole field—once every time they pass a polar surface, they also become zero and change their direction four times—midway between the poles, and, if the currents are to be maintained continuously in the same directions they must be commutated whenever these changes of direction occur. There will therefore be required four brushes in this case instead of two. In a six pole field there will be six reversals and there must be six brushes, and so on, two additional brushes must be added for every additional pair of poles introduced into our field. In Fig. 50 is shown the arrangement of the brushes in a four pole machine—the ring winding being used for illustration as being simpler for the purpose. In the bipolar (two pole) field it will be remembered that the positive brush was placed diametrically opposite the negative brush. In the four pole field this is not so, because the north pole of the magnet is not opposite the south pole. They are at right angles to each other and therefore in order that the brushes may have the same position relative to the field that they had before, viz., at right angles to them, they are in the four pole field at right angles to each other also. It will be seen from Fig. 50 that the positive and negative brushes alternate and by connecting two circuits in the proper way to these brushes we would have two independent currents. In fact while in the four pole field we have practically two separate bipolar magnets, we also have, when a single armature is added, practically two distinct generators or motors. Or, as is more usually the case these two independent circuits are united into one and we have, if everything is properly arranged and proportioned, a single machine equivalent to the output of the two considered separately. It is evident that this can be accomplished by connecting the two positive brushes (those marked ×) together and to one end of the circuit and the two negative brushes (those marked —) to the other end of the circuit, and in large multipolar generators this is usually the method employed—all of the brushes from which the current is coming being connected together, (the positive brushes,) and all of those into which the current is passing, (the negative brushes) being connected together, and these are attached to the positive and negative terminals of the line circuit.

When the brushes of the same kind are thus connected together the electromotive force of the whole armature is simply that of any of the sets of coils from one positive brush to the adjacent negative brush. In the diagram, Fig. 50, the coils of the four quarters of the armature are in multiple arc with each other, and since there are therefore four paths of the same size for the current, the resistance offered to the passage of the current is only one-fourth what it would be if the coils of all four were in series, or if the coils on one-half the armature were in parallel with those



FIGS. 49 AND 50.

on the other half, as would be the case were this a bipolar field and there were but two brushes.

Referring again to Fig. 50, since in a four-pole field the opposite poles are alike, the coils on the armature diametrically opposite to each other as they sweep by these poles will always have electromotive forces generated in them in the same direction. This being the case, we can connect the diametrically opposite coils with each other, either in series or in multiple, so that they practically form but one coil, and by bringing the ends of this coil to the proper commutator blocks again reduce the number of brushes to two. In this case the brushes will be most conveniently located at right angles to each other, about half way between a north pole and its two adjacent south poles, or between a south pole and its two adjacent north poles. It is evident that if opposite coils be connected in series the electromotive force generated will be doubled, while the resistance is also doubled, and if they are connected in parallel the electromotive force will be that of either coil alone, while the current will be doubled and the resistance halved. This method of connecting together the opposite coils of an armature in a multipolar field is the usual one in multipolar street car motors, for the reason that it reduces the number of brushes, which is a very desirable accomplishment, and also enables the brushes to be more conveniently located for inspection than would otherwise be possible.

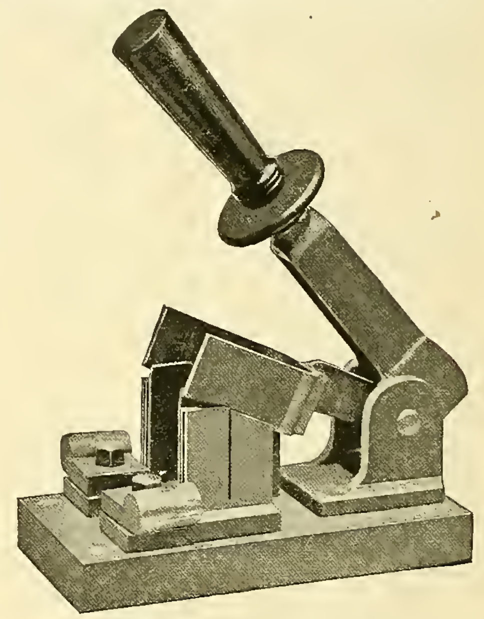
We will have noticed another advantage in multipolar machines. In discussing bipolar machines, it was stated that in any given case the electromotive force generated by a coil revolving in a magnetic field depended upon the number of revolutions it made per minute in that field, or in other words, upon the rapidity with which it cut the lines of force. We have just seen that in a four-pole field the coil cuts the lines of force twice as often in each revolution as it does in a bipolar field. The armature, therefore, need revolve only *half* as fast in a four-pole field as in one of two poles, to produce the same output, and thus we are enabled to make slow-speed generators. The same may be said of motors, and it will have been observed that all slow-speed motors, such as the gearless motors, are provided with multipolar fields. The philosophy of this, simply stated, is that if a given current fed to a motor having two poles will give it at any specified speed a given power, the same current acting upon a motor with four poles would produce a motor practically equivalent to two machines of the bipolar type, and as the power of a motor is also dependent upon its speed, a four-pole motor will produce the same power at half the speed of a similar motor with only two poles.

Thus far we have said nothing as to how we get the magnetism in our field magnets. We have assumed, however, that they are electromagnets, viz., that the field magnets are made of soft iron and have no magnetism of their own, but are converted into magnets by passing electric currents through coils of insulated wire properly wound around them, and this is now the universal practice in all but very small generators. Permanent magnets made of very hard tempered steel might be used however, but as a permanent magnet can never be made so strong as an electromagnet of the same size, and for other equally good reasons, which need not be mentioned here, the latter are preferred. The earlier dynamos were, however, frequently constructed with permanent magnets. Such machines are properly called *magneto-electric* machines. Examples of magneto-electric machines are found in the apparatus employed in the telephone fixtures for ringing up the exchange. In the call box will be found a strong permanent magnet between whose poles there revolves a small iron bobbin (armature) wound with fine wire. As this is rotated by turning the crank it generates alternating currents which pass over the line and ring the bells. It would be a simple thing to attach a commutator to the armature which would convert the alternating currents into direct currents as already described, but the telephone call bell has been adapted to alternating currents, so that the complication of commutators is not necessary.

Another method of obtaining our magnetism is to construct our fields of soft iron and wind them with coils and connect these coils with some independent source of electricity such as a large battery or another dynamo. When the current flows through the coils of course the fields become highly magnetized as we have seen. A machine whose fields are thus excited is called a *separately excited* dynamo. This method has some advantages, chief of which is that the exciting current coming from a separate source is entirely independent of the fluctuations of current in the trolley circuit which would, if current from the latter were added, produce similar variations in the magnetism of the fields which would in turn still further complicate matters. It has the disadvantage, however, of requiring a separate machine for this purpose, which in very small plants would be scarcely warranted by the attendant advantages. In large electric power stations it is quite customary to find a small machine used solely for this purpose, its current being employed to excite the fields of all generators in the plant.

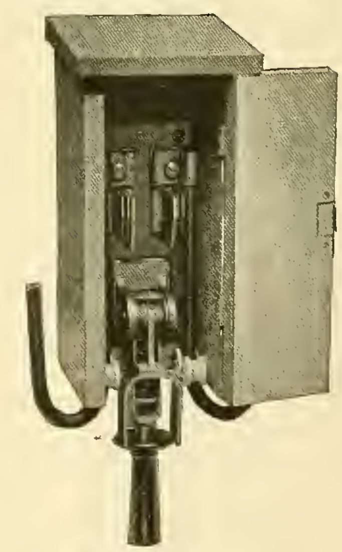
AJAX LINE SECTION SWITCH.

Many electric railways have been built and operated, without any means of disconnecting a part from the rest of the line, or of dividing the

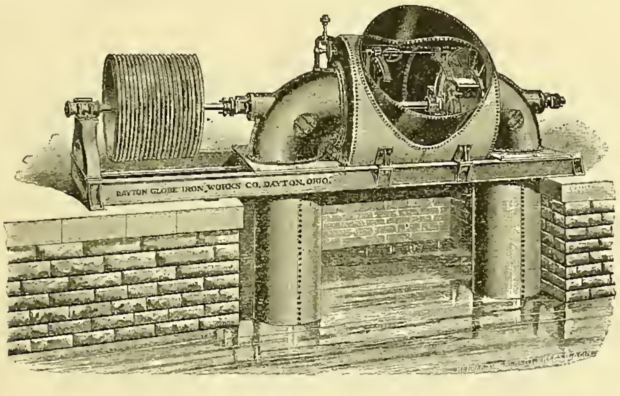

AJAX LINE SECTION SWITCH.

entire system into sections; but the operators have sooner or later discovered the convenience, or necessity of inserting section insulators and switches, so that certain sections of the trolley wire might be cut out of circuit for repairs, or during the progress of a fire.

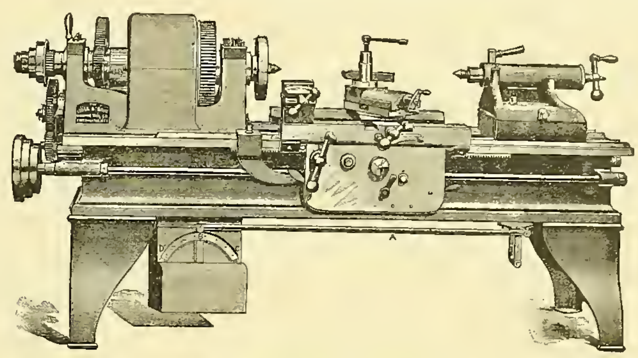
For this purpose a modification of the Ajax switch has been designed, which, when mounted


AJAX SWITCH, OPEN IN BOX.

in a neat wooden box, 13x6x6⅝ inches, (outside dimensions) will occupy a minimum of space on the pole. This is the most compact form of the Ajax switch yet designed, and it is calculated to maintain the claims to superiority in conductivity and breaking capacity for which the Ajax switches are justly noted. The capacity of the switch is 200 amperes. In some cities, an ordinance compels the railway companies to so arrange their circuits that no section of trolley wire shall embrace more than two blocks of continuous conductor, and that each section shall be controlled by a switch placed within easy reach



AMERICAN TURBINES.



MOTOR DRIVEN LATHE.

of the firemen. Even where such provision for the convenience of the firemen is not compulsory, it will be found an adventage to the railway companies to adopt such a system on thickly settled streets; for without the section switch at hand, the firemen will soon learn to use their clippers or axe to sever the wires, rather than work among heavily charged conductors, so that the section switch may be termed an economizer of repairs, as well as a preventive of delays to traffic. These switches are made by C. S. Van Nuis, of New York City.

AMERICAN TURBINES IN STREET RAILWAY WORK.

The outfit in the accompanying cut represents a pair of 30-inch American turbines placed in flumes 5 feet diameter, 5 feet and 2 inches long,

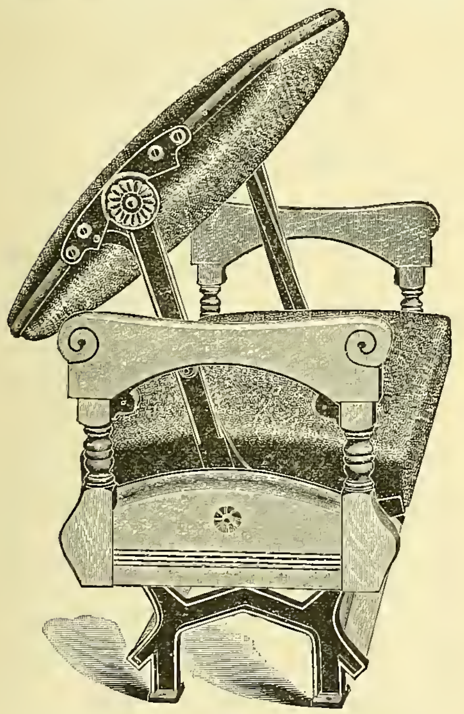


FIG. 1. HARTFORD WOVEN WIRE SEAT.

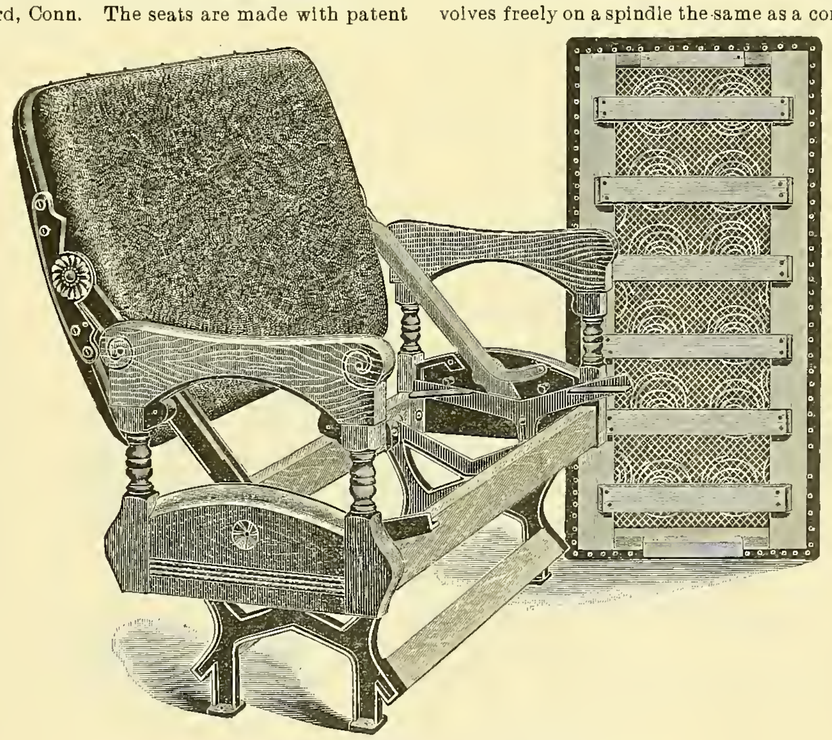


FIG. 2. HARTFORD WOVEN WIRE SEAT.

made of $\frac{3}{8}$-inch tank steel, with cast iron heads and mouth-piece for attaching supply pipe 42 inches in diameter. The flume is supported by two steel I beams 20 feet long, with cast iron cross ties for connecting I beams, and brackets for bolting down the flume. These wheels are working under an actual fall of 94 feet, and the power is transmitted vertically from the water wheel shaft to a line shaft by means of a rope drive. The driving sheave pulley on the water wheel shaft is 40 inches in diameter with 20 grooves for 1-inch manilla rope and transmits 400 H. P. The water is discharged from the flume through two cast-iron quarter turns, to which are connected the wrought iron draft tubes. The water wheels are regulated by means of the Replogle electric governors, which control both the supply and discharge of the wheels.

The Ithaca Street Railway Company has two pairs of horizontal turbines of the same size, placed adjoining one another, and the water is brought to both flumes through a wrought iron supply pipe 60 inches diameter, nearly six hundred feet long. The main supply pipe ends in a standpipe made of cast iron in the shape of a letter "T," with inlet pipe 60 inches in diameter and outlet pipes 42 inches in diameter. The supply pipes leading to the flumes are furnished with Ludlow valves for shutting off and on the water. The turbines are manufactured by the Dayton Globe Iron Works Company of Dayton, O.

HARTFORD WOVEN WIRE CAR SEATS.

The accompanying illustrations show the high backed tilting car seats manufactured by the Hartford Woven Wire Mattress Company, of Hartford, Conn. The seats are made with patent reversible backs, with woven wire seat and back cushion springs. Fig. 1 shows the method of reversal of the back cushion and the tilting of the seat cushion, while Fig. 2 shows the reversing arrangement as well as the open woven wire mesh work of the seat cushion, which allows a free escape for dust and complete ventilation for the seat cushion. The claim is made for these seats that less space is occupied in reversing them than for any other seat on the market. For this reason, it is claimed that a greater number of seats can be placed in a car, thus giving a greater seating capacity. With the exception of the covering, these seats are made entirely of metallic material. A special point in its favor from a sanitary point of view is that it has an open base so that there is no lodging place or storage for dust provided. No upholstery is needed, as the seats may be covered with rattan, leather or carpeting. The illustrations show the seats as adapted for steam roads, but they are made of the same style for use on electric cars. In these, however, the base of the seat arm curves in to allow trap doors to open over the motors.

MOTOR DRIVEN ENGINE LATHE.

We present herewith a lathe in which the design includes an electric motor, taking the place of the usual cone pulley. The lathe is reversed and the speed regulated by the movement of rod *A*, this with the back gears, arranged as usual, giving not only a much wider range of speeds than can be obtained by cone pulley, but a much more finely graduated speed; in fact the speed may be anything from the highest to the lowest desired.

The armature of the motor is wound on a phosphor bronze spider with a carrier disk which revolves freely on a spindle the same as a cone pulley. It is surrounded by pole pieces inclosed in housin the lower half of which is cast in one piece with head stock proper, to which the upper half is substantially fitted and secured by means of four bolts. This construction forms what is known as an iron clad motor, entirely free from external magnetism. This is necessary in order to keep small particles of steel and iron from adhering to the lathe, making it impossible to keep it clean.

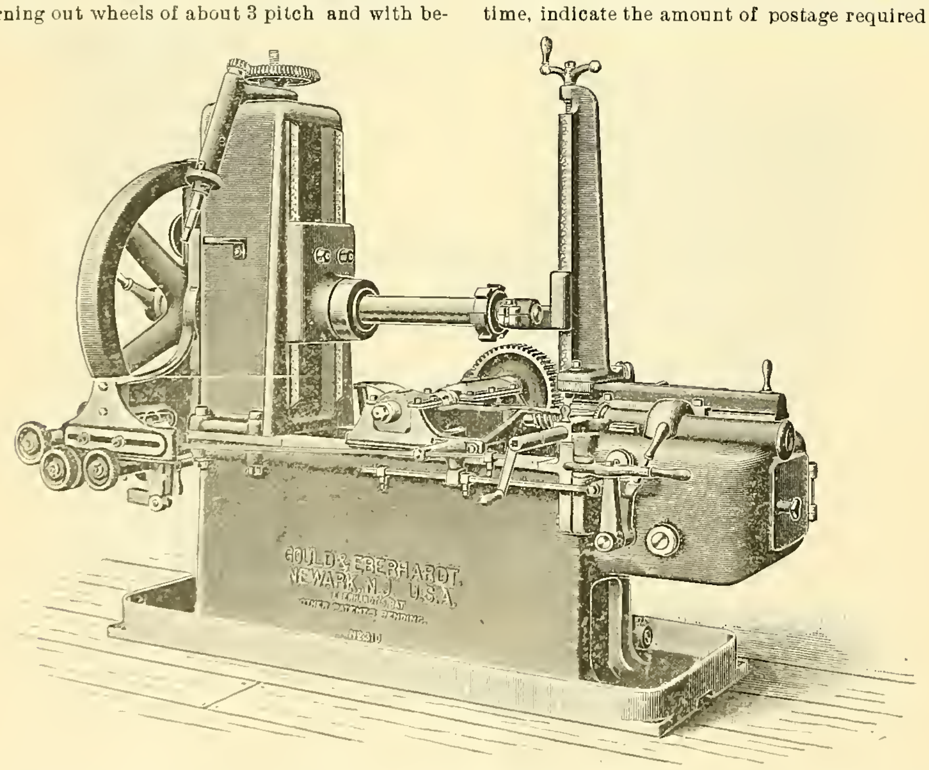
Among the advantages secured by such an application of electricity are that tools may be placed independently of fixed conditions overhead, such as shafting, cranes, etc., and with regard to the arrangement best suited to handle the product most conveniently and the operator has the best control of his machine, especially when a variable speed is necessary.

The head screw is placed on the inside of the bed, directly under the front *V*, and is inclosed in a brass tube, protecting it from dust and chips. In this position it takes hold of the carriage directly under the line of strain, and obviates that twisting tendency which is so common in lathes where the screw is placed on the outside of the bed. All the feeds of the carriage can be thrown in and out or reversed from the front of the apron. This is a particularly desirable feature inasmuch as the operator is not compelled to leave his work, and it does away with the complicated gearing in the head-stock. The carriage is provided with a stop, which throws out the feed automatically, and may be set at any point along the ways. This is very convenient for turning or boring a given length, and also prevents the lathe from being damaged by any careless ness of the operator. The spindle is hollow and of large diameter; the boxes are made from the best phosphor bronze, and are provided for taking up wear.

This lathe was built by The Lodge & Davis Machine Tool Company of Cincinnati, O., which is giving special attention to equipping the various classes of machine tools it is building with electric motors. The motors, which are furnished by the Card Electric Motor and Dynamo Company of the same place, are simple, substantial, and of sufficient capacity for maximum load, entirely free from complication and requiring very little attention in use.

EBERHARDT'S AUTOMATIC GEAR CUTTER.

The recent development of the electric motor for street car work has opened a new field which has made a demand for a machine capable of turning out wheels of about 3 pitch and with be-



EBERHART'S AUTOMATIC GEAR CUTTER.

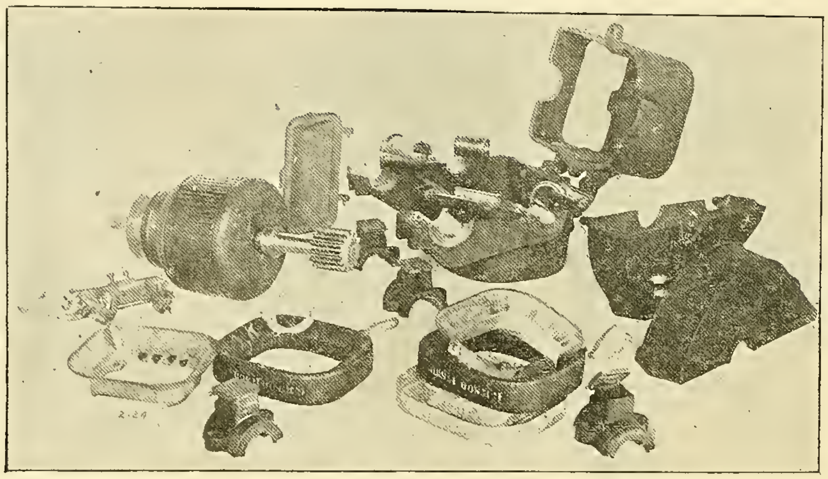
tween 60 and 70 teeth, 4 to 5 inches face and to do this work 10 hours a day requires a machine very rigid and simple in construction. It is claimed for this machine that it is remarkable in two respects, viz., in the quality and the quantity of work it accomplishes. The machine is so constructed that it turns out from two to three times the number of such gears that could be cut by the machines of the old type and this without strain to the wearing parts of the machine, all of which are so designed as to be of the simplest form, and most handy for manipulation. The cutters are held in the center of the cutter slide so that all wear is equally distributed. But two belts are used, one from the main shaft to the countershaft and one from the countershaft to the machine. No belt tightener or cone pulleys being required, variations of speed and feed are obtained by the use of the change gears. These machines are manufactured by Gould & Eberhardt of Newark, N. J.

COLUMBIA POSTAL SCALE.

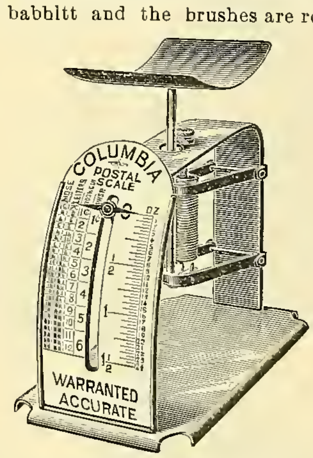
The accompanying illustration shows a simple scale intended for office use where mail matter of all sorts is handled. The illustration shows that the scale will weigh up to 24 ounces, and that the pointer on the opposite side will, at the same time, indicate the amount of postage required for any class of mail matter. The dial is upright instead of circular, and therefore easier to read than the ordinary style of scale. For the same reason the construction is much simpler, and the moving parts work easily together without friction. The spring has free action, and can be regulated if required. These scales are manufactured by Rand, McNally & Company, 166-8 Adams street, Chicago.

PARTS OF THE G. E. 800 MOTOR.

The standard General Electric railway motor is the G. E. 800, the parts of which are shown in the cut. Its light weight and simplicity of construction and manipulation, it is said by the company, have rendered it a general favorite among street railway men. By its use is claimed a decided economy in track expense and diminished maintenance and repair charges. The armature is of the iron clad type with embeded winding. The bearings are lined with the best quality babbitt and the brushes are readily accessible. When the motor is mounted on the axle and closed it is both water and dust proof.



PARTS OF THE G. E. 800 MOTOR.



COLUMBIA POSTAL SCALE.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

General Indications.—Dealers in what are known on Wall Street as "outside" securities report that the inquiry for traction securities noted in former letters shows no signs of abatement. The point is made that traction roads must soon play a prominent part in the matter of negotiating new securities. The change of power from steam to electricity in the street railroad department of transportation must in the near future furnish the basis for a large part of the investment securities hitherto supplied by the construction of railroads during the past twenty-five years.

Traction Stocks Listed.—Beginning yesterday, traction stocks are regularly called at noon on the Consolidated Exchange. The New York Stock Exchange has listed the securities for one or two big companies and will soon give quotations to the bonds and stocks of other companies whose securities are to be floated in Wall Street. With this publicity given to them there has naturally been greater attention given to traction stocks by investors, and the volume of business is assuming fair proportions. Some of the investment dealers do not look with favor on the action of the two exchanges in allowing trading of traction shares on their floors, as they fear that a speculative movement may ensue that will create fictitious values and destroy a real investment demand for the securities. But any broadening of the market for traction securities must in the end embrace values, in that it makes it easier to buy or sell, and the action of the two exchanges in putting traction stocks on the list of securities to be traded in is a recognition of the important part that the big street railway systems play in the financial world.

BONDS IN DEMAND.—Broadway and Seventh Avenue 5s, Broadway new consolidated 5s and Third Avenue 5s have been the bonds mostly dealt in the past ten days. Several large blocks of these issues have been placed with private investors, and the big insurance companies are manifesting a very gratifying disposition to make large investments in this class of securities. Third Avenue Railroad bonds and shares have been a trifle inclined to weakness on fears that the new Lexington Avenue cable line of the Metropolitan Traction Company which is being rapidly pushed to completion, will take away a good deal of business. President Elias of the Third Avenue road tells your correspondent, however, that no such results are feared. If anything, the completion of the Lexington Avenue line will be a relief, as the Third Avenue road at many hours of the day has more traffic than it can handle, notwithstanding the fact that more cars now pass a given point in a specified time under the swifter cable service than with the old horse power system.

LONG ISLAND TRACTION.—It is expected that there will be a good deal of activity in the stock of the Long Island Traction Company, which was quoted in the unlisted department of the Stock Exchange for the first time on Monday of this week. This stock represents control of most of the Brooklyn street railway companies. The Traction Company guarantees 10 per cent. dividends on Brooklyn City Railway stock and expects to earn 5 per cent. or more on its own stock. The stock has been as high as 40, but it is now quoted on the Stock Exchange at 22. There is plenty of this stock to go around. Naturally it has not been long enough before the general public to invite spirited speculation, but that Wall street itself is pretty well loaded with the stuff was shown when the stock was offered at 21⅝ immediately after a supposed sale of 200 shares had been made at 22½. Insiders talk of a price "between 50 and par," but enough stock will come on the market at even present figures to effectually check any such an advance.

NEW ORLEANS TRACTION has been somewhat looked after this week on the news as published in this column last week that the control was to pass into stronger hands. A movement of some definiteness is expected when the stock is once listed. North Shore Traction of Boston also comes in for some attention, but the most demand has been for the unlisted second grade bonds.

OTHER COMPANIES in whose securities Wall street will soon have a chance to dabble are those of two syndicates that have purchased western street railways. Thomas Nevins & Son, of Orange, N. J., have purchased 80 miles of street railways of Detroit, Mich., for $8,000,000 stocks and bonds; and to operate them, a company is being formed in Wall street that will have $10,000,000 capital, all of which will be eventually listed in the Stock Exchange. Three Kansas City street railway lines have also just effected a consolidation, and their united capital of $4,300,000 is seeking a local representation and quotation. Then there is the Central New Jersey Traction company just incorporated at Trenton, N. J., with a present capital of $150,000 and a potential one of $10,000,000. This too offers more opportunities for the placing of Wall street capital.

PHILADELPHIA TRACTION stocks have boomed more than ever. New York has taken a hand in the speculation devoting its attention principally to Metropolitan Traction and Philadelphia Traction. It was thought at one time that a clew had been discovered as to the reason of the present enormous advances in the shares of all the Philadelphia roads in the report that the people behind the Metropolitan Traction Company were engineering a syndicate to control all the street railroads of Philadelphia. There has been denial of this report as well as of the story that a New York syndicate had offered $150 a share for control of the Philadelphia Traction Company. Your correspondent can state, however, that there really is a definite movement on foot to consolidate all the Philadelphia street railway interests. The astonishing amount of money seeking investment has led to investigations into the value of securities hitherto not thought of by capitalists, and the lucrative results produced by the introduction of the trolley system on Philadelphia roads has aroused the attention of people with lots of idle money at their disposal. It is too early to state what the scheme may result in, but it is in serious contemplation.

MORE PHILADELPHIA SECURITIES.—Some further issues of securities are to be brought out in Philadelphia. The Thirteenth and Fifteenth streets road will issue $500,000 new bonds, of which $100,000 will be used to take up the present outstanding 5s falling due in 1903, and the remaining $400,000 will be turned over to the Philadelphia Traction Company, the lessees of the line, to repay the money used for trolleying the road. It is denied that the Philadelphia Traction Company itself is, as rumored, to issue several millions of stock in the fall to pay for the new trolleys. Electric Traction stockholders will authorize, on Thursday of this week, an issue of $2,500,000 more stock at par, entitling each holder to take as many shares at par as he now has. The stock is now quoted around 90, a final payment of $15 having been made last Saturday, making the stock now full paid. A payment of $3 a share has just been made on People's Traction. There is also a well defined rumor that the dividend on Philadelphia Traction next month will be increased from 6 to 8 per cent.

TWO PITTSBURG STOCKS that are traded in in the East—Dusquesne Traction and Pittsburg Traction—have had quite an advance recently, the first being now quoted around 31, and the second at 63, on the improvement in earnings resulting from the gradual resumption of work at Pittsburg.

WEST END STREET RAILWAY shares of Boston have gone up and down on the various stages of the movement to compel it to put its overhead wires under ground. But a bill has now been passed through the lower house of the Massachusetts Legislature that heads off the ordinance passed by the Boston board of aldermen, and President Little and his associates in the board of directors feel easier.

INCREASED EARNINGS.—People who claim that the trolley is a great saving, point with pride to the record made by the Columbus, O., Street Railway Company, whose March net earnings increased 52 per cent. as compared with last year, before the trolley was in operation, and whose net earnings for the quarter ending March 31, increased 70 per cent. The net increases are due to the large decreases in operating expenses, thus confirming the claim made by the upholders of the trolley system. The stock of this company is largely held in New York and Philadelphia.

DIVISION OF ELECTRIC TRACTION STOCK.—The directors of the Second and Third Streets line of Philadelphia have decided to divide the Electric Traction stock in their treasury among their stockholders in the proportion of 40 shares of Electric for every 100 shares of Second and Third. This fine dividend was made in consideration of the transfer to the Electric Traction Company of a majority interest in the Lehigh Avenue and Omnibus Company's stock.

INCREASE OF CAPITAL.—The capital stock of the Electric Traction Company of Philadelphia itself is to be increased this week from 50,000 to 150,000 shares at the special stockholders' meeting. The increase will be distributed proportionately among stockholders at par. The holders of the Fifth and Sixth Streets road will have 15,000 shares distributed among them, in payment of certain resources of the Frankford and South wark.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, this city, said yesterday: "There has been a fair reaction from the high prices of last week in cable stocks, and we look to see the prices go still lower. The disturbing factor has been labor troubles, but with a speedy settlement in that quarter public sentiment will change. The new West Chicago tunnel will be opened to-morrow. In Philadelphia the traction stocks, while not making any higher quotations, have all been very steady this week, until to-day, when Philadelphia led the reaction with a decline from last night's figures of 7 per cent., on a report that five millions new stock would be issued, although the meeting to vote on the question will not be held until June 20. Metropolitan Traction, in sympathy with the weakness in Philadelphia, declined from 119½, yesterday's closing price, to 117, subsequently rallying to 118. Electric Traction stockholders voted yesterday to increase the capital stock from 50,000 shares and to allot $2,500,000, or 50,000 shares, at once to stockholders, giving the privilege of subscribing share for share. This had the effect of a drop from 87½ to 82. The money is for trolleying the road. People's and Baltimore Traction were neglected; the former declined 1 per cent. to 3¾ on a call made this week for $8 in two installments, making the stock $25 paid in, par $50."

Earnings of the Chicago Lake Street Elevated.—The last monthly statement of the Lake Street Elevated Railroad Company shows that the total March earnings were $45,500 and the total expenses including salaries and operating and contingent expenses, $28,500. This left $17,000 with which to pay interest on its $6,000,000 bond issue which amounts to $25,000 monthly. The company is thus earning within $8,000 of the total amount necessary to pay expenses and interest. The statement is considered by the officials as hopeful, especially in view of the fact that this report takes no account of the increase in traffic due to the opening of the Forty-eighth street station, and to the addition of smoking cars to the trains. The Fifty-second street station is soon to be opened.

The Urbana & Champaign Street Railway Company, of Champaign, Ill., has decreased its capital stock to $35,000, and has consolidated with the Champaign Rapid Transit Company and has changed its name to the Urbana and Champaign Electric Street Railway Company.

Dividend.—The board of directors of the Westinghouse Machine Company has declared a quarterly dividend of 1½ per cent. on the common capital stock of the company, payable to stockholders of record on April 18.

The St. Louis Car Company has increased its capital stock from $100,000 to $500,000.

NEWS OF THE WEEK.

Pasadena, Cal.—A company is to be formed by Col. Green of Pasadena, Andrew McNally of Chicago, Senator Barker of Philadelphia, and others for the purpose of constructing an electric railway between Los Angeles and Pasadena. The new company will not only take in all the existing street car lines in Pasadena, but has, it is stated, acquired the Main street line in Los Angeles. Maj. A. W. Barrett, formerly of the Consolidated Electric Street Railway Company of Los Angeles, has been engaged as general manager of the construction and operation of the new line. Senator Barker will soon leave for Philadelphia and while in the East a corporation will be formed under the laws of New Jersey to build the road. It is stated that the work of building will soon begin and be pushed rapidly.

Lancaster, Pa.—A suit in equity has been begun by William E Evans, of New York, against the Pennsylvania Traction Company and others. The suit is brought to contest the right of the company to lease and control street railways throughout the state of Pennsylvania. The following companies are made defendants: The Lancaster City Street Railway Company, the Lancaster and Millersville Railroad Company, the Lancaster and Columbia Railway Company, the Columbia and Ironville Street Passenger Railway Company, of West Hempfield township; the Lancaster and Strasburg Railway Company, the Columbia and Donegal Railway Company, the Lancaster Traction Company, the Pennsylvania Traction Company, and the Provident Life and Trust Company, of Philadelphia.

Atlanta, Ga.—W. C. Hall and Dayton Hall have purchased an interest in the Atlanta Traction Company, and the company will begin the construction of several miles of new railway. The following officers have been chosen: Dayton Hall, president; W. C. Hall, vice-president; W. L. Seddon, secretary. The company will build several suburban lines, and proposes to build tracks on several of the principal streets of the city, not at present occupied.

Cable Patent Void.—In the case of the Butte City Street Railway Company vs. Pacific Cable Railway Company for an infringement of patent for improvement in street cable railways, issued by Andrew S. Halladie, and assigned to appellee, the court decided the patent void for "want of invention."

Turn-Table Patent Invalid.—In the case of the Pacific Cable Railway Company against the Butte City Street Railway Company the United States Circuit Court in Montana has decided that a patent issued to Joseph Britton for a cable turntable is invalid.

Albany, N. Y.—The Albany City Railway Company has arranged to start at once its Troy-Albany freight service. The company has three freight cars which are similar in appearance to railroad baggage cars, but are only thirty feet in length.

H. M. Whitney Will not Resign.—Mr. H. M. Whitney, formerly president of the West End Street Railway Company, Boston, says there is no truth in the rumor that he is to resign from the directory of the West End company.

B. E. Tilden & Co., manufacturers of replacing frogs, sustained a considerable loss on April 9, by the destruction of their Chicago shops. The firm still has on hand sufficient replacers to meet orders.

Milwaukee, Wis.—Henry C. Payne, of the Milwaukee Street Railway Company, has announced that on May 1 the wages of the men will be reduced from 19 to 17½ cents per hour.

Cannot Carry Freight.—The Massachusetts state senate has rejected the bill to authorize street railway companies to carry merchandise.

TRADE NOTES.

Dixon's Graphite Cycle Lubricant.—The Joseph Dixon Crucible Company, Jersey City, N. J., is putting a cycle chain graphite on the market, which for purity of graphite and usefulness is said to be vastly superior to anything of the kind heretofore prepared. The graphite is not only of the choicest stock, but is ground to an impalpable powder, and then reground with a high grade of lubricating oil. This material, when applied to the chain of a bicycle, penetrates the bearings and thoroughly lubricates and protects them from wear and rust. The Dixon company will shortly put the same material on the market in the form of a solid stick, for the convenience of wheelmen who wish to carry it in their tool bags.

William Tod & Co., of Youngstown, Ohio, have received an order from the Edison Electric Illuminating Company, of Brooklyn, N. Y., for two 1,200 horse power engines, designed by E. F. Williams. The type is vertical, three cylinder compound, having one high pressure and two low pressure cylinders, acting on three sets of cranks, the high pressure cylinder discharging its steam into a receiver, common to both low pressure cylinders. The service is to be "direct connected" with two 400 K. W. Edison generators, the armatures to be mounted on the ends of the crank shaft being "overhung."

The McLean Armature Works, 197 South Canal street, Chicago, reports that its business is very satisfactory and is steadily extending and increasing. As this company winds and repairs armatures of every make and description, it is no unusual thing to find here a dozen or more types of armatures, and often embracing the little fan motor and the big power generator. Armatures from the first practical machines put on the market, and from the latest pattern of street car motors frequently lie side by side in this big electrical hospital. The company does a large amount of street railway work.

The United Columbian Electric Company, of 280 Broadway, New York City, is sending out a new pamphlet giving a description and some illustrations of the Winkler twin-series railway motor. A special feature of this pamphlet is a table giving the details of a test made upon the line of the Union Railway Company, New York City, February 21, of this year. This table gives the results of tests made with Westinghouse, General Electric, and Winkler e quipments, using similar cars and trucks, loaded in each case with 4,180 lbs. and run over the same route.

The Hoppes Manufacturing Company, Springfield, O., manufacturers of the Hoppes feed-water purifier, have secured the contract for the purifiers to supply the boilers with pure feed-water for the City Electric Light Plant now being built by the public lighting commission of Detroit, Mich. The Hoppes purifiers have been selected after very strong competition. The order calls for seven 300 H. P. purifiers to carry 165 pounds of steam working pressure. Each purifier is required to heat and purify 9,000 pounds of boiler feed-water per hour.

Pepper & Register of Philadelphia, have directed our attention to a statement in our trade notes of the issue of March 24, to the effect that the bond method of Stern & Silverman had been adopted by the Electric Traction Company of that city for its entire system. They say, "We beg to call your attention to the error, as the bond which will be adopted will be that manufactured by the Technic Electrical Works and the contractors for the total bonding of the Electric Traction Company's lines will be Pepper & Register."

The Joseph Dixon Crucible Company, of Jersey City, N. J., has issued for the benefit of the trade a little pamphlet called "Graphite as a Lubricator Scientifically and Practically Considered." This pamphlet is a second and revised edition and includes the results of scientific tests by Professor R. H. Thurston and others, on the lubricating properties of graphite. It contains much valuable information for power users.

The Western Telephone Construction Company, of Chicago, is receiving very enthusiastic testimonials from railway and street railway officials relative to the working of its magneto telephones. Supt. Tuttle of the N. A. Telegraph Company, Minneapolis, says that the instruments work finely over a metallic circuit 120 to 200 miles in length.

The Johnson Company, of Johnstown, Pa., has a force of men engaged in tearing out the end of the rail mill in order to erect an annex building about 100 feet square. Many other improvements are being made, the saw and straightening presses being moved in order to get more space.

The Fort Wayne Electric Company, through its Texas agent, Mr. E. J. O'Beirne, has sold to the city of Austin a large municipal plant. Mr. O'Beirne has recently added an extensive system of towers to the sale, aggregating about $150,000.

The Whitney Electrical Instrument Company has closed its general offices at 146 Franklin street, Boston, and all future business will be transacted from the company's works at Penacook, N. H.

The Sunbeam Lamp Manufacturing Company is now permanently located in its new offices at Room 304, 100 Washington street, Chicago.

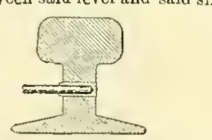
The Sioux City (Ia.) Engine and Iron Works has resumed operations with a force of 200 men, after a shut down of 6 weeks.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued April 10, 1894.

517,871. Car Brake Mechanism. William Lawrence, New York, N. Y., assignor to the Lawrence Electric Company, same place. Filed January 21, 1893.

In a brake mechanism the combination of a shaft, a clutch thereon, a lever to operate said clutch, and sliding bar, and means between said lever and said sliding bar for moving the former by the latter, said bar movable in either direction from either end of the car without changing the movement of the operating lever.



NO. 517,884.

517,884. Rail Connection. Theodore C. Paulsen, Chicago, Ill. Filed December 29, 1893.

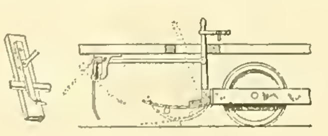
This is the combination of two large conductors having holes therethrough with caps closed at one end and a wire having one end inserted into each cap, whereby when said caps are driven into said holes, said conductors will be electrically connected together. (See illustration.)

517,886. Electric Railway. Henry S. Pruyn, Hoosick Falls, N. Y., assignor to James S. Gibbs, Chicago, Ill. Filed November 1, 1893.

In an electric railway system, an insulator containing an internal contact chamber, and having its lower end open and its upper end closed air-tight, a reciprocating contact rod moving in said contact chamber, and an air outlet leading from the contact chamber to the lower end of the insulator, whereby the insulator will act in the nature of a diving bell, in the presence of water, and thereby protect the contacts against moisture.

517,894. Fender for Street Railway Cars. Eldridge J. Smith, Washington, D. C. Filed December 18, 1893.

This is a flexible apron so made flexible to permit buckling up when a fixed obstruction is encountered provided with a flexible edge and hinged to the sill of a car in combination with hinged fingers and connecting rods. (See illustration.)



NO. 517,894.

517,904. Car Brake. Peter D. Van Vradenburg, Binghamton, N. Y. Filed September 7, 1893.

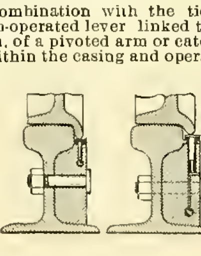
In a brake for vehicles, a disk or wheel secured to revolve in unison with the traction wheels, in combination with a pair of clamping shoes embracing the disk, right and left screws adapted to actuate the shoes toward and away from the disk, and cables, substantially as described, for actuating the screws.

517,940. Electric Railway System. Chas. D. Tisdale, Boston, assignor by direct and mesne assignments to himself and John D. Gould, East Boston, and Charles Healy and James E. Jenkins, Lynn, Mass. Filed January 17, 1893.

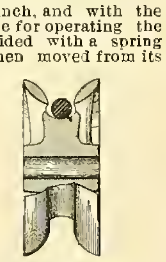
In an electric car, the combination with a truck provided with two axles, each axle being furnished with one conducting wheel and one insulated wheel, the conducting wheel of one axle being arranged diagonally opposite the conducting wheel of the other axle, of a motor attached to the truck frame, and conductors connected with the brushes of the motor and directly with the axles of the truck substantially as herein shown and described, whereby the current flows from one of the track rails through one of the conducting wheels and axle attached thereto, through the motor, through the other axle and the other conducting wheel to the other rail. (See illustration.)

517,944. Punch and Fare Register. John M. Black, London, England. Filed March 22, 1893.

In combination with the ticket punch, and with the thumb-operated lever linked to a slide for operating the punch, of a pivoted arm or catch provided with a spring pin within the casing and operating when moved from its normal position to prevent the punch from being operated, until the apparatus is opened to effect a disengagement of these parts.



NO. 517,940.



NO. 518,015.

517,948. Method of and Means for Speed Regulation of Electric Locomotives. Charles E. Emery, Brooklyn, N. Y. Filed October 14, 1892.

In combination with a change switch to connect several motors to operate singly or in series and in combination with a regulator and rheostat for regulating the current and with handles for operating the said switch and the said regulator from a working platform, an apparatus for locking the change switch by the motion of the current regulator and unlocking such switch when such regulator is in the desired position. (See illustration.)

518,006. Electric Locomotive. William Lawrence, New York, N. Y., assignor to the Lawrence Electric Company, same place. Filed January 21, 1893.

The combination of a commutator having contacts with forked brushes adapted to be engaged by said contacts, and means for moving either of said brushes into engagement with said contacts, and with side brushes.

518,015. Ice Cutting Trolley. Robert W. Thompson Cleveland, Ohio. Filed November 4, 1893.

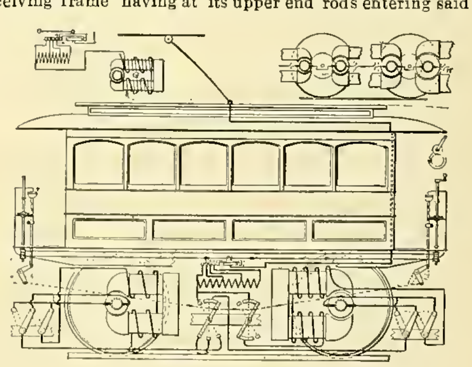
In a combined trolley wheel and wire stripper, the combination of a hub provided with a central disk grooved on its edge, peripheral rings secured by radial arms to the disk and hub at either side of the disk but separated therefrom by annular openings, and cutting inner edges integral with the rings. (See illustration.)

518,071. Trolley Wire Insulator. Louis McCarthy, Boston, Mass. Filed June 8, 1893.

This is an insulator for trolley wires comprising an outer case or receiver having one or more arms by means of which the insulator may be secured to the span wire, an insulated portion fitting within said receiver, a screw bolt passing through the top of the outer case or receiver and entering the upper part of such insulated portion for securing said insulated portion within said receiver and a screw connection for securing said insulator to the ear or slip on the trolley wire.

518,115. Car Fender. William V. McManus, Baltimore, Md. Filed November 8, 1893.

The improvement in car fenders consisting of the guide bars, the links suspended freely above said bars, the receiving frame having at its upper end rods entering said links and projecting above the guide bars, and provided near its front end with slots inclining upward toward their front ends, pins or projections from the guide bars entering said slots and springs on which the rear end of the frame is freely suspended.



NO. 517,948.

518,126. Car Fender. Benjamin Tranter, Brooklyn, N. Y., assignor of one-half to William Burton, same place. Filed December 13, 1893.

The combination, with a car, of a fender arranged beneath the car and having its rear end pivotally connected therewith, rollers on the front end of the fender, braces pivoted to the front end of the fender and adapted to slide vertically on the car, and a lever mechanism for moving the fender forward and backward.

518,170. Elevated Railway. Lee Anderson, Paris, Tex., assignor of one-half to J. J. Dickerson, Ben H. Denton and Jas. H. Johnston, same place. Filed October 21, 1893.

In an elevated railway a car having wheels above and below the same and adjustable connections for varying the distance between the upper and lower wheels.

STREET RAILWAY GAZETTE

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CONTENTS.

Chicago to St. Louis Again. The project to build an air line electric railway from Chicago to St. Louis, of which we heard so much last year has been revived after an enforced retirement due to the financial troubles that prevented the carrying through of any large undertaking of this character. The project, as we have always maintained, is a most commendable one, and there is no good reason, from an engineering point of view, why the line should not be built and operated successfully. Both civil and electrical engineers stand ready to build and equip the line when the necessary capital is forthcoming; and there ought to be no serious difficulty in raising money for such an undertaking.

Tunneling Buildings. A novel plan of condemning the right of way through valuable buildings is proposed by the Northwestern Elevated road in the city. The scheme is detailed elsewhere in our columns in connection with an illustration of the proposed plan. The track structure will be entirely independent of the buildings and will stand upon its own foundation. One of the most interesting innovations, however, is the plan to place "shops" along the sides of the car tracks entirely through the buildings so that the passageway will be in the form of an arcade with the car tracks along the center. The project is certainly a bold one, involving the expenditure of very large sums of money in its fulfillment, and its outcome will be watched with interest.

Underground Electrolysis. The discussion of Mr. Farnham's paper, printed in our last issue, has brought out the opinion that in many cases corrosion of pipes is attributed to electrolytic action very much as many fires are attributed to electric wires—because there seems to be no other reason for the injury. Of course, most of the cases cited by Mr. Farnham were well authenticated, but it is certainly not impossible that some at least of the electrolytic action may be due to other causes—in some instances perhaps to earth currents, as was suggested by Prof. Stine; or the corrosion may be a chemical one due to the action of the gaseous products of the soil and its contents. It is safe to say that the whole truth of this matter is not yet known, and that while there is undoubtedly much damage rightly ascribed to the action of the "stray" currents of the electric railway, it is as yet too early to jump to the conclusion that every piece of rotten water pipe that is dug up in the neighborhood of an electric railway is the result of the electrolytic action of the railway current. We understand that Mr. Farnham, since reading his paper, has made some further investigations as to the minimum voltage that will produce the results shown, and these may have some bearing in locating the ultimate cause of the trouble.

Conductors' Liability. An interesting decision outlined elsewhere in this issue holds that a conductor's liability for the safe transportation of his passengers extends much further than has often been supposed. It is held that his duty has not been discharged to the public when he has stopped his train and waited what may appear, according to his schedule, a reasonable time for passengers to embark. He is bound, so the court holds, to exercise the highest degree of diligence practicable to protect passengers and prevent accident. He is also bound to know when he starts his car suddenly with full force that no person attempting to embark is at that moment with one foot on the platform and the other on the ground and with his hand upon the railing in the act of getting on board, or is otherwise in a position of danger. The decision goes further in this respect than would seem justified, especially as in the case tried it was shown that the defendant might with perfect safety have boarded a trail car beside which he was standing, when as a matter of fact he ran alongside the train to catch and get on board the grip car. The court appears to take the ground that what the conductor may deem a reasonable length of time for a stop may not be so considered by the public, and that the opinions of the latter are bound to be respected. Such rules strictly applied in practice would practically prohibit rapid transit.

Activity in Chicago. More real activity in street railway work in Chicago and vicinity has been manifested during the past 10 days than for a long period. The Van Buren street tunnel, a magnificent piece of engineering carried through to completion by the West Chicago Street Railway Company, has been opened, the new cable put in service and the cars are now regularly operated around the Dearborn street loop. The Northwestern Elevated has filed its plans, and only awaits the permit of the city officials to begin operations on its new lines. The North Chicago Electric Railway Company has let the contracts during the week for its car, track and station equipment, and will soon begin construction work. In the south end of the city ground was broken a few days ago for the tracks of the Englewood & Chicago Electric Railway Company's lines, and the contract for the equipment and construction of the overhead work has been placed. The Chicago General Street Railway Company has found additional equipment necessary, and has placed an order for 25 cars. Besides all this work now in progress, there is the continued agitation for the introduction of the overhead trolley on the horse lines of the north, south and west sides of the city. Indeed, the ordinance granting the necessary rights for the north and west side lines passed the council a few days ago, as stated elsewhere in these columns, but this will undoubtedly be vetoed by the mayor who believes in nothing that does not originate with himself. The rights for the south side lines are yet to be acted upon, but will undoubtedly be reported favorably and passed in some form at an early meeting of the council. The two west side elevated lines, the Metropolitan and the Lake street, are both pushing construction, the former getting ready for an early starting of its cars and the latter making needed extensions. With all this activity in street railway matters entirely within the city limits of Chicago, the people ought soon to be well supplied with satisfactory rapid transit.

Local Institute Meetings. The holding of local meetings of the American Institute of Electrical Engineers in this city has proved even more satisfactory than had been anticipated. The plan necessarily involved a number of difficulties, but these fortunately have proved much smaller obstacles than was anticipated and the continued success of the meetings is now assured. That the meetings should occasionally be held one week later than the corresponding meeting of eastern members in New York City does not in the least detract from the interest in the reading and discussion of the papers by the Chicago members. The attendance at the last meeting and the discussion of Mr. Farnham's paper furnishes good evidence of this fact, the postponement in this case being deemed advisable because of the large number of lantern slides that formed an accompaniment to Mr. Farnham's report of his investigations. The mere fact that the paper has been published during the week in the technical journals in no way detracts from the interest in such a meeting. Indeed such publication is always desirable and for this very reason advance copies of the Institute *Transactions* are printed and circulated among the members before the paper is presented by the author. This method is pursued so that the more thorough acquaintance with the contents of the paper which any member may thus acquire will lead to more thorough discussion—a feature of such meetings that is always of the greatest importance. When thus published in advance the paper may be and often is taken up for discussion at once, its actual reading before the members being considered unnecessary when it has already been carefully studied by those most interested. The relative attendance at the two meetings—100 in New York and 60 in Chicago—when the comparative membership in and around the two cities is taken into consideration indicates a more active interest in the work of the Institute among the western members than among those in New York and vicinity.

PROGRAM OF THE ATLANTA STREET RAILWAY CONVENTION.

The following is a list of the subjects and special committees appointed to report upon them at the thirteenth annual meeting of the American Street Railway Association, to be held in the city of Atlanta, Ga., October 17, 18 and 19, 1894:

Can the T Rail Be Satisfactorily Used in Paved Streets? Joel Hurt, president, Atlanta Consolidated Street Railway Company, Atlanta, Ga.; S. Hendrie, manager, Wyandotte & Detroit River Railway Company, Detroit, Mich.; H. J. Crowley, engineer, Atlanta Consolidated Street Railway, Atlanta, Ga.

City and Suburban Electric Railways: Edwin C. Foster, superintendent, Lynn & Boston R. R., Boston, Mass.

Mail, Express and Freight Service on Street Railway Cars: Richard McCulloch, electrical engineer, Citizens' Railway, St. Louis, Mo.

The Best Method of Treating Accidents and Complaints: John B. Parsons, general manager, West Chicago Street R. R. Company, Chicago, Ill.

Street Car Wheels and Axles: D. S. Cook, electrical engineer, Trenton Passenger Railway Company, Trenton, N. J.

Transfer and Commutation: Rodney Curtis, president, Denver Tramway Company, Denver, Colo.

The T Rail Construction of the Terre Haute Street Railway Company: M. F. Burke, superintendent, Terre Haute Street Railway Company, Terre Haute, Ind.

A Standard Form for Accounts for Street Railways: H. I. Bettis, consulting engineer, Atlanta Consolidated Street Railway Company, Atlanta, Ga.

CAR FENDER COMMISSION IN BALTIMORE.

Mr. Leonard, chairman of the City Passenger Railway committee, of Baltimore, has introduced and had passed unanimously by both branches of the city council the following resolution:

Resolved by the Mayor and City Council:—That the mayor, city register and city commissioner be and they are hereby constituted a commission to inquire into and report in writing to the city council as soon as may be convenient, the description of car fender which, in their judgment, is desirable for the city council, in compliance with chapter 210 of the acts of 1894, to require the city passenger railway companies to adopt.

That the said commission be and hereby is authorized and empowered, if in their judgment desirable to do so, to employ one or more competent engineers or other experts and to send the same to inspect the passenger railway systems of other cities to aid the commission in their investigation.

That the sum of $2,000, or so much thereof as may be necessary, be and is hereby appropriated to defray the expenses of said commission and such expert or experts as they may employ, said sum to be taken from the amount set aside for ordinances and resolutions. And be it further

Resolved, That the said commission be requested to submit with their written report to the council such form of ordinance as they would advise to be enacted in the premises.

PROGRAM OF THE ANNUAL MEETING OF THE AMERIAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual meeting of the Institute will be held at Philadelphia on the afternoon of May 15. At this session the results of the election of officers will be announced and the reports of the council and treasurer will be read. Other matters to be brought up will probably be the revision of the election rules and recommendations of the committee on units and standards. The annual dinner of the Institute will occur in the evening. Wednesday and Thursday will be devoted to the reading and discussion of papers, the list reported by the committee being as follows:

Discriminating Lightning Arresters, and Recent Progress in Means for Protection Against Lightning; Alexander Jay Wurts.

The Law of Hysteresis (Part III) and the Calculation of Ferric Inductances; Charles P. Steinmetz.

Alternating Currents and Fuse Wires; Dugald C. Jackson and R. J. Ochsner.

The Waste of Zinc in Open Circuit Batteries when Standing Idle; Henry A. Lardner.

Some Storage Battery Phenomena; W. E. Griscom.

Central Station Economy; C. Reginald Van Trump.

A Review of the Progress of the American Institute of Electrical Engineers, Edwin J. Houston,

Standardizing Electrical Measuring Instruments: (a) By the Potentiometer Method; (b) An Improved Direct Reading Potentiometer; Elmer G. Willyoung.

Experiments with Two-Phase Motors; Louis Duncan.

Test for Closed Coil Arc Dynamo; R. B. Owens.

Relative Advantages of Toothed and Smooth Core Armatures; Alton D. Adams.

Resonance Analysis of Alternating and Polyphase Currents; M. I. Pupin.

IS THE CUTTING OF LINES OF FORCE A NECESSITY?

Editor Street Railway Gazette:—In your issue of April 14, page 168, I note Mr. Perry's explanation of induction without the "cutting" of lines of force. I now see that the difference between him and myself rests in the fundamental conception of the magnetic lines. His idea is

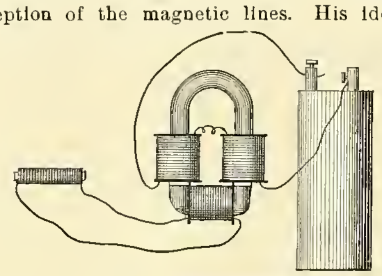
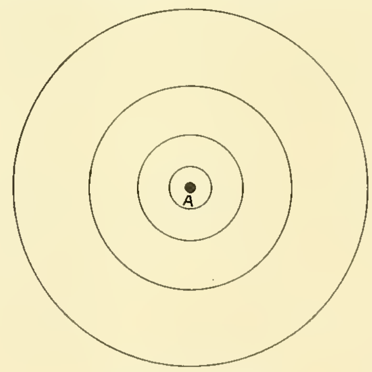


FIG. 19. (REPRODUCED.)

that in his figure 19, before referred to, "the lines of force rush out from the north pole, *thread* themselves *through* the solenoid and enter the south pole * * * ." Hence the lines must have a beginning and an end. My idea is that the lines of force are closed (endless) curves, and and as such cannot get into or out of the secondary solenoid of figure 19 without cutting it. This was Faraday's idea, and is, so far as I know, the idea held in treatises on magnetism and electricity. Lines of force are not supposed to start into existence when a magnetic field increases, but are supposed to "contract towards the wire or magnet" as the magnetic strength rises.

Take the simple case of a straight wire perpendicular to the plane of the paper and carrying a current: Let A in the figure be sec-



LINES OF FORCE.

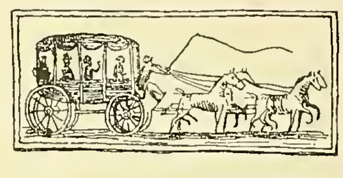
tion of the wire by the plane of the paper. The lines of force are circles increasing in diameter to infinity. If the current in the wire increases these circles diminish in diameter and are crowded more closely together. If the current diminishes they expand, and if it ceases they disappear by enlarging to an infinite diameter. They behave as though they repelled each other, and were drawn in toward the wire against their mutual repulsion by the effect of the current. I cannot conceive of a line beginning at some point in space and rushing round the wire until it returns into itself. The lines in Mr. Perry's figure 19 are the resultants of just such circular lines around the individual wires of the primary coils. When the primary current is turned on the closed curves come crowding in upon each other cutting through both secondary and primary, developing the E M.F. of the one and the counter E.M.F. of the other. The effect of the iron core in figure 19 is simply to permit of more lines of force being crowded into the same space. It is as though the lines repelled each other less in iron than in air. If the iron of figure 19 were continuous and homogeneous, I do not see where Mr. Perry would find a north pole from which the lines could start to thread through the coil, according to his theory. According to all conventions the lines do not exist there until the primary current is started, and I find it impossible to conceive of their spinging into existence in the core and threading through the coils.

It is perfectly correct and proper to describe the E M.F. in a closed circuit such as the coils of a transformer or of the armature of a dynamo, as proportional to the rate of change in the number of magnetic lines passing through it, but in the case of conductors carried around the pole of a magnet so called unipolar induction I do not see but we are compelled to consider the rate of "cutting," for here the number of lines passing through the area does not change. If lines of force are closed curves there *must* be cutting whenever the number of magnetic lines in a closed circuit change, and the rate of cutting must be the same as the rate of change. It seems to me, therefore, that the cutting of lines of force is the general condition of the development of E.M.F., of which the change in the number of lines passing through an area is only a special case.

Vineland, N. J. Wm. A. Anthony.

FROM JERSEY CITY TO NEWARK BY STAGE COACH AND TROLLEY.

It would be interesting, in view of the opening for public use in the last week of the new electric line connecting Newark and Jersey City, N. J., to trace the evolution of the facilities for travel and traffic between the two cities from the days of stage coaches up to the present time. Exactly one century ago, a new line of stages was established between the two cities, in addition to one which had been running several years. The advertisement of the new line appeared in *The Newark Gazette* of June 18, 1794, and here it is, reprinted verbatim from a brown, worn, time-eaten copy of that paper:



FROM JERSEY CITY TO NEWARK 100 YEARS AGO.

A four-horse stage will leave Archer Gifford's, in Newark, every morning (except Sunday), at half past five o'clock, and will leave Powles Hook at 5 o'clock in the afternoon for Newark. This arrangement gives time for doing business in the city and the coolest hours for traveling. Passengers chosing this conveyance may apply for seats to John Bond, at A. Gifford's.

J. N. Cumming.

And here is the advertisement of the rival line printed in the same paper:

The subscriber, after acknowledging past favors, begs leave to inform his friends and the public that, for their greater convenience, his stage will leave Newark at 6 o'clock every morning and Powles Hook at 4 o'clock every afternoon, Sunday excepted. Passengers are desired to take their seats the evening previous by sending their names to the subscriber only, and not to the taverns, as through hurry of business of the landlords they are frequently forgot. Extra stages, horses and chairs, and saddle horses to be had of the subscriber, or of J. H. Butman, No. 50 Cortlandt street, New York, on very reasonable terms, to go to Paterson, or any other part of the continent, to whom application may also be made for seats in the above stage.

N. B.—Passengers will also be taken up and set down in any part of the town.

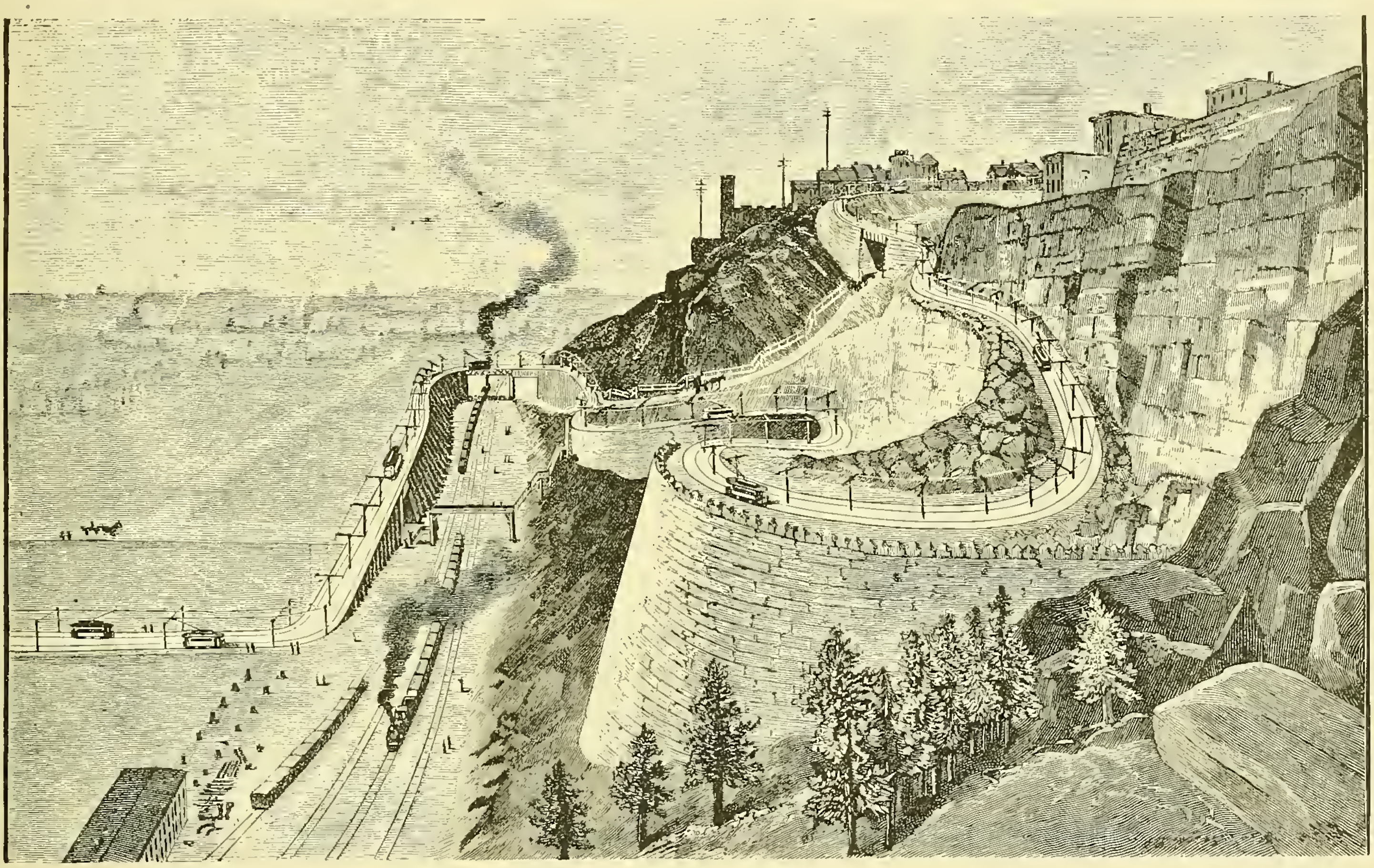
Newark, June 10, 1794. Thomas Ward.

The new line of the Consolidated Traction Company between the two cities was put in operation on the 20th inst.

Detroit, Mich.—Ex-United States Senator Dorsey of Denver, Colo., was in Detroit recently looking after the interests of himself and friends in connection with the purchase of the street railway lines of the city, in case the mayor's franchise should not be accepted by the Citizens' company.

THE HILLSIDE LINE OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

The North Hudson County Railway Company is a corporation owning a number of miles of surface and elevated railroads in Hudson County, New Jersey, which extend in their operations from Jersey City to the northern line of the county. This part of the country is characterized by the beginning of the hill which eventually forms the basis of the Palisades. Between the river and the foot of the elevated ground is a large area of flat land. The North Hudson County Railway Company has to provide transportation from the ferries on the river side to the top of the hill, involving a rise in some cases of nearly 200 feet. There are three means of access to the hill top—one from Hoboken Ferry by elevated road operated by trolley; and another at the terminus of the West Shore ferries by elevator and elevated road. We illustrate herewith a third structure, by which the summit of the hill is reached by a trolley line, known as the Hillside electric road. The view shows the general construction and line of the road, and its extreme picturesqueness, in addition to its engineering interest, will be obvious features not at all exaggerated in our illustration. A map of the road was published in our issue of March 24. The portion of the road which we illustrate commences at Madison avenue and Fifteenth street, at West Hoboken, a point nearly opposite Fifteenth street in New York City, and includes the interesting part, as from the ferry to this corner it is an ordinary surface trolley road. Here the ascent begins. By two loops it climbs the hill to Palisade avenue, the horizontal distance in a straight line between these two points being 700 feet. By constructing the loops as shown a line 3,688 feet long is developed for the ascent of 160 feet. The rise begins with a wooden trestle running nearly parallel with and to the east of the railroad tracks of the New York, Lake Erie and Western Railroad and of the New Jersey Central Railroad, the cars as they ascend going almost directly south. A couple of blocks below is a curve of 90 degrees, with a radius of 75 feet, crossing the tracks of the railroads just mentioned on an iron truss. Going around another curve of similar radius and of 93° 58′, the road curves along the face of the hill, gradually rising and crossing the Hillside wagon road, which course on the ascent is now in a general direction to the north, until at an elevation of 110 feet it enters the northern loop, and with a radius of 60 feet goes around a curve of 215° 16′. The course is now to the southwest, and, still climbing the hill, the line crosses near the 140-foot contour line for a second time the Hillside wagon road, and going through an arc of 100° 32′ with 100-foot radius, it reaches its destination 160 feet above its commencement and connects with the rest of the system. Our cut is reproduced from the *Scientific American*.



HILLSIDE LOOPS OF THE NORTH HUDSON COUNTY ELECTRIC RAILWAY.

POSITION OF SINGLE TRACK ELECTRIC RAILWAY IN COUNTRY ROADS.

The great extension of the electric railroad system in his state, says Henry Manley, of Massachusetts, in the current number of *Good Roads*, requires the settlement of a question that has long troubled those having to decide it, that is, the position of a single track electric railway in country roads. Two positions have been in common use for roads in such localities, one being the center of the road, the other, the side of the road wholly away from the traveled part. The objection to the first position is, that practically the whole road is given up to the street railway, all travel by other vehicles must be on the inclined surface toward the gutters and upon both sides of the street railroad requiring the maintenance of two roads each of an inferior character. The use of the second method, interferes materially with proper surface drainage, etc., brings the railroad in front of every man's door, leaving no place for teams to stand, and being a nuisance in receiving and delivering goods of any kind. In entering villages it becomes absolutely necessary to change the position of the track to approximately the center of the roadway. This matter has received the attention of the highway commission, but I have never heard that they have expressed any opinion as to which is the better method.

As a contribution to the solution of this question I would suggest that the track be placed in the proper position for one track of a double track system, that is to say, that the center of the track be placed parallel with the center line of the street and about five feet distant from it. This will allow the construction of a good roadway which shall occupy the center of the street and one side; this roadway can be properly drained and maintained as a single roadway; only vehicles may use the middle and highest part of the road; the car tracks will be sufficiently distant from every man's door to allow teams to stand in front of it. If a second track is required it may be placed in a corresponding position on the other side of the roadway. This arrangement would also allow connecting tracks on intersecting streets to be laid to the best advantage without change of general plan. This proposition seems to me to overcome most of the disadvantages named, and to be open to the one criticism that it brings the electric car uncomfortably near to the line of ordinary travel. I would not say that I have given this matter sufficient consideration to be absolutely of the opinion that this is its best place, but there certainly seems to be less objection to this position than that of either of the others mentioned.

OHIO VESTIBULE LAW UNCONSTITUTIONAL.

The street railroad vestibule law of Ohio, under which several indictments are pending against the two consolidated companies of Toledo, has been declared invalid by the common pleas court in Springfield, O. Judge Miller there sustained a demurrer interposed by the defense and discharged the accused.

The sole ground of objection to the statute, which was deemed insurmountable, was the fact that it provided for protection of drivers of electric cars only, leaving drivers of cable and horse cars without protection. A similar objection has been raised by the defense in the Toledo cases.

Danbury, Conn.—The construction of an electric road is again under consideration.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Sixteenth Article.)

THE DYNAMO-ELECTRIC PRINCIPLE.

There is still a third method and this is the most usual one, viz: to make the dynamo excite its own fields by causing either, all or a portion of the current generated by the armature to pass around the field magnet coils. But the question naturally arises, how are we to start such a machine into action? When the armature stops the current stops and the magnetism of the fields disappears. If we start the machine from rest there being no magnetism in the fields, there will be no lines of force for the armature wires to cut—the armature will therefore generate no current and our provision for utilizing that current to excite our field will be useless. So reasoned the early builders of electrical machines and it was thought necessary for a long time to separately excite the fields at least until the machine got into action. It was therefore a very important discovery that such was not necessary. It seems that all iron however soft has a *little* magnetism which it either derives from the earth's magnetism or retains from previous magnetization (residual magnetism).

This may be very slight, but it is sufficient so that when the armature is revolved before the pole pieces it generates a very slight current. No matter how insignificant this current may be, as it passes around the field magnets it adds somewhat to their magnetism. This increased mag-

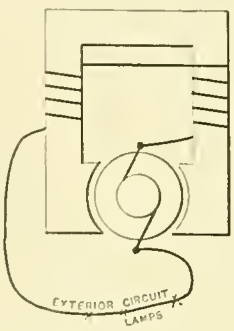


FIG. 51.

netism of the fields enables the armature to generate a little stronger current than before, and this produces more magnetism and that more current so that by the continued reaction between the field and armature, the machine "builds itself up," as the phrase is, until the magnets have arrived at full strength and the armature is putting out current to its maximum capacity.

This "building up" of the machine from practically nothing to its maximum output without outside help except from the power necessary to drive the armature, seeming at first sight to be very much like the attempt to lift oneself over the fence by one's bootstraps is known as the "dynamo electric" principle. These "self-exciting" machines which are by far the most numerous of those employed to-day are the true "dynamo electric machines."

SERIES, SHUNT AND COMPOUND WINDING.

The dynamo electric principle gives rise to three distinct types of machines. In the first type all of the current from the armature passes around the field coils, as in Fig. 51, before it goes out to the exterior circuit. Since the field coils are in *series* with the armature, a machine so wound is called a *series* dynamo or motor, as the case may be. It is evident that if resistances are placed in the outer circuit the amount of current that will flow around the coils will be lessened. This will lessen the strength of the field magnets, and this will still further lessen the amount of current that the armature can give, and if the exterior circuit becomes broken so that no current can flow, of course the field magnets no longer having any current in their coils lose their magnetism, and the armature ceases entirely to generate current. If the break in the outer circuit be now closed again the dynamo will gradually build itself up as before described under the heading "Dynamo Electric Principle," until it again attains its full strength, but this will take an appreciable time. A series dynamo, of course, could not be used on a multiple arc street railway or on the usual incandescent circuit, for on either of these circuits we want to have at our command the full strength of the current the moment we start the first car or turn on the first light. We cannot wait for the dyna-

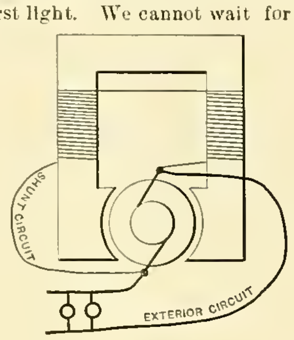


FIG 52.

mos to build themselves up. There are other objections also to series dynamos for these purposes, but for other purposes they have their use.

In the second type, Fig. 52, we only use a portion of the current generated by the dynamos to excite the fields. From the brushes there are two circuits, between which the current divides; one of these is the line circuit, which is of heavy wire sufficient to carry all the current required in the exterior circuit, and the other is a thin wire of great length and therefore of high resistance, which is wound in many turns around the field magnet cores. Since this latter wire is of high resistance, but little current passes through it; but as it passes many times around the magnet there are sufficient ampere turns with the small current for our purpose. This latter wire, which forms in this case the magnet coils, is in multiple arc or in parallel or "*in shunt*" with the exterior circuit. This type is therefore called the "shunt dynamo."

There is a law in the flow of electric currents to which we have before referred, that when several paths are open to the current the latter will divide itself among them according to the relative conductivities of those paths. In Fig. 52 the current has two paths open to it—one through the fine wire of high resistance, which from the magnet coils and the other through the large wire which forms the external circuit. The

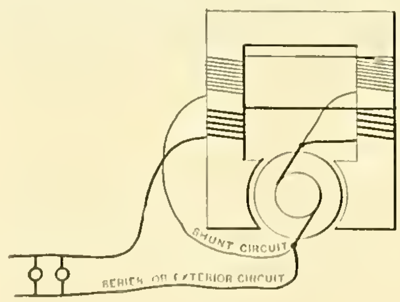


FIG. 53.

shunt circuit, as will be observed, is always closed so that no matter whether the external circuit be closed or not a current will always be passing through the field coils and the full magnetism which they are capable of imparting to the magnet is always maintained. The shunt dynamo is therefore peculiarly fitted for multiple arc circuits (street railway and incandescent lamp circuits) because as we know multiple arc circuits are always open when there are no translating devices (lamps, cars, etc.) operating. But if the magnetism of the fields be maintained the full current is always available the moment it is wanted. But the exterior circuit is one of variable conductivity. The resistance between the trolley wire and the ground is only half as great when two cars are running as when only one is in operation. The *relative* conductivities of the two paths therefore changes with the number of cars operated, being greatest in the outside circuit when there are many cars.

Now, supposing that with the speed at which our armature is driven and the magnetism which the ampere turns of our shunt coils is capable of producing our dynamo is capable of generating an electromotive force of just 500 volts when but one car is in operation. If a second car be started up the conductivity of the exterior circuit will have been increased and it will take a relatively larger portion of the total current generated by the armature. This will leave less to go around the magnet coils and the magnets become weaker. With weaker fields the electromotive force generated by the same speed of armature becomes less and we will no longer have a current of 500 volts, but something less than that. This loss of electromotive force is what is technically called termed "drop" and while in very short lines with but a car or two operating it may not amount to much; it becomes very serious in long lines with many cars or lights to feed. To correct this fault we sometimes have recourse to the third method of winding, which is known as *compound* winding, and the machines so wound are known as compound dynamos. The compound winding (Fig. 53), is a combination of the series and shunt windings. As shown in the diagram the winding consists of two coils, one consisting of a few turns of coarse wire

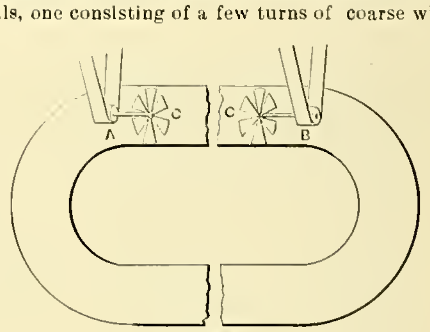


FIG. 54.

in series with the armature, through which all the current which goes to the exterior circuit passes, and the other consisting of the fine wire coils in parallel or in shunt to the latter. Now if we reduce the resistance of the exterior circuit by putting on additional cars, while we weaken the magnetizing effect of the fine shunt coils, as in the last case, the additional current which is diverted to the exterior circuit which has to pass through the series coils, compensates for the other loss. By putting on fewer or more turns of the series coils, we may exactly compensate for any loss of electromotive force that might be occasioned in a shunt machine by the addition of cars or length of line, or by putting on more turns than is needed for exact compensation may even cause the electromotive force to rise as the load on the dynamo increases. A machine wound to produce the latter effect is said to be "*over compounded.*"

THE REVERSIBILITY OF THE DYNAMO.

It will have been observed that heretofore we have referred to the dynamo and to the motor as though they were synonomous terms. We have done this not indiscriminately, but as the one or the other served the purpose of illustration the better. But as a matter of fact, the dynamo and the motor *are* one and the same machine.

Supposing we have in a pipe *C* two fans exactly alike (Fig. 54), each furnished with a pulley by which it may be belted to a line shaft or to other machinery. If we drive *A* rapidly it will force a current of air through the pipe *C* from *A* to *B*, and this current of air will cause *B* to revolve like a wind mill. If on the other hand we drive *B* by its pulley, the current of air which it will produce will drive A, and if the current be strong enough the latter, acting as a motor, may drive other machinery to which it may be belted. In the first case we have driven the fan A by belting it to a driving pulley, and it has become a generator of a current of air which, upon being conducted by the pipe C to the similar fan B has caused the latter to revolve as a motor, rendering it capable of driving other machinery through its pulley and belt. In the second case, B, as a generator drives A as a motor.

It is evident that these two fans are perfectly reversible as regards their functions. By driving either one it becomes a generator of air current capable of driving the other one as a motor. That is to say, if we apply mechanical energy to either, it gives out wind energy, if we may use such an expression, and if we apply to it wind energy, it will give out mechanical energy.

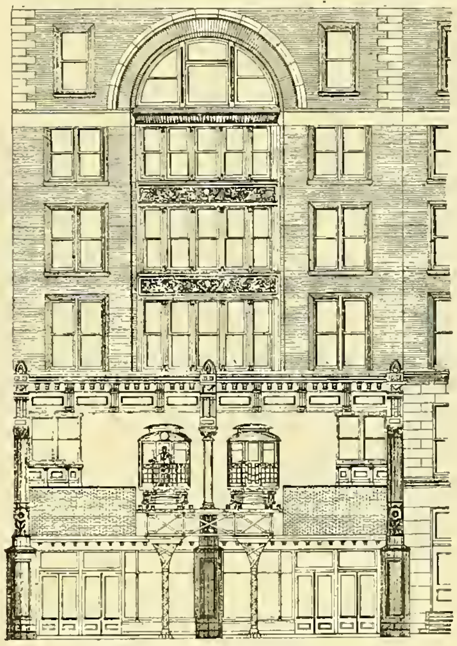
So it is exactly with the dynamo electric machine. If we drive the armature by steam or other power, the machine will generate an electromotive force—electrical energy—and if we apply electrical energy to its armature, the latter will revolve and give out mechanical energy. If two exactly similar machines have their brushes connected by electrical conductors they will behave toward each other exactly as do the fans. Since they are exactly alike, it is immaterial which we shall employ as a generator and which as a motor. If the armature of one is driven it will give rise to an electric current corresponding to the current of air in C, which by giving rise to a current will cause the other to revolve as a motor, the general rule being that any machine that will make a good generator will also make a good motor, and *vice versa*.

It will be seen from the above that the electric motor bears the same relation to the generator as the driven pulley on one shaft does to the driving pulley on another, and that the electric current by which the energy is conveyed from the generator to the motor performs the same office, exactly as the belt does which connects the driving pulley with the driven pulley. It is perfectly clear that either of two lines of shafting may be used as the driving shaft by connecting it with the steam engine, and if the pulleys which are belted together on the two shafts are of the same size it will make no difference in the operation of the machinery, to which shaft it is belted, but in mechanical operations it is often desirable to give the driven shaft a different speed from that of the line shaft, and for that reason the pulleys on the two shafts would be given different diameters to adapt them to the required conditions. So in electrical machinery, the motor may differ radically in *appearance* and also differ somewhat in minor details from the generator, to better adapt it to the particular work it has in hand. Thus in the street car motor compactness is a prime requisite, and it is allowable to sacrifice some of the requisites of a good machine in order that this one feature may predominate. But motors will not differ more in appearance from generators than they do from each other. While the construction of the two machines—the dynamo and motor—may be and frequently are, the same, the theory upon which they operate is entirely different—the one being the reverse of the other. The same drawings are, however, entirely applicable to the explanation of the motor.

NORTHWESTERN ELEVATED IN CHICAGO TO TUNNEL THROUGH BUILDINGS.

The Northwestern "L" proposes to solve the problem of a down-town loop by the adoption of the novel plan of boring a route through the second stories of buildings. The proposed plan provides for the condemnation of a strip forty feet wide through business houses on its right of way from the river to the alley north of the First National Bank building and then east to Wabash avenue. Every building in the way of the line—which will be on one side or the other of the alley where one exists—will be tunneled. The structure is arranged so that it rests on its own foundations, entirely independent of the building.

Over the structure that is built through the business district buildings eight stories high will be erected, so that the line, with the exception of the street crossings, will be practically a tunnel or conduit. Along the elevated roadway on both sides, from State street to the river crossing,



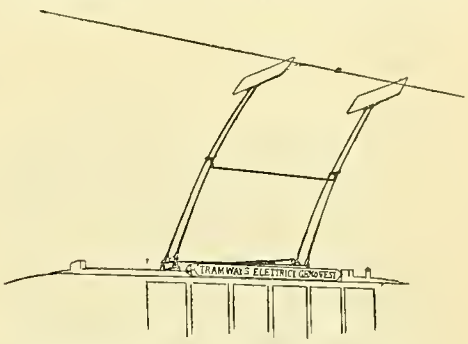
TUNNEL THROUGH BUILDINGS.

stalls will be built which will be leased for various purposes. A continuous walk will be built in front of thes stalls for passengers, and the trains in the down-town district will run at a slow rate of speed. Above the second story the building will be rented for whatever purpose seems best adapted to the wants of the community. In order to still further utilize the property of the railroad company, the space on the surface and below the railroad track will be improved and also leased. In this way the company expects to secure a perfect down-town terminal, with an income sufficient to pay at least the interest on the cost of the investment.

The company's plan contemplates a two-track structure on the south side and the stopage of trains at all street crossings, with electricity as the motive power. North of the river a four-track structure is proposed, the two inner tracks to be used for express trains. The plan, it is admitted, will involve the expenditure of millions, but its adoption, it is claimed, will enhance the value of property and its rents.

OVERHEAD CONTACT ARRANGEMENT OF THE GENOA ELECTRIC ROAD.

The accompanying illustration shows the contact arrangement used on the electric railway cars at Genoa, Italy, by the Siemens & Halske Company of Berlin, the contractors for the equipment. The actual traveling contract consists of the upper side of a rectangular frame supported by two tubular uprights. This upper side of the rectangle is easily renewed when worn. It presses against the under side of the trolley wire, being held against it by strong spiral springs. Two contact bars and two frames are provided for each car as shown in the illustration. The advantage claimed for this method of contact are greater reliability as compared with the wheel



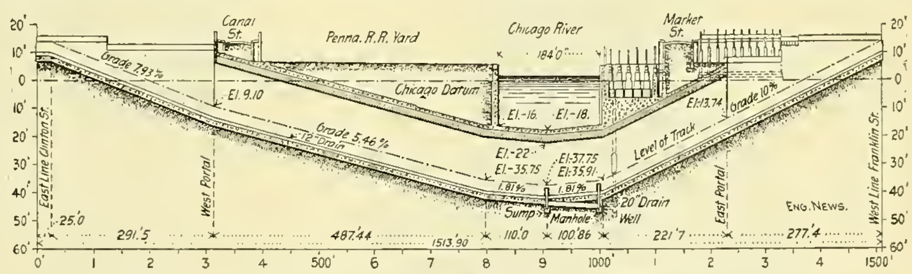
OVERHEAD TROLLEY OF THE GENOA ROAD.

contact as there is freedom from the danger of the trolley jumping from the wire. The contact bar is nearly as long as the width of the car. For this reason much less "guying" of the trolley wire is necessary in passing around curves, as the line may be allowed to follow chords rather than conform to the circumference of the circle.

VAN BUREN STREET TUNNEL, CHICAGO.

The new tunnel of the West Chicago Street Railroad Company under the Chicago river just north of Van Buren street forms now a part of the route of the Blue Island avenue and Halsted street cable cars. Up to the present time the cars were operated by cable within a block of the tunnel approach and were drawn into the business center by horses. Work on the tunnel was started about four years ago and it has been prosecuted under unusual difficulties. The section of the tunnel was, in the first place, unusually large and the material penetrated very unfavorable, being for the most part a soft, plastic clay having a natural slope of about 3 to 1. Again, the tunnel passed underneath the foundation of several large buildings and but a short distance underneath the tracks of the Pittsburg, Ft. Wayne & Chicago R. R. on the west bank of the river, all of which had to be either rebuilt or temporarily supported without seriously disturbing business. To this is to be added frequent and often long interuptions of the work by litigation, which required it to be done in sections often remote from each other, which had to be connected whenever circumstances would permit.

The profile of tunnel which is reproduced from *Engineering News* gives the dimensions of the tunnel which is by far the largest and best constructed street railway tunnel in Chicago. Between the outside tracks and the walls there is a clearance on each side of five feet. In the other tunnels the space at certain points is not over five inches and accidents have on several occasions resulted from the proximity of the cars to the walls.



VAN BUREN STREET TUNNEL OF THE WEST CHICAGO STREET RAILWAY COMPANY.

As the profile shows the grades are steep and to prevent the possibility of accidents from cars slipping it was determined to utilize a rack rail on each track. A pinion on each car which meshes into the racks can be instantly locked in case the car starts to slip and the car be brought to a standstill.

CHICAGO TROLLEY ORDINANCES PASSED.

At the regular meeting of the council this week the West and North Side trolley ordinance, which the old council refused to pass about three weeks ago, was taken up and after some amendments were incorporated it was passed by a vote of 48 to 18. One of the amendments passed was that the trolley system should not be used in that section of the city bounded on the north by the river, on the west by the river, and on the south by Twelfth street; it was also providing that where the cable power is now used, or where the companies have the right to use cable power, the trolley system shall not be used. This was adopted. The following also went through:

That for and in consideration of the privileges therein granted by the City of Chicago to the said North Chicago Street railroad company, the West Chicago Street railroad company, and the lines leased by the aforesaid companies. the said companies shall, at their own cost and expense, erect and maintain on the posts which they may erect within a radius of one mile of the City Hall, electric light lamps, to be of equal power of the lamps now used by the said city and to be placed on every second post or at a distance of every 200 feet, the same to be erected under the supervision of the Department of Public Works.

The principal provision of the ordinance in addition to the amendment given above is as follows:

That Sec. 1 of an ordinance passed by the city council of the city of Chicago March 21, 1892, authorizing and empowering the West Chicago Street Railroad Company and the North Chicago Street Railroad Company to operate their several and respective lines of street railroads by any or all of the four certain motors or motive powers, therein named; or by such other motor or motive power which said companies or either of them, shall see fit to adopt and use; provided, however, that such motor or motive power shall be practically noiseless, and, before using, shall be approved by the mayor and commissioner of public works; be, and said Sec. 1 of said ordinance is hereby amended by striking out the last clause in said Sec. 1, which reads as follows: "In event of electric power being used, the same shall be placed underground, and its method of construction shall first be approved by the commissioner of public works;" and substituting in place of said clause, and adding to said Sec. 1, the following: If electric power shall be used by means of overhead contact wires, such overhead wires, together with the necessary feed wires may be suspended from poles set within the curb limits of the street on either side thereof, or from bracket poles placed in the center of the street along such line or route; such poles and wires to be erected and maintained for the purpose of supplying electric current which can be used for power, heat and light purposes; and with the right to connect the wires herein authorized with the generator or power station, or any station or car house in connection with said railroad or railroads, or with any power house or station along any line or lines of railroad of said companies, or either of them used by either, in connection with its cable, horse, or electric system, a d all wires and conductors for the transmission of electricity in and along the street shall be constructed in a substantial and workman-like manner and under supervision of the commissioner of public works so as to interfere as little as possible with the public travel.

It is reported that Mayor Hopkins will again interpose his veto and the ordinance will then come up for passage again.

REVIVAL OF THE CHICAGO & ST. LOUIS ELECTRIC ROAD PROJECT.

Chief Engineer Hughes of the Chicago and St. Louis Electric Railroad says that ground will be broken and work be at once commenced on the Chicago division, extending to Alpine Heights, a distance of some thirty miles from Chicago. It is the intention of the company to extend a spur track from Alpine Heights to Joliet, a distance of about six miles. About forty miles of the Edinburg division was made ready for the track prior to the financial panic and this section will now be pushed to completion. Arrangements will be made with either the Metropolitan or Lake street "L" roads or the Atchison to bring its trains into the heart of the city. Arrangements have been completed for terminal facilities in the new union depot at St. Louis and for crossing the Mississippi river on the Merchants' bridge. The road is to be standard gauge. Seventy-five pound T rail will be used. Dr. Wellington Adams, the general manager of the company, has been busy perfecting his plans and arranging to raise the money necessary to push the road through to completion. The route surveyed is several miles shorter than any of the steam roads connecting the two cities.

The company confidently expects to run its trains at a speed of 100 miles per hour and has letters from the General Electric Company stating that it has no hesitancy in guaranteeing to build high speed motors capable of doing the work required and of filling the order for same within eight months of receipt.

GETTING ON AND OFF STREET CARS.

A recent decision in the United States court of appeals for circuit in which Chicago is located is important, as it affects the question of liability for street car accidents. A man named Hyman Cohen attempted to get on board one of the Madison street (Chicago) cable cars at Halsted street. The cars had stopped, but were about ready to start up. Cohen could have got on the rear car without difficulty, but he ran forward to get on the grip car. He had taken hold of that car when it started suddenly and he was thrown to the ground, receiving injuries.

Cohen sued the street railway company for damages in the United States circuit court. On the trial the judge called the attention of the jury to the fact that he had passed by the car which he might have boarded without danger for the purpose of getting on the grip car. This raised the question of contributory negligence, and the verdict of the jury was in favor of the company.

The case was appealed, and was thoroughly tried in the court of appeals. The judgment in favor of the company, based on the verdict, was set aside and a new trial ordered. The court seemed to hold that a passenger had a right to select one car in preference to another on which he should ride, and that he was not guilty of contributory negligence in choosing the grip car and passing by another car for the purpose of reaching it.

It was also held that if the car starts while a person is getting on or off and injury is caused the company is liable. On this point Judge Bunn, of the court of appeals, said:

The conductor of street cars, having the safety and even the lives of patrons in his keeping, has not discharged his whole duty to the public when he has stopped his train and waited what may appear, according to his schedule, a reasonable time for passengers to embark. He is bound to exercise the highest degree of diligence practicable to protect passengers and prevent accident. He is bound to know when he starts his car suddenly out with full force that no person attempting to embark is at that moment with one foot on the platform and the other on the ground and with his hand upon the railing in the act of getting on board, or is otherwise in a position of danger.

This is a significant caution to conductors, and it was emphacized by a judgment of several thousand dollars against the street car company.

REDUCTION OF STREET CAR FARES.

The Ottumwa Electric Railway, of Ottumwa, Iowa, has adopted a plan originated by its president and general manager, Mr. W. R. Daum, by which frequent patrons of the road can be given reduced rates that would not be available for the occasional rider. The company issues coupon books containing 100 tickets each, offering one book for $4.50, three for $12.90, five for $20.25, ten for $38. In addition to this the company agrees that the cover of each book, if presented at the office, will be accepted toward the purchase of another book at the following values: 25 cents if presented within 90 days, 50 cents if presented within 60 days, 75 cents if presented in 30 days from the date of issue. By this means those people who ride most frequently obtain the lowest rates. The company has limited this offer until May 15, and as an additional inducement further agrees that if 1,000 books are sold before that date the time will be extended 30 days for the acceptance on the covers at the values marked on all books sold by that date. The system is said to be working very successfully.

The Rochester (N. Y.) Railway Company, on and after April 25, will sell eleven tickets for 50 cents, and will issue a coupon book containing 110 tickets and sell the same at $5. The company will endeavor to have these tickets and books on sale at central locations throughout the city. The tickets and books can be purchased at any time at the office of the company. Tickets in packages of eleven can also be obtained from the conductors. The books must be obtained either at the company's office or at places where they are left for sale.

NEWSBOYS TO BE KEPT OFF NEW YORK STREET CARS.

Hereafter no newsboy will be allowed on any of the cars of the principal street railway lines in New York. This plan has been privately discussed among the leading surface railroad men of the city for six months. Notices have now been posted in the cars of the railroads in the agreement notifying the passengers, the conductors, and the newsboys that the boys will not hereafter be permitted to board the cars to sell papers. Two things led to this radical step. The first is the large and increasing number of accidents to newsboys. The introduction of the fast running cable has greatly increased the number of accidents to the newsboys and the companies have already paid out large sums of money on this account. The second cause is the great volume of complaints from the patrons of the roads, especially of the cable lines The Metropolitan Street Railway Company is the leader in the movement. The syndicate which owns the system has already established a similar rule for its roads in Philadelphia, Trenton, New York, Jersey City, and other places.

MEETING OF THE AMERICAN INSTITUTE IN CHICAGO.

On last Wednesday evening, the paper read at the New York meeting of the American Institute of Electrical Engineers a week previous, was read by Mr. A. V. Abbott, of the Chicago Telephone Company, and discussed by the Chicago members at their meeting at the Armour Institute. The meeting was well attended by members as well as others residing in Chicago and vicinity who were interested in the subject of electrolytic action on underground pipes and cables. Mr. Farnham's paper was printed in our last issue.

Among the members present were Messrs. Abbott, Arnold, Armstrong, Hibbard, Haskins, Rodman, Ray, Gutmann, Stine, O'Dea and others. The total attendance, which was over sixty, included a number of non-members, among whom may be mentioned Mr. Beach, a former president of the Chicago Electric Club, Mr. Welles of the Western Electric Company, Mr. Knox, electrician of the Chicago City Railway Company, Mr. Keithley, of the same company, and Alderman Mann, who has been a vigorous opponent of the introduction of the trolley in Chicago streets.

The western members are well satisfied with the success of the local meetings, and are especially pleased with the facilities offered by the Armour Institute people for the holding of meetings in the lecture rooms of that institution.

AMERICAN RAILWAY IMPROVEMENT COMPANY.

The Boston *News Bureau* says of the work of this company: "The American Railway Improvement Company of Boston has been reorganized with G. Arthur Hilton as president; vice Edmund Davis, George A. Beatey treasurer, and W. G. Wheildon assistant treasurer. The company has a capital of $1,000,000, of which $700,000 is paid in. The directors are as follows: Edmund Davis, W. G. Wheildon, G. Arthur Hilton, Thomas McCowbray, New York, and George A. Beatey. This board will be increased to nine members later. Mrs. Charles Hemenway and T. Quincy Brown of Boston have taken a large interest in this company and Mr. Brown will no doubt accept the vice-presidency. Branch offices have been opened in New York and Baltimore. The company has purchased the property of the Boston Chair Manufacturing Company, at Ashburnham, Mass., which covers six acres and is remodeling the plant for the manufacture of electric cars and electrical equipment. It has orders on hand now for 100 cars and equipments.

"The company has contracts on hand to build the following roads: Westchester and Philadelphia, 28 miles long, paralleling the Pennsylvania R. R., to cost $600,000; Baltimore, Hartford County & Susquehanna, Baltimore, Md., to cost $380,000; Union Street Railway, Sterling, Ill., to cost $190,000; Long Branch, Red Bank & Eatontown Railway, New Jersey, to cost $300,000; Braintree, Holbrook & Randolph Railway."

NEW WESTINGHOUSE STREET RAILWAY MOTORS.

In order to meet the requirements of street railway companies that demand, for reasons of their own, motors that are lighter and especially that have less weight upon the car axles, the Westinghouse Electric & Manufacturing Company has placed upon the market the motor herewith illustrated and described.

The new motor appears to resemble the company's No. 3 single reduction motor without the iron frame which serves as its support. The absence of this frame reduces the weight of the new motor without diminishing its rigidity. As a circular form of field may be mathematically proven to afford the greatest strength for any given weight of material, as a four-pole field must evidently give greater output than one of only two poles, and as the toothed armature, with a two circuit winding and lathe wound coils have many advantages, all these features are retained in the newly designed machine. The new motor is of the single reduction type; and the No. 12 is manufactured in three standard sizes of 20, 25, and 30 H. P., respectively. The No. 10 is designed for heavier work, and has 40 and 50 H. P. capacity.

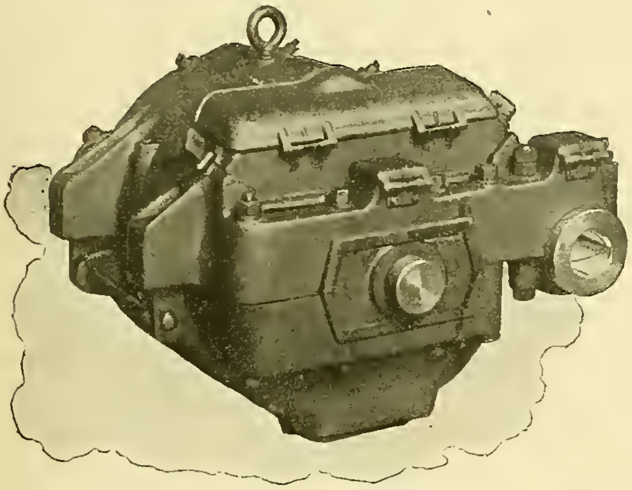


FIG. 1. NEW WESTINGHOUSE MOTOR.

The armature is of the drum type and is wound with machine made coils. Each of these coils consists of heavy insulated wire wound in rectangular form. The two longer sides of the coil are enclosed in cells of special insulating material, the whole being then wrapped with insulating tape of a superior quality. The coils are connected to the commutator segments so that the armature winding has only two circuits.

The field consists of four pole pieces projecting radially inward from a circular yoke or ring which parts in a horizontal plane through the shaft. In order to secure rigidity of construction, the two lower pole pieces, half of the circular yoke and end plates are made in a single, solid casting, which secures strength and at the same time completely protects the lower half of the motor. These features are well shown in Fig. 3.

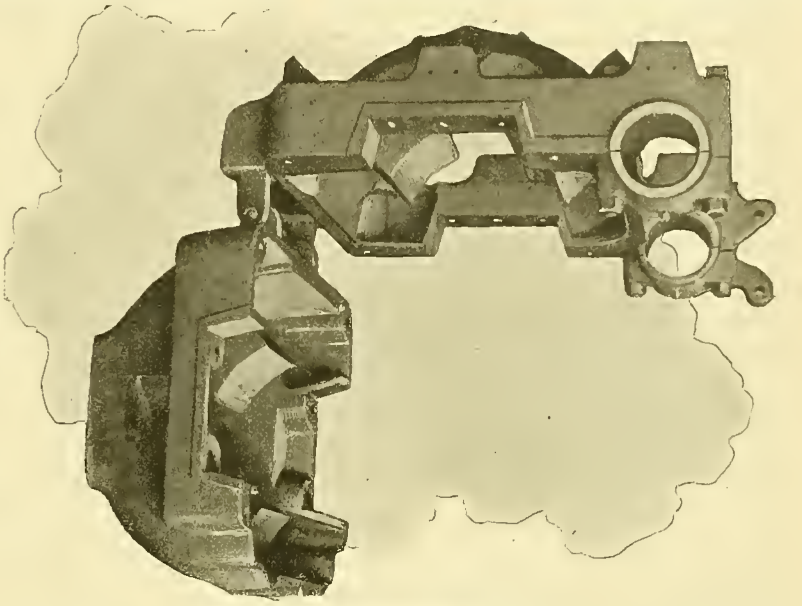


FIG 3. NEW WESTINGHOUSE MOTOR.

The rectangular frame which was a distinct feature of the No. 3 has been incorporated into the upper half of the field of the No. 10 and No. 12, so as to do double service, forming a part of the magnetic circuit and a part of the frame, and thus giving sufficient strength to the motor to hold the armature shaft always in perfect alignment with the car axle. On the side which is furthest from the axle of the car, the two halves of the yoke are hinged together, so that the interior parts of the motor are made easily accessible without the necessity of dismounting. The lower field casting has three openings, one directly below the commutator and the others at opposite ends of the casting. These openings are closed by water-tight covers, which may be removed to give access for the purpose of repair or removal of dust or dirt.

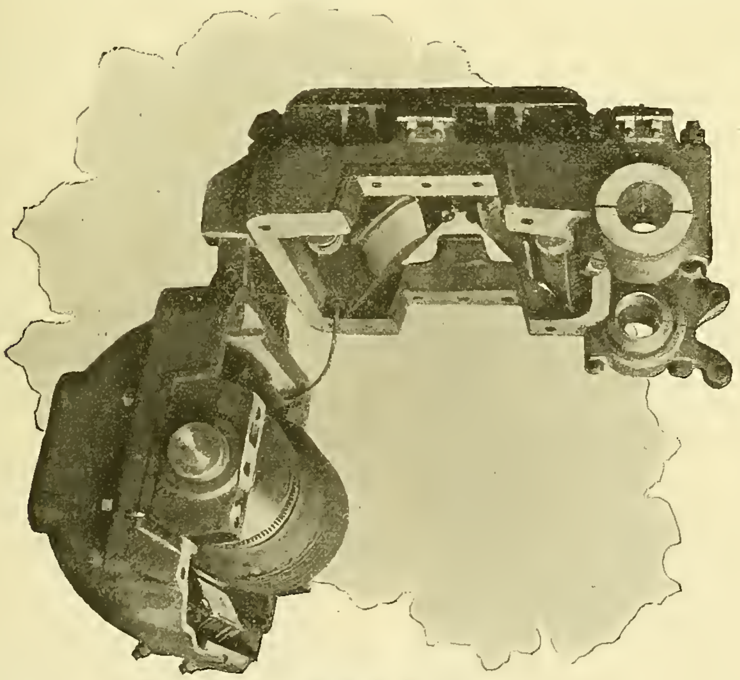


FIG. 2. NEW WESTINGHOUSE MOTOR.

The field coils are wound and insulated in the same manner as in the No. 3 motor, although the capacity of the winding has been somewhat increased.

The two brush-holders, 90 degrees apart on the top of the commutator, are held in position by a frame which is so designed as to constitute a part of the end of the upper field, and, together with a lid, completely encloses the commutator end of the motor, and entirely protects the inner parts. The lid is hinged and normally kept closed by a stiff spring, thus protecting the motor from water, snow and dirt, but allowing easy examination of the brushes and commutator.

The method of suspension relieves the axle of practically all the direct weight of the motor and avoids it is claimed what has been termed "hammering" of the rail joints. By reason of the increased strength of the upper field yoke, it is possible to suspend the motor directly in the line of its center of gravity, by means of suspension bars which run parallel to the sides of the truck, and have their ends supported upon spiral springs. The motor is thus freed from jars and yet accurately maintains the meshing of the gears while yielding to the motion of the truck. By reason of improvements which have been introduced and of a more efficient utilization of the iron in the fields and armature and of the copper in the windings, it has been possible to effect a material reduction in the weight of the new motor. This however has been done only so far as is believed to be consistent with a margin of mechanical

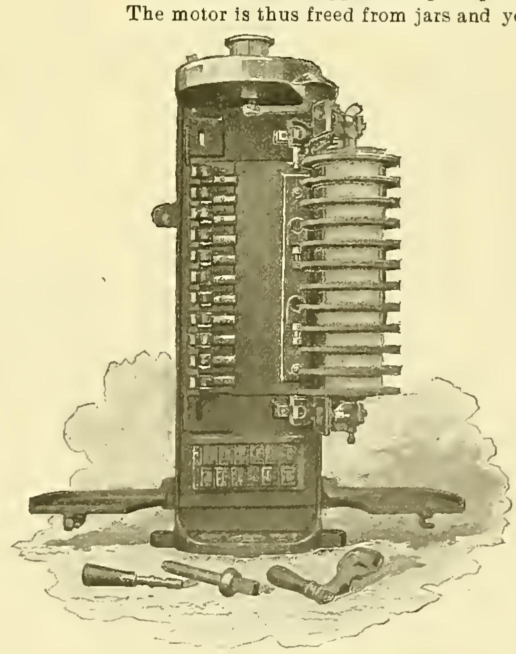


FIG. 4. WESTINGHOUSE CONTROLLER.

strength adequate to meet the severe conditions of electric traction.

There is, perhaps, no feature of more practical value in a railway motor than the provision which is made for the rapid yet thorough inspection of the fields and armature. Reference to the Figs. 2 and 3 shows the advantages of the new motor in this respect. The hinged lid, already referred to, permits ready handling of the brushes and inspection of the commutator. The openings in the lower field afford access to the lower part of the motor. When it is desired to gain access to the whole interior of the motor, the car is run over a pit and the lower half of the field opened down, either with or without the armature, as may be desired. The armature bushings are carried in pillow blocks which, when the motor is closed, are secured to both the upper and lower field. By removing the bolts holding the pillow blocks to the upper half of the field, the lower half may be opened down with the armature, which can then be rolled out upon a board, thus avoiding the necessity of lowering the armature into the pit and again raising it. By removing the bolts between the pillow blocks and the lower half of the field, the armature is kept in the upper half of the field, permitting removal of the field coils, etc., in the lower half. The lower half of the field is readily opened down by the use of a rope passed around the axle, which is thus made to take the part of a pulley block. By this construction and arrangement of parts, all repairs can be easily made from the pit, and consequently the grease and dirt accompanying repair work is not introduced within the car, a feature which will be readily appreciated.

The No. 14 controller stand, is a platform controller having two removable handles, one for controlling the speed and the other the direction of travel of the car (Fig 4.) The handles are provided with locking devices which prevent their removal except when in the position for no current. The electrical combinations of the motors made by the new controller are improved over those of the earlier type in that the motors divide the work equally, and the car starts more easily and attains its maximum speed more smoothly. The construction of the new controller is similar to that of the old type. Corresponding positions of the handle give speeds to the car similar to that of the old style. This feature will at once recommend itself from the fact that motormen accustomed to running cars with the Westinghouse "G" controller will be able to use the new one with confidence.

Since the best results are always obtained by frequent inspection of the apparatus, the new controller is designed with special reference to making this as simple and as easy as possible. The controller drum is so supported that it can be swung clear of the contacts (see Fig. 4,) the supports for the two bearings of the drum shaft being hinged at one side of the controller back. In this way ready access to the drum and contacts is secured.

The controller is made both fire and waterproof. The cover of sheet iron, lined with asbestos cloth, is easily and quickly removed. The cylinder or drum is built up of thick porcelain and vulcabeston rings. The latter extend sufficiently beyond the porcelain to render arcing from one contact to another impossible. By raising the points of arcing above the surface of the insulator, any tendency to disintegrate the porcelain is avoided. The contact strips are made with replaceable tips. At the left of the drum are placed the contact blocks, which resemble short, thick fingers split diagonally into two sections, to secure perfect contact and even wear. The cut shows two plugs placed at the right of the frame. Their function is to enable either motor to be cut out of circuit, by the removal of either plug, thereby rendering unnecessary the use of the usual cut-out box within the car. The controller has a double back in which are located the wires and connections, so that any danger from grounds or short circuits within the controller is avoided. The reversing handle projects from the side of the stand. A single throw of this switch reverses the current in both motors.

Comments and Views of Contemporaries.

No Money for Lobbying.—The West End Street Railway Company still seems to be the object of bitter attack upon the part of those whose interest it is to operate for a falling market. Not content with the attacks made late in the winter, the City Hall contingent has been endeavoring to "fry fat" out of the company by resurrecting such ancient claims as a promise to pave Essex street and Harrison avenue as far as Dover street, made by the Metropolitan railroad in the year 1861, and by the latest device of compelling the company to bury its wires before November 1, an obviously impossible undertaking in so short a time. However desirous the people of Boston may be to have all wires put underground, a most commendable undertaking, it is not believed that they desire to have this done at the dictation of a speculating coterie who are determined to compel the company to pay out hush money, or get their revenge and fill their pockets by depressing the company's shares in the stock market. Doubtless the real animus of many of these vigorous attacks is to compel the resumption of the policy heretofore pursued by many corporations, of distributing financial favors through the lobby, both at the city hall and at the state house, a line of policy which it is understood has been resolutely opposed by the present West End management. The final outcome of the contest will be watched with deep interest, as the fight differs from the warfare waged against the Bay State Gas Company in that West End stock is widely distributed among *bona fide* investors and is not watered, while holdings of Bay State Gas stock were concentrated in few hands, and the stock itself represented no actual property other than the equity in a valuable gas plant.—*United States Investor, Boston.*

Street Railway Speed.—The proposition to restrict the speed of trolley cars to six miles an hour is a ridiculous one. A healthy pedestrian walks at a speed of four miles an hour. Such a law would give the patron of the street car but little advantage over the pedestrian. The speed of trolley cars should be regulated by local ordinances. The residents of a town or city know what speed is proper to permit in their streets and they are the best judges of the matter. It has been seriously proposed to restrict the speed of trolley cars in the City of Buffalo to six miles an hour. A service subject to such restrictions would be but little better than no service. It certainly would not be equal to the old horse-car service. The speed of the trolley cars is not great enough in this city to satisfy the average patron of the street railway now. Any reduction would drive him to despair and to the bicycle.—*Buffalo Enquirer.*

STREET RAILWAY AFFAIRS IN ENGLAND.

(From Our Special Correspondent.)

Overloading Cars.—That somewat irrational and absent factor of civilization called "public sentiment" appears—so far as England is concerned—to object on æsthetic grounds to the introduction of trolley systems for street railways; and might therefore be said to prefer horse torturing rather than "offend" the sight with poles and wires not a bit worse in reality than those to which we have long been accustomed for telegraph work. However, it must be said, in justice to the idea of an average Englishman, that if he doesn't want to abolish the street car horse altogether, he desires to let it down as easy as possible while it lasts—during its whole existence of three years; and cast iron is no name for the rules and regulations intended to prevent overloading the poor animals that crowd the work of a lifetime into two or three years. It puts the British public on the horns of a considerable dilemma when the manager of a tramway company feels obliged (as was the case a week or two since in Belfast) to make the following remarks: "I have been forced, in defense of my men, to withdraw all cars from the roads on which football matches are played. It is impossible to prevent overcrowding, but the car inspectors line the road and take the names of my people, and they lose their situations. Only to-day one of my men was prosecuted for having two more than his proper number inside the car, although there were four less than the maximum allowed outside" (i. e., on a double decked car). Apart from the overcrowding, one would feel inclined to say that this manager didn't know enough to come in out of the rain, if he couldn't carry enough extra people on the football ground routes to pay all the fines that a court of law could impose, until such time as the municipal regulations were altered, or the adoption of electric motors allowed of greater loads being carried. As a confession of weakness in coping wi h rush traffic, that manager's remarks deserve a large-sized cake.

Beginning to Stir.—A slight movement among the street railway companies in England in the direction of mechanical working instead of horse traction, is manifested by the issue of applications to Parliament during the next session for power to convert old lines and equip new ones—in nearly every case with a view to adopting electricity as the motive power. For Barrow in Furness, Croydon, Dudley & Wolverhampton, Liverpool, South Staffordshire & Hull, Provisional Orders are sought for these purposes, in three cases—Croydon, Liverpool & Hull, by the local authority itself—while for Aberdeen, Bristol, Harrow Road & Paddington (London), West London & London Tramways, bills are being promoted in Parliament, with similar objects. The last named is for an extension of the Brixton cable line. The bare intention of these applications will serve to show how different is the procedure in this country from that usual in the States. In England it is a matter of no small expense to obtain a franchise for street railways, the costs of application to Parliament mounting up enormously However, this is perhaps no worse than spending money on boodlers

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

Feed Wires to Go Underground.—There is some degree of excitement at present in this city caused by the somewhat singular outcome of the agitation against all overhead electric wires. As we have noted in previous issues of the Gazette there has been a very spirited campaign continued over several weeks against the wires. The state legislature and the board of aldermen have been discussing the subject and it certainly looked toward the close of the campaign that overhead wires were doomed to speedy burial. A legislative committee after touring through the country reported adversely on the petition and the matter dropped for the time being. In the board of aldermen matters have taken a very different turn. The city fathers, on Monday last, passed an order compelling the West End Railway Company to place its feed and return wires underground by November 15, 1894, while orders directing that telephone, telegraph and electric light wires shall also be buried, was referred to a committee on streets and sewers.

The W. S. Hill Electric Company, of Boston, whose various types of electric light and power switches have earned for them such an excellent reputation, is at present working its staff of employes night and day, executing three of the largest orders ever placed in this country for railway apparatus of its special make. The aggregate weight will be several tons, and in every case they are "repeat" orders.

The General Electric Company is engaged in building the largest electric railway generator ever constructed in the history of the art. Last Thursday the field pieces were cast at the Lynn Works. The bottom one of these when finished, will weigh no less than 32,000 pounds. The castings will be shipped to Schnectady, N. Y., where the machine will be built. It is for the Philadelphia Traction Company.

Collision of Electric Cars.—Last Saturday there was a somewhat serious accident on the Haverhill, Merrimac and Amesbury Electric Road which came near resulting in the loss of several lives. The collision took place near Salisbury Beach where, at a sharp curve in the road, two cars dashed into each other head on. The cars were partially demolished, and there were several broken heads and limbs. Neither of the motormen were to blame, as they could not see around the curve, and were not aware of each others approach until too late to avoid the accident.

Rapid Transit.—The last of the public hearings on rapid transit for Boston has been held and the final work of the legislative committee was devoted to the task of examining the merits of the various systems presented for acceptance. Among these systems was the Mack elevated railway, the advantages of which were set forth by ex-Judge Corcoran, who said in brief: "We ask no state aid in the furtherance of our enterprise, nor do we ask for any special privileges or exemptions in the way of taxes or immunity from land damages. We merely ask for powers that will place us absolutely in the control of the railroad commissioners." A list of names of the incorporators of the Mack company was also submitted. The merits of the Meigs' system were set forth by Mr. G. H. Towle, who also gave it as his opinion that the proposed subway through Tremont street would not solve the problem of facilitating traffic and travel through the congested districts of the city. Mr. R. T. White, inventor of the yoke system of elevated roads, explained his system at length, and stated that he was prepared to proceed immediately with the construction of the road should he secure a charter. He had abundance of capital at his command and he enumerated the names of a number of capitalists who are ready to furnish the money. The Hon. E. Moody Boynton, inventor of the Boynton bicycle system, explained his invention and expressed his readiness to begin the work of construction at once if he were granted a charter.

FROM WAKEFIELD TO LYNN.—The first celebration of "Patriots' Day," the new Massachusetts holiday, which was observed on Thursday last, April 19, was availed of for opening the new extension of the Wakefield & Stoneham Electric railway between the first named town and the city of Lynn. This extension is going to be of imemense advantage to the district, for while the actual distance between the two places is only short, hitherto the way to get from one to the other has been by way of Salem, Malden or Boston. Another extension by the same company is well under way and will shortly be completed. It will connect Wakefield Center by way of Lake Quannapointt to Reading. There are many shoe factories scattered over the district and there is abundant promise of a lucrative business being soon developed by the railway company.

SIGNAL FOR SINGLE TRACK.—The accidents which now and again have occurred and are occurring on single track electric railways having sharp curves which prevent the move in charge from seeing what may be ahead and coming towards them, have set inventors at work devising some apparatus in the nature of a signal to prevent such accidents. One of the best and most reliable pieces of mechanism for this purpose thus far invented is a signal made by F. W. Beals, 137 Oxford street, Lynn, Mass. By its use, as soon as a car enters a single track section of a road, an electrical contact is made by the wheels which displays a signal at the opposite end of the section, whether it be a long or a short distance, this enables the motorman on a car coming in the opposite direction to know just what to do. He knows, though he may not be able to see the other car owing to curves or other obstructions intervening, that he must wait until it comes up and passes him.

ELECTRIC HEATING OF CARS.—Great improvements are being made by the New England Electric Heating Company in its system for heating cars by electric current. The method is being simplified and rendered more efficient, and indications favor the belief that next winter there will be few if any electric railways in New England which have not adopted the system for the comfort of their patrons.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

RESULT OF LISTING STOCKS.—It is gratifying to report that the listing of traction stocks on both the New York Stock Exchange and the Consolidated Stock Exchange has given an impetus, by reason of the publicity thus given to transactions in these securities, to the interest manifested by investors to such an extent as to argue well for the magnitude of business soon likely to be done in this class of securities. The point made that the addition of a speculative feature to traction stock values would result in practically killing the existing demand for traction securities as an investment pure and simple is not well taken, as any measure that creates increased public interest must eventually lead to a broader market and increased business and should be encouraged as a matter of benefit to everyone concerned.

THIRD AVENUE RAILROAD STOCK has practically monopolized the local market this week. President Elias is authority for the statement that earnings are increasing at a rate far beyond the most sanguine expectations regarding the results of the cable car system. The cable cars are taking business from the Manhattan Elevated Company to such an extent as to cause that road's management a deal of concern. In order to find out to what an extent the cable cars are making inroads on their own traffic, the Manhattan Elevated people have resorted to the expedient of putting spotters to watch the fare registers in the cable cars and the results of these investigations are not cheerful from the elevated road's standpoint. It is on statements of such a pleasing character that the predictions are made that Third Avenue stock, now selling around 180, will be at 250 within six months, and will rise to 300 within a year or a year and a half. The bonds now sell at 115, which is a very good price for a 5 per cent. mortgage, so that a rise in their value is not very likely. But very large dividends are an early probability, so that the predicted rise is well founded. The railroad committee of the board of aldermen has under advisement the application of the company for permission to extend its tracks from 125th street and St. Nicholas avenue north to the city line and from the same point down Manhattan avenue to 116th street, where passengers will be trausferred to the new lines of the Metropolitan Traction Company. Lawyer Edward Lauterbach, in behalf of the company, says that the company's request will be granted.

EIGHTH AVENUE STOCK has gone off a little on the showing made during the March quarter, when net earnings fell off $7,793 as compared with a year ago. The statement shows gross earnings of $162,709, a decrease of $3,951; operating expenses $130,624, increase $3,843; net earnings $32,085, decrease $7,793; gross income $37,-302, decrease $9,121; fixed charges $24,050, increase $1,350; surplus $13,252, decrease $10,471. That is, the only increases were in fixed charges and operating expenses, the very items where economical management should have effected a saving. The stock now is quoted at 250 bid.

REPORT OF BROOKLYN TRACTION COMPANY.—In contradistinction to this gloomy showing is the report of the Brooklyn Traction Company (Atlantic Avenue Railroad Company) for the quarter ending March 31, 1894. There are net earnings this year of $60,320, as against a deficit last year of $11,343, a gain of $71,663, and there is a surplus, after paying charges of $59,647, of $15,912, as compared with a deficit for the March quarter of 1893 of $24,685, an increase of $40,597. The cost of the road is figured in the balance sheet at $5,440,639; the capital stock is $2,000,000, and the bonded debt $4,499,000, but the company also owns $1,295,642 stocks and bonds of other companies. The showing made is extremely pleasant reading to the friends of the company who have been insisting all along that the introduction of the trolley would result in large gains in net earnings, and their predictions are seemingly verified by the report just issued. Apropos of this matter, there is interest in the information given by a director that the Brooklyn Traction Company has made a contract with insurance companies doing such business to insure its passengers against accident. He says the cost is trifling and is a real saving to the company on business done since the introduction of the trolley system.

OTHER QUARTERLY EARNINGS made public this week are those of the Forty-second Street, Manhattanville and St. Nicholas Avenue Railway, which reports for the March quarter a deficit after meeting interest payment of $13,146, an increase of $5,810. The profit and loss deficit is now $69,402; the stock is quoted at 45 bid.

NEW ORLEANS CONSOLIDATED TRACTION.—It is permitted now to make public the name of the Wall street banking house that is to take over the control of the New Orleans Consolidated Traction Company. It is H. B. Hollins & Co. Connected with them is Mr. Manuel Lehman, of the banking house of Lehman Brothers, which is identified with scores of southern enterprises. The Hollins people are closely connected by family and business ties with the Vanderhilts. It is their intention to engage in street railway enterprises to quite an extent, and, as they can command any amount of capital for their enterprises, their success is always assured beforehand. Quite a demand exists for New Orleans Traction stock, but very little has as yet come upon the market.

METROPOLITAN TRACTION stock closed to-night at 114, as compared with a quotation a week ago of 122. The selling of this stock has been persistent for the last few days, and the efforts of the bear crowd have been materially aided by free sales for the account of the operators who bought stock on the rise from 105 up. This liquidation seems at about an end now, and there are reports that another rise will soon be engineered in the bright prospects of big profits that the new lines afford. Regarding the new branches of the system in New York, it is reported that horse cars will soon be replaced on the Columbus Avenue line, running as far as Ninety-fourth street, pending the introduction of the cable. Within the next 30 days the same policy will be followed on the Lenox Avenue branch from Ninety-sixth street to Harlem.

PHILADELPHIA STOCKS.—The feature of the whole Philadelphia market on recent days has been the break in Philadelphia and Electric Traction stocks. Philadelphia has been declining right along since the announcement that the capital-stock would, despite recent official denials, be increased. It is now $10,000,000 and is likely to be made $15,000,000. The authorized capital was fixed by the legislature last winter at $30,000,000. President Widener says that the new stock will be issued at par. Philadelphia Traction closed Tuesday around 103, so that the purchaser at the present price who takes his share of the new allotment will find his entire blocks stand him at about 85. If the dividend rate is increased to 8 per cent. as proposed, the investor will receive about 5 per cent. on his investment. The point is made though that the traction managers will find it no easy problem to solve how they can meet fixed charges of $1,400,000, which will be gradually increased, and also earn satisfactory dividends upon $15,000,000 of stock. The gross revenues of the system are in the neighborhood of $5,000,000 annually and the problem is not an easy one.

PITTSBURG TRACTION STOCK, of which mention was made last week, continues strong in the Eastern market. It is now reported that a dividend of $3 per share will soon be declared, $1.50 in cash and $1.50 in stock.

SOME NEW BOND OFFERINGS made in this market are Camden, Gloucester and Woodbury Electric Railway of New Jersey first mortgage 6 per cent. gold bonds at 90 flat, and Scranton and Carbondale, Pa., Traction Company first mortgage 6 per cent. bonds at 102. The latter issue is free of state tax, and the net earnings of the company are said to be more than double the annual interest charge.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn street, this city, said yesterday: "Extreme dullness has characterized dealings in cable stocks this week and prices have sagged without much pressure. With the unsettled condition of labor it is foolish to look for higher prices in the immediate future. The new tunnel is proving a success. Indications point toward the trolleying of cross-town lines by all street railway companies in the near future. At Philadelphia there was a decided set back during the week in traction stocks. The announcement of a proposed issue of five million stock by the Philadelphia Traction Company started a selling movement in it that was communicated to Metropolitan and the others. Metropolitan broke from 123 to 113, Electric from 90 to 80 and Philadelphia from 115 to 102. At above low prices the market hardened and there has been a gradual advance throughout the list. The Philadelphia Company has opened its Ridge avenue line and the earnings are reported as enormous. Insiders in Philadelphia predict 150 before July 1.

General Electric Business.—"Rialto" in the Boston *Advertiser* quotes from a circular issued by Vice-President Griffin of the General Electric Company, dated Schenectady, March 15, soliciting business and noting reductions in prices of apparatus and supplies, as follows: "Since January 1, 1894, we have sold over 1,000 railway motors, over 13,000 horse power in power generators, over 11,500 horse power in lighting machinery, and about 1,000,000 incandescent lamps." On the basis of this business Rialto figures that the General Electric Company did a gross business of a little over $1,000,000 for the first ten weeks of the year, and says at this rate the company is doing a gross manufacturing business of $5,000,000 per annum, outside of repairs, financiering and some minor electrical output.

Baltimore Traction Earnings.—The Philadelphia *Stockholder* says: "The Baltimore Traction Company is, apparently, getting the worst of its competition with the City Passenger Railway Company. This is indicated by the payments of the park tax for the quarter ended March 31 by both companies. The City Passenger paid $17,444.66, indicating that the company's gross receipts were $193,829.55, an increase of $38,716.22 over the corresponding quarter of last year; the Traction Company, on the other hand, paid $14,594.67, indicating gross receipts of $162,163, as against $224,072.55 for the corresponding quarter last year. The decrease in gross is, therefore, $61,-909.55 for the quarter. There was, of course, a material reduction in expenses, but whether it equaled the loss in gross is problematical."

Pennsylvania Steel Company.—Creditors and stockholders committee have agreed upon the following plan of reorganization for Pennsylvania and Maryland Steel companies: To make a 6 per cent. consolidated mortgage for $6,500,000, $3,000,000 to be reserved to take up the first mortgage and the balance paid to creditors for 60 per cent. of their claims, remaining 40 per cent. of claims to be paid in cash. Stockholders will subscribe for $1,500.000 7 per cent. non-cumulative preferred stock at par to provide new cash capital and will relinquish enough of their present common to give creditors a stock bonus of 15 per cent. on their claims. To provide against contingencies coupons on the new mortgage may for three years be paid in scrip, if not earned.

Nashville Overland to be Sold.—In the consolidated cases of Rudolph M. Hunter vs. Overland Railway Company, and General Electric Company vs. Overland Railway Company, Chancellor Allison has delivered a decision ordering a sale of the road. There were issued in bonds February 17, 1892, $100,000 first mortgage bonds and $143,000 in general bonds, which $100,000 were set aside to secure the first mortgage bonds, and the remaining $43,000 sold; also $67,000 in income mortgage bonds, aggregating $200,000. All these are outstanding, and on none of them has any interest ever been paid, except on the first mortgage bonds.

Contract Awarded.—The contract for the St. Joseph and Lake Shore street railway at St. Joseph, Mich., has been awarded to L. J. Highand of Chicago. Work will be commenced at once and there are hopes of getting the road in operation by July 1. The road will be about eight miles in length, extending from St. Joseph to Stephensville through the best fruit section in Michigan, and the company expects to do a large freight and package business in addition to the passenger traffic. The Chicago Electric Truck Company of Chicago has been awarded the contract for the trucks for this line.

Philadelphia, Pa.—The stockholders of the Schuylkill electric railway held a meeting last week and decided to increase their bonded indebtedness $55,000. Some $10,000 of this money will be spent to purchase new motors. There is a strong feeling in favor of extending the line to Middleport, and one of the chief reasons for increasing the bonded indebtedness is to have a fund ready when work on the proposed extension shall be deemed expedient.

Westinghouse Business.—The annual report of the Westinghouse company it is stated will be published about May 10, and will, according to reports, show that the company is more prosperous than ever before. The present net earnings of the company are said to be about $100,000 per month.

Elizabeth, N. J.—It is rumored that the New Jersey Consolidated Traction Company is about to purchase the line of the Elizabeth City Horse Railroad Company which runs parallel to the old line to Elizabethport. The price is reported to be $700,000.

Lititz, Pa.—The Lititz & Lancaster Pike Company, whose original capital was $24,000, has leased its property for 999 years to the Lititz & Lancaster Electric Railway Company, at an annual rental of 12½ per cent. on the original capital.

Nashville, Tenn.—The United Electric Railway of Nashville was sold last week under a decree of the United States Court, and was bid in by the bondholders for $141,400. This will be followed by a re-organization of the company.

Freeport, Ill.—R. S. Brown of Easton, Pa., has bought the street railway on behalf of a syndicate composed of himself, Congressman Haines of New York, and Congressman Mutchler Shibley of Pennsylvania, and they will convert the road into an electric line.

Bids Wanted.—The Street Railway and Illuminating Properties' trustees will receive until Friday proposals for $65,000 more of its preferred shares.

Dividend Declared.—The Pullman Palace Car Company has declared its usual quarterly dividend of $2 per share, payable May 15.

New Incorporations.

Hillsboro, Tex.—The Hillsboro Investment and Electric Company has been chartered for the supply of light, heat and electric power to the public, and for the construction and operation of a street railway within or near the city of Hillsboro, in Hill county. The capital stock is $50,000, and the incorporators, A. T. Rose, H. T. Ivy and E. G. Shield.

The Dallas & Oak Cliff Electric Railroad Company, capital stock $200,000, has been organized at Oak Cliff, Tex.; incorporators, D. Edward Greer, of Oak Cliff; J. N. Simpson, Charles F. Carter, of Dallas; Thomas H. West, Alvah Mansur, Edward S. Whitaker, Henry C. Scott. St. Louis.

The Houtzdale & Suburban Electric Railway Company of Hazleton, Pa., has been organized to build an electric railway in Clearfield county. The capital stock is $100,000, and the incorporators are A. Markee, J. E. Giles and E. S. Doud of Hazleton.

Chicago.—The Chicago Street Car Advertising Company has been incorporated with a capital stock of $20,000.

NEWS OF THE WEEK.

Baltimore, Md.—Arrangements which have been pending for some time for the construction of an electric road from Pikesville to Emory Grove have been completed. The road will be known as the Pikesville, Reisterstown & Emory Grove electric railway. It will start from the terminus of the Pimlico and Pikesville branch of the Traction Company and run through Cross Keys, Owings' Mills, Smoketown, Reisterstown, Glyndon and to Emory Grove. The whole distance is 10½ miles. The power house will be at Owings' Mills. The company is authorized to issue $250,000 5 per cent. 40-year bonds, of which only $185,000 are to be issued until the road is ready for operation. Henry A. Parr is president and Middendorf, Oliver & Co. are the financial agents.

Detroit, Mich.—The annual meeting of the Citizens' Street Railway Company was held last week, when the old board of directors was re-elected. The members are D. M. Ferry, W. C. Colburn, M. S. Smith, H. B. Ledyard, W. C. McMillan, Geo. H. Russell and John C. Donnelly. W. W. Cook of New York had been a member of the old board, but Mr. Donnelly succeeded him some time ago. The directors met during the afternoon and elected the following officers: D. M. Ferry, president; W. C. Colburn, vice-president; John R. Stirling, secretary; Geo. H. Russell, treasurer; J. D. Hawks, general manager; J. H. Fry, superintendent.

Frank Peck, who has been connected with the Kansas City Cable Railway Company for more than five years and who has been assistant general manager and superintendent for two years, has tendered his resignation to C. F. Holmes, general manager of the newly consolidated system. Mr. Holmes accepted it with reluctance and expressed to Mr. Peck, in the warmest terms, his appreciation of the work which he had done in the way of improving and maintaining the Ninth street cable service. Mr. Peck will be succeeded by Mr. Thomas Barrett, who has served for sometime as superintendent of the Grand Avenue Railway Company, and who is recognized as a capable man.

St. Louis, Mo.—The report of the subway committee will not be ready for another month. W. S. Chaplin, a member of the committee, said in regard to removing street railway wires from the streets: "The trolley wires of the electric cars will have to remain undisturbed for the present. They are not necessarily fatal, and there is no underground system that can be worked advantageously on the electric cars. If all the wires but the trolley wires are put underground, the commission will feel that it has accomplished a great work."

Toledo, O.—The use of street cars for carrying mails was inaugurated last week, and is working well. The carriers go out in the morning with their first delivery, make their collections from the boxes on their routes, and send them in in pouches with the crews of the street cars. The cars again take out the mail, distribute it for the carriers at the different stations. In this way the time formerly lost by the carriers in coming to and returning from their districts is saved. The street car men who have to handle the mails take the regular oath administered to government employes who perform this class of service.

Pittsburg, Pa.—In a suit brought by William C. Adams against the Federal Street & Pleasant Valley Passenger Railway Company, a verdict of $7500 for the plaintiff was given. Adams is a salesman for a candy firm, and, when he boarded the street car, had with him an ordinary sized sample case. After collecting fare from Adams, the conductor demanded an extra fare for the sample case. This extra fare was refused and Adams was ejected from the car. He brought suit for damages with the above result.

Washington, D. C.—The National Rapid Transit Company has asked congress for a charter authorizing the construction of an elevated electric road between New York and Washington. The road is to carry passengers, mails and light freight cars on each train, and is to cover the distance in about two hours, and the passenger rate is not to exceed two cents per mile per passenger. The matter was referred to a special committee, which will hear the arguments for and against the project.

Contracts Let in Chicago.—The contracts have been closed for nearly all the material required for the North Chicago Electric Railway equipment. The General Electric Company will furnish the car equipments, 25 in number, using the G. E. 800 motor. The Siemens & Halske Electric Company will supply four 550 K. W. generators. Brownell accelerator cars and Brownell trucks will be used. Washburn & Moen will furnish the wire, and the Johnson Company the rails.

Chicago.—The construction of the Englewood & Chicago electric line was begun on Wednesday last. About three hundred men began the construction of the line at Sixty-third street and Vernon avenue. It is expected that ten miles of the road will be in operation in 60 days. The road is to connect Park Manor, Brookline, Oakwoods, Eggleston, Auburn Park, South Englewood, Tracey, and Washington Heights, all of which are suburban towns in the southern part of the city.

Washington, D. C.—The Washington & Arlington Railway was sold at auction last Saturday to R. H. Phillips, as agent for C. S. Henchman, of Philadelphia, and Woodbridge & Turner, of New York, the chief creditors of the road, for $2,500. The property sold at Rosslyn consisted of a ninety-nine year lease from the Alexandria Railway and Improvement Company, about two and a half miles of track, with overhead electric equipment, four cars and some supplies.

Newark, N. J.—A recent act of the New Jersey legislature permits street car companies to handle freight as well as passengers. The Consolidated Traction Company, of Newark, is about to enter into a contract for the delivery of beer to saloons. Most of the breweries and saloons are on its lines and the cost of delivering the beer at present is very heavy. The South Orange Company will make its first test on coal, and is having cars built with that end in view.

Toronto, Ont.—The Toronto and Montreal Street Railway companies are pushing a suit for the return of $50,000 duties which the companies paid under protest on imported steel rails. Rails of not less than 25 pounds per yard for railway tracks are on the free list. Under this provision the companies claim that rails should be brought in free of duty. The case hinges solely on the interpretation of the words, "railway" and "tramway."

St. Louis, Mo.—The suit of the Adams Electric Railway Company against the Lindell Electric Railway Company began on Friday of last week before Judge Hallett in the United States Circuit Court at St. Louis. The suit is brought for infringement of the Adams patent No. 300,828. The case has been in progress for several years and testimony has been taken by deposition in all parts of the country.

Brooklyn, N. Y.—During the week articles of agreement have been signed by A. L. Johnson, representing the Johnson Company of Johnstown, Pa., and J. M. Edwards, representing the banking house of R. S. Wilson & Co., involving the expenditure of about $6,000,000 for the construction of the new trolley lines of the Nassau Electric Railway Company.

Kansas City, Mo.—The Kansas City Cable Railway Company is making a number of changes and rearranging its offices at the corner of Fifteenth street and Grand avenue. The company will make improvements at Washington Park, costing $10,000. The whole question of transfers has been submitted to a committee of the directors, with the general instructions that a liberal system of transfers will be favored.

Kansas City, Mo.—The County Board has granted a franchise to the Westport & Waldo Electric Railway Company for a double track electric railway from the southern limits of Westport at Oak street to Seventy-fifth street, thence west to Broadway. According to the terms of the franchise, the road is to be finished within a year, and such pavement as the county may direct is to be laid between the rails.

Opelika, Ala.—The electric railway line to Auburn is reported as being an assured fact. Only $50,000 remains to be subscribed to realize the necessary capital of $60,000. The construction company organized to build and equip the line takes one-half of this stock. A prominent railway official of Columbus, Ga., is said to be interested in the project.

Scranton, Pa.—The Scranton Traction Company has under consideration the rebuilding of its entire track between Carbon street bridge and the fair grounds. The company has secured the franchise of the Valley Passenger Company, and the streets over which that company has the right of way will be occupied as soon as practicable.

Leavenworth, Kan.—It is reported that the Leavenworth Electric Railway Company will probably build its power house on the land owned by the Leavenworth Coal Company north of the city, and that the structure formerly used by the coal company as a city lighting plant will form part of the new power station.

Atlanta, Ga.—The Atlanta Consolidated Railway Company is making important and extensive additions to its power equipment which will add a great deal to its facilities. Two new generators will be installed and an engine of 1,000 H. P. The new cars are being built at the company's own shop.

Steel Motors for Brooklyn.—The Nassau Street Railway Company, of Brooklyn, N. Y., has awarded a contract for 60 car equipments, consisting of two 30 horse power motors for each car, to the Steel Motor Company of Cleveland, O., motors to be delivered so that cars can be running July 15. Further contracts for 120 motors will be immediately placed.

Chicago, Ill.—President Worthy of the Metropolitan Elevated says that the line of that road in the southwestern part of the city has not yet been definitely settled, and may not be for some time. It is expected that the road will follow the alley between Twentieth and Twenty-first streets.

Kansas City, Mo.—W. J. Smith, ex-president of the Kansas City Cable Railway Company, who recently received a large sum of money, approximating $1,000,000, for his stock in the road, has decided to erect a mercantile and office building in that city, to cost not less than $200,000.

Worcester, Mass.—The directors of the Worcester Consolidated and the Worcester Traction companies have decided to finish the general reconstruction of the road undertaken last summer. A number of extensions will be made and new track will be laid on a number of streets.

Cortland, N. Y.—An electric road is proposed to connect Cortland, Homer and McGrawsville. P. S. Page and Horace E. Hand of Scranton, Pa., are two of the syndicate who have control of the Cortland & Homer Horse Railway Company, which will form part of the system.

Fall River, Mass.—The contract has been let to furnish 100 uniforms for the conductors, drivers and motormen in the employ of the Union Street Railway Company. These uniforms will be similar to those worn by the railway men on the West End road in Boston.

New York City.—The board of aldermen has ordered the Metropolitan Traction Company to lay tracks on Lenox avenue in accordance with the provision of its charter as granted in 1851. This will form an extension of the company's Sixth avenue line.

Monroe, Mich.—The Toledo, Monroe & Detroit Electric Railway Company has obtained its franchise through Monroe. The road, according to the present intention of its projectors, will extend from Detroit to Toledo, and will be completed in eighteen months.

Baltimore, Md.—The committee on transit of the Massachusetts state legislature has been visiting Baltimore and inspecting the Belt Line tunnel preparatory to presenting a report to the legislature on the proposed underground street railway for Boston.

Danbury, Conn.—The Danbury & Bethel Horse Railway Company at its annual meeting held last week elected the following directors: S. C. Holley, Harrison Wagner, A. C. Pond, W. B. Ferguson, M. H. Griffing, Michael McPhelemy and Chas. B. Mason.

New Haven, Conn.—The State street line is to be extended to Schutzen Park. The New Haven & Centerville Railway Company is seeking permission to use electricity as a motive power and run double tracks on a number of streets in the city.

Kansas City, Mo.—The new Kansas City cable railway management is improving the consolidated lines, and at present has a force of about thirty-five men at work upon its tracks. New rails are to be laid on a large portion of the old Ninth street line.

Washington, D. C.—The House of Representatives has passed the bill extending the time allowed the Metropolitan Street Railway Company to change its motive power and put in an underground electric system or forfeit its charter.

Washington, D. C.—The Washington, Alexandria & Mt. Vernon Railway Company has accepted the proposed amended route of its electric railway and as a consequence has abandoned its plan of crossing a portion of the flats.

Peoria, Ill.—The authorities have reported adversely upon the petition of John C. White to build an electric road, the cause assigned being that he had not secured the consent of a majority of the property owners.

Andover, Mass.—The suburban street railway of Lowell and the Lowell, Lawrence & Haverhill road of Lawrence are each seeking to gain a location for a track between Lawrence and Lowell by way of Haggetts Pond.

Sacramento, Cal.—The entire electric plant of the Capitol Gas Company, which holds contracts for the lighting of the city and the running of street cars, was burned April 18. The loss amounts to $300,000.

Keokuk, Ia.—The Commonwealth Street Railway & Power Company will build a new power house at some point along its line, and will add a lighting business to its street railway enterprise.

Leavenworth, Kan.—Work is progressing rapidly on the construction of the new electric lines. The number of men actually employed last week is reported as being over 200.

Belleville, Ill.—Several Belleville capitalists have subscribed for stock in the new electric railway company, thereby insuring the completion of the city street car line.

Philadelphia.—The trolley cars began running on the Ridge avenue line last week. Thirty-four cars were started and run at intervals of one and one-half minutes.

Albany, N. Y.—John Boyd Thatcher has been experimenting on the tracks of the Albany railway with a new system of compressed air for street car propulsion.

Wilmington, Del.—An underground trolley system is being tested at the works of Harlan & Hollingsworth. Electrician Shaw is in charge of the test.

Camden, N. J.—The Camden Horse Railroad Company has applied to the board of public works for permission to extend its tracks over a number of streets.

Terre Haute, Ind.—The second car built by the company itself for the Terre Haute Street Railway Company left the shops and is now in regular service.

Sacramento, Cal.—The Central Electric Railway Company has secured a generator, and has constructed a temporary plant for the operation of its cars.

Cleveland, O.—The new works of the Johnson Company will be at Lorain, but the business will be conducted from offices to be located in Cleveland.

Jersey City, N. J.—The new line of the Consolidated Traction Company, connecting Newark and Jersey City has been opened for regular traffic.

Du Quoin, Ill.—The Du Quoin Street Railway Company has certified to a dissolution of the organization and has surrendered its charter.

Baltimore, Md.—An ordinance prohibiting street cars from running closer than 50 feet apart has passed both branches of the city council.

Rochester, N. Y.—The Grand View Beach Railway Company has secured the contract for lighting Windsor Beach with arc lights.

Baltimore, Md.—The Baltimore Traction Company is making a number of extensions and improvements in its electric system.

Fond du Lac, Wis.—The street railway company contemplates extending its line on Forest street from Main to the railway depots

Pittsburg, Pa.—The new Bloomfield Ben Venue branch of the Duquesne Traction Company was opened for travel last week.

New York City.—The Chamber of Commerce rapid transit bill has passed the assembly at Albany by a vote of 82 to 38.

Appleton, Wis.—A company proposes to construct an electric road from Neenah to Kaukauna by way of Appleton.

St. Johns, N. B.—The St. Johns electric railway has been sold to Montreal capitalists for $92,000.

Springfield, Ohio.—A project is on foot to connect Columbus and Springfield by an electric road.

PERSONAL.

S. A. Douglas, formerly of Chicago, has resigned his position with the General Incandescent Arc Light Company, of New York, and has established a brokerage business at 29 Broadway, in that city.

M. O'Dea, electrician of the University of Notre Dame, was in the city this week and attended the local meeting of the American Institute of Electrical Engineers.

W. A. Mosscrop, formerly associated with the interest of the Erie City Iron Works and the Ball & Wood Company in New England, was in Chicago this week.

Frank Billings, of the Walker Manufacturing Company of Cleveland, was in Chicago this week looking after the business interests of his company.

Joseph E. Lockwood, of Detroit, representing the interests of Mr. McMillan, the owner of the Detroit Electrical Works, was in Chicago a few days ago.

Edward I. Robinson, vice-president and general manager of the Laclede Car Company, of St. Louis, was in New York City during the week.

L. H. Rogers, of the Sperry Electric Railway Company of Cleveland, was in Chicago this week looking after the interests of his company.

Sidney E. Short, of the electric railway department of the Walker Manufacturing Company of Cleveland, is in Chicago this week.

P. M. McLaren, general agent of the Abendroth & Root Manufacturing Company, of New York, is in Chicago this week.

Norman McCarty, of Detroit, was a visitor in Chicago early this week.

James K. Tillotson, of Toledo, Ohio, was in Chicago this week.

TRADE NOTES.

The International Register Company, 197 South Canal street, Chicago, reports the closing of a contract with the Toledo Consolidated Street Railway Company to equip its entire system with the well-known Pratt portable register. The adoption of this register throughout by so large a system is certainly a high endorsement of its merits. The railway company has heretofore been using stationary registers which were apparently giving satisfaction. But about fifteen months ago it purchased a number of Pratt machines and the comparative tests made during the past year have proved so favorable to the Pratt registers that President Lang decided to adopt them exclusively and by May 1 there will be no register but the International in use on the consolidated lines, the total number being 135. This change necessarily involves quite an expenditure, as the stationary registers will be relegated to the scrap pile, but, from the results of the tests, the company feels amply justified in the change and expenditure. Manager A. H. Englund of the International Register Company is quite elated over this contract as it further demonstrates the excellency of the Pratt register and the high favor in which it is held by so practical a railway manager as Mr. Lang.

James I. Ayer & Co., of St. Louis, have met with excellent success in their engineering business since the concern was established the first of the year. At present they have on hand the reconstruction of the plant of the Citizens' Electric Light & Power Company, East St. Louis; the erection of an electric lighting plant for the Mercantile Club, St. Louis, and one for J. L. Hudson's large new clothing house in St. Louis; the overhauling of the plant of the Pastime Athletic Club, St. Louis, and they are just completing a report on the plant of the Metropolitan Electric railway and the Springfield Electric Light Company at Springfield, Mo. This is in addition to their work as consulting engineers for the Merchants' Exchange of St. Louis and for the lighting plant of B. F. Stevens, Spirit Lake, Iowa.

In Winding Armatures, field coils, transformers, etc., oil paper has come into quite general use for insulating purposes in place of shellaced cloth, tape, etc. When properly made it is said to be far superior to cloth or tape; is claimed to be decidedly cheaper, much handier to use and insures a much neater, better job The Beardsley Manufacturing Company, 234 Lake St., Chicago, claims to make the very highest grade of this paper and reports that the demand for it is rapidly increasing as the quality becomes known. One thickness of it will resist the highest voltage used. It is also uninjured by heat, water, gases or chemical action. It is therefore practically an ideal material for the work for which it is intended.

Berlin Iron Bridge Contracts.—Dr. Drysdale, of Philadelphia, has placed the contract for an iron roof over the new power house for the hospital for the insane, at Norristown, Pa., with the Berlin Iron Bridge Company, of East Berlin, Conn. It was desired that the roof be fire-proof and ordinary corrugated iron could not be used on account of the drip. The roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering. The McNeal Pipe and Foundry Company, of Burlington, N. J., has placed the contract for two cleaning sheds with the Berlin Iron Bridge Company.

Berlin Iron Bridge Orders.—The Delaware, Lackawanna & Western Railroad Company has placed the order for two engine house roofs with the Berlin Iron Bridge Company, of East Berlin, Conn. Both roofs will be covered with the company's patent anti-condensation corrugated iron. The laundry, kitchen, engine and boiler rooms for the Green Island Improvement Company's new hotel at Lake George, N. Y., will be built of iron and will be fireproof. The work is to be furnished by the Berlin Iron Bridge Company.

Useful Souvenirs.—The General Electric Company has sent us one of the neatest and most useful advertising souvenirs that we have ever seen. It consists of a Wells' double-indexed diary with pages about 5x7 inches in size, one page being allowed for each day of the year. The year date is left blank, so that the diary is practically a perpetual one, as the year may be filled in for any year desired. The name of the general electric Company appears on the front cover, which, by the way, is flexible morocco, and the names of the principal sales offices on the back cover.

Recent Orders.—The new electric light and power station for the Brush Electric Light Company at Baltimore, Md., will be one of the finest in the southern states. The boiler room is 83 feet wide by 129 feet long. The dynamo room is 130 feet square, the floor space in the latter is entirely free from posts. The roofs are designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn., and are made entirely of iron, covered with their patent anti-condensation corrugated iron roof covering.

A Neat Paper Weight.—We are in receipt of a neat paper weight from Mr. H. R. Keithley, showing in cross section the joint formed by the Chicago rail bond when properly applied to a rail. The piece of metal certainly shows an excellent joint. Mr. Keithley is the inventor of this method of bonding.

The American Car Company of St. Louis has opened an office in Chicago at room 1140 Monadnock block. This office will be in charge of P. K. Andrews, formerly connected with the J. G. Brill Company of Philadelphia.

The Heine Safety Boiler Company has removed its Chicago office from the McVicker building to 1521 Monadnock. J. H. Harris still remains in charge of the Chicago office.

The Pullman Company has closed a contract with the Brooklyn Heights road in Brooklyn, N. Y., for 50 cars, and with the Chicago General Street Railway Company for 25 cars, 10 of which are trailers.

The J. G. Brill Company of Philadelphia has secured an order from New Orleans for 125 cars, also an order from Brooklyn, N. Y., for a number of additional cars.

The Peckham Motor Truck & Wheel Company has been awarded the contract for 15 trucks for the new electric cars of the Chicago General Street Railway Company.

The J. G. Brill Company of Philadelphia has removed its Chicago office from the Phenix building to the Monadnock.

RECORD OF STREET RAILWAY PATENTS.

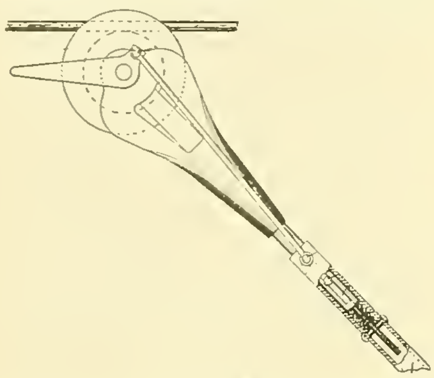
Patents Issued April 17, 1894.

518.213. Insulating Turnbuckle. Henry P. Ball, Schenectady, N. Y., assignor to the General Electric Company, Boston, Mass. Filed December 22, 1893.

This is an insulating turnbuckle comprising an eye-bolt having a screw thread and adapted to engage the shank, a cup rotatable about the shank and an eye-plate attached to the cup by having a lip of the cup turned over to engage the plate.

518.221. Electric Motor Car. Harold P. Brown, New York, N. Y. Filed December 21, 1891.

This consists of the combination with the car and mechanism for communicating motion from the motor to the car, of an electric motor having field magnets furnished with both series field coils and shunt field coils, and an additional or choking magnet adapted to be placed in connection with the series field in starting the motor or car.



NO. 518,357.

518,232. Regulator for Dynamo Electric Machines. William H. Elkins, Cambridge, Mass., assignor to the General Electric Company, of New York. Filed January 3, 1893.

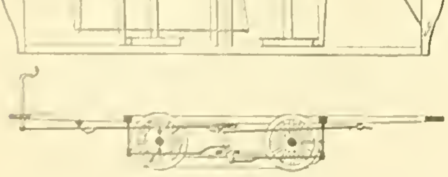
The combination in a current regulator comprising shifting commutator brushes, of a motor magnet, with a controlling magnet and two or more sets of contacts controlled by the controlling magnet, one of which controls a shunt of small resistance around the motor magnet and the other comprises a similar shunt with considerably higher resistance.

518,236. Rheostat. Jonathan P. B. Fiske, Lynn, assignor to the General Electric Company, Boston, Mass. Filed February 25, 1893.

In a rheostat, the combination with a series of contact plates, of a switch arm carrying two brushes of different resistance, and arranged to traverse different portions of the contact plates.

518.293. Electric Railway System. Charles D. Tisdale, Boston, Mass., assignor by direct and mesne assignments of five-sixths to John D. Gould, New York, N. Y., and Charles Healy and James E. Jenkins, Lynn, Mass. Filed April 26, 1893.

This consists of the combination with a truck provided with three insulating wheels, two upon one side of the truck and one upon the other, of a motor mounted on the truck, and a trolley wheel arranged upon the side of the truck having two insulating wheels and arranged to form an electrical contact with the rail upon the side of the track supporting the two insulating wheels.



NO. 518,401.

518 345. Controller for Electric Motors. William Cooper, Minneapolis, Minn. Filed August 28, 1893.

This covers the method of operating electric motors, which consists in first arranging the motors in series in an open circuit, then inserting a total resistance and closing the circuit through the same, then gradually cutting out a part of said resistance, then shunting the current around the remaining resistance and into said motors while in series, then breaking or opening the circuit and while open coupling said motors in multiple arc, and afterward reinstating the remainder of said resistance, and finally gradually cutting out the same.

518.357. Automatic Trolley Wire Finder. Theodore Straus, Baltimore, Md. Filed January 26, 1894.

The combination with a trolley arm, of a sliding extension at the outer end of said arm, a spring arranged to urge said extension outward, a trolley, pivoted guides upon the extension, and connections between the guides and the trolley arm, whereby the former are automatically made operative when the trolley leaves the wire. (See illustration.)

518,362. Trolley Wheel. John D. Ansley, Cambridge, Mass. Filed July 27, 1893.

The combination with a trolley wheel or pulley having in its hub an annular recess or chamber for reception of a lubricant, of a pure copper bushing having a perforation or perforations communicating with said chamber.

518,365. Rheostat. Alva C. Dinkey, Allegheny Co, Pa. Filed December 1, 1893.

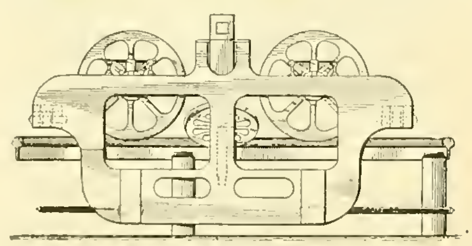
In a rheostat a shaft having a lever, a connection between said shaft and a collar upon a second shaft, a crank-pin carried by the collar, a link pivoted to the crank-pin and to a lever arm, and an actuating connection between the lever arm and the traveling contact arm of the rheostat.

518,371. Car Starter and Brake. Carl H. O. Leverkus, Cologne-on-the-Rhine, Germany. Filed January 9, 1894.

In combination, in a car starter apparatus, the truck frame, a vertically movable frame carrying the car body, an elevating means between the truck frame and the movable frame, the driving connections engaging the car axle for operating the elevating means, the clutch for throwing the driving connections into and out of engagement with the car axle and the transmitting devices between the driving connections and the car axle for transmitting the falling movement of the car body and frame to the said car axle to start the car.

518,373. Strain Insulator. Louis McCarthy, Boston, Mass. Filed January 15, 1894.

This is an insulator comprising a case, metallic connections within said case, and insulating material between said connections, said insulating material consisting of a series of sheets of mica and a layer of molded composition.



NO. 518,535.

518,401. Car Brake. Frank E. Gillang, Toledo, Ohio, assignor of two-thirds to Francis M. Oliver and Frederick J. Shovar, same place. Filed August 18, 1893.

In a car brake, a friction drum upon the axle, a rope or cable coiled around the same, brake actuating mechanism connected with the rope or cable by flexible connections attached to the brake mechanism upon each side of the friction drum, and normally slack, and connections with the rope or cable and each brake rod upon the car. (See illustration.)

518,414. Bond for Electric Railways. Julius Meyer, New York, N. Y. Filed January 18, 1894.

In an electric railway, the combination, with conductors, of a bond or bonds connecting the same, a container, means for attaching the container to said conductors, and insulating material in the container for insulating the bond or bonds and its or their connection with and points of contact with the conductors.

518,439. Metallic Tie and Rail Fastener. William T. Armstrong and George H. Wadsworth, Cleveland, Ohio. Filed November 11, 1893.

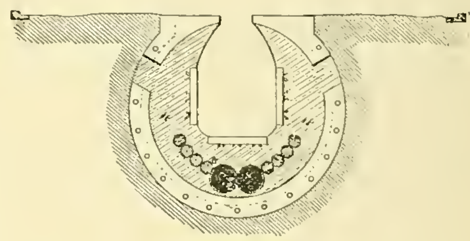
In combination with a rail fastener, a metallic tie provided at each end with two slots having their outer edges beveled, adapted to co-operate with a clip or dog the distance between the inner edges of said slots being a little less than the width of the bottom of a rail, and two elongated openings outside of said slots.

518,535. Truck. Johan M. E. Penning, Haarlem, Netherlands. Filed December 8, 1893.

This is a truck for an engine, motor-car, or car, composed of sections hinged together, supporting wheels attached to the frame and designed to bear upon and run over a single rail, driving-wheels and guide-wheels attached to the frame and designed to bear upon the rail, the sections of the frame being connected by a point above the rail, whereby the weight of the frame and appurtenances tends to hold the driving and guide wheels in contact with the rail. (See illustration.)

518 540. Electric Railway Conduit. Paul H. Banholtzer, Philadelphia Pa. Filed November 16, 1893.

In an underground trolley system, the combination with a conduit having openings in its sides in addition to the slot opening, of conductors arranged in the said conduit, a plastic material forced into the conduit through the side openings, and securing the said conductors in place. (See illustration.)



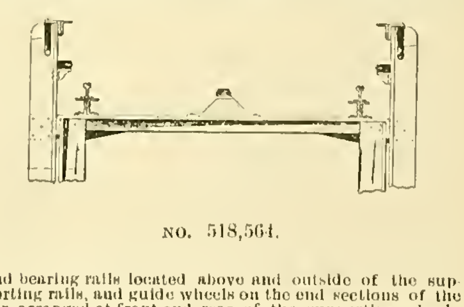
NO. 518,540.

518,564. Elevated Railway. Charles C. Burton, Utica, N. Y., assignor by direct and mesne assignments of a part of his right to George M. Ludlow, Chicago, Ill., Louis E. Holden, Beloit, Wis., and Curtis G. Hussey, Allegheny, and John C. des Granges, Pittsburg, Pa. Filed September 15, 1892.

The combination with supporting rails and guide rails located above and outside of the same, of an elevated structure comprising longitudinal stringers sustaining the supporting rails and guide rails, cross pieces extending beneath and outside of the stringers which sustain the supporting rails, and upright parts or posts attached to said cross pieces and to the stringers supporting the guide rails. (See illustration.)

518,565. Railway Track and Car. Charles C. Burton, Chicago, Ill., assignor by direct and mesne assignments of a part of his right to George M. Ludlow, Chicago, Ill., Louis E. Holden, Beloit, Wis., and Curtis G. Hussey, Allegheny, and John des Granges, Pittsburg, Pa. Filed September 15, 1892.

This comprises the combination with a car consisting of two end sections provided with supporting wheels and a middle section pivoted to and suspended between the end sections, of a track structure embracing supporting rails, and bearing rails located above and outside of the supporting rails, and guide wheels on the end sections of the car, arranged at front and rear of the supporting wheels and bearing upwardly and outwardly against the said bearing rails.



NO. 518,564.

518,571. Fender for Tram Cars. Franklyn S. Hogg, New York, N. Y. Filed November 6, 1893.

In a tram car or like vehicle, a rock shaft, a fender secured to the forward face of a rock shaft, extending downwardly and forwardly therefrom, a second fender extending from the opposite side of the shaft, plungers connected with the main fender, and means for limiting the movement of the plungers.

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VOL. X. CHICAGO, MAY 5, 1894. No. 18.

CONTENTS.

New York Rapid Transit. The outlook for rapid transit in New York City is not encouraging. The rapid transit bill passed by the legislature with its clause referring to the people the question whether the city shall incur indebtedness for the construction of a railway removes the possibility of immediate action of importance. The people evidently must be satisfied with existing transportation facilities for some years yet.

Endorsement of the Trolley. In the fight that has been waged against the trolley system in Chicago every sort of absurd argument has been advanced by those opposed to its introduction. The opposition has secured the aid of the daily press, but those best qualified to judge from actual experience of the merits of the overhead system have not been invited to give their testimony, as it was realized that their opinions would not be adverse to the only successful means of operating electric railways. The views of several prominent railway managers were secured by those who believe in the improvement of transit facilities in Chicago, and their communications are presented elsewhere in this issue. Their praise of the trolley system will not be surprising to the readers of the STREET RAILWAY GAZETTE, but it stands in striking contrast to the sensational and absurd attacks of the opponents of the electric railway.

Chance for Prize Seekers. At the recently adjourned session of the New York state legislature a bill was passed offering a prize of $50,000 for the invention of a safe, economical and satisfactory system of street car propulsion. This move leads to the suspicion that it is an effort to perpetuate the offer of one of the New York City street railway companies from which nothing has yet been realized, and from which if reports are true nothing is likely to result, except the disappointment of more than a thousand inventors whose hopes had been aroused by that apparently genuine and liberal offer. It is a very easy matter to formulate a prize offer for a competition such as the one proposed that shall be practically prohibitory in its terms and from which it is sufficiently easy to retire with the announcement that "all bids have been rejected." If the proposition of the legislature results in nothing more than that of the Metropolitan Traction Company appears to have done, no good is to be expected from the offer.

Chicago Trolley Ordinance. The last electric railway ordinance passed by the city council of Chicago provides that the companies who are granted the privilege of introducing the trolley system shall pay by way of compensation certain sums annually for the extension of the system of municipal illumination. This method of taxing the corporations is certainly far preferable to the plan formerly suggested by the mayor, by which they were to be compelled to maintain electric light plants for the illumination of the streets. It is a generally accepted doctrine that companies should pay a reasonable amount for the privileges conferred upon them by municipal franchises but there seems to be no good reason for forcing them into the business of electric lighting. The compensation which the city exacts for the trolley privilege is by no means small but the offer which the new ordinance makes has at least one great advantage; it is definite and it is a comparatively easy problem for the companies to determine whether they can afford to pay the sum which is demanded.

Electric Motors on the Metropolitan. It is now stated definitely that the Metropolitan Elevated Railway Company of Chicago, will operate by electricity its road soon to be opened. The matter of motive power has been under investigation for months, and while it has been repeatedly asserted that electricity was to be adopted there has been no official confirmation of the report until the last week. It is announced that the company has not selected a system, but in all probability it will somewhat closely follow in the line of the World's Fair intramural road, the successful operation of which beyond a doubt led the officials of the company to adopt an electrical system. The decision of the Metropolitan company is beyond a doubt a strong endorsement of the electric motor. Electricity and steam were considered solely on their merits and the former was selected because it was regarded as reliable as steam and much more economical. The decision to use electric motors may involve delay in the opening of the road as it will now be necessary to construct a generating station of considerable capacity.

The Increase in Wages. There has been a vast deal of discussion during the last few months among street railway employes regarding actual or probable reductions. Few of the number, however, realize, we imagine, how marked has been the improvement during the last twenty-five years in the condition of the men in charge of street cars in the great cities. One of the veterans in the service of the West End company in Boston recently showed to the writer a time table which was in effect in 1862 on a railway which now forms part of the West End system. A comparison with a time table of to-day disclosed the fact that the driver of 1862 was obliged to work each day over two hours more than the Boston motorman of to-day and that while the latter's daily wages are $2.25 the driver in the war times was paid at the rate of $35 per month. In other words during the last thirty odd years the street railway employe's hours of labor have been decreased fully 20 per cent. and his wages have been almost doubled. The improvement in all cities perhaps has not been so marked as in Boston, but the illustration shows that a decided advance which the men are sometimes inclined to disregard has been scored by labor in the street railway field during the last three decades.

Steam vs. Electicity. We take pleasure in publishing this week a very full abstract of the exhaustive paper of David L. Barnes on the use of electricity for that class of railroad service now handled by steam locomotives almost exclusively. The appearance of the paper in the proceedings of the Western Railway Club is significant, especially when we consider the favorable view taken by the author of the paper in regard to the use of electricity in future railroading. To be sure Mr. Barnes' views are very conservative, but they are on this account all the more valuable and they are by all odds the fairest statement of the problems involved that we have had from the steam railroad engineers. The advocates of the electric railway railway have too often perhaps looked upon the steam railroad man as a defender of the steam method of railroad traction who would not if he could see any advantage in the electrical method of operation. Mr. Barnes has certainly taken a much broader view of the whole problem and has endeavored to state the case fairly for all concerned. He has always taken a greater interest in this question than almost any other steam railroad man, a fact that may be due to his association with the design of the trucks and frames of the electric locomotives which the General Electric Company is now building for the Baltimore & Ohio tunnel service. Mr. Barnes concludes that if the conditions are such that a cheaper class of fuel can be used in the central station than on the steam locomotive, there may be a considerable saving in cost of fuel, while there is no saving in weight of fuel. On the elevated railroads in Chicago for instance where the fuel costs about $7.00 a ton on the tenders, and the fuel for a central station could be purchased for $1.75, he finds a saving in cost of fuel of 63 per cent. is possible, although even in this case allowance should be made for the difference in quality of fuel, which would reduce the possible saving to about 50 per cent. In local suburban work and for switching, where the same fuel could be used on the locomotive as in the central station, he estimates that there will be no saving in the cost of fuel, and if it was found that the locomotive required a somewhat better quality than the stationary plant, and if the stationary plant could use bituminous slack, say at $1.50 a ton, while the steam locomotive coal costs $2.20 a ton, the saving in cost of fuel would be 22 per cent. These figures show how the conditions which regulate the price of fuel control almost completely the saving effected by electric motors. He further says that for long lines with considerable distances between stations, the efficiency of the current is also greater; the gain in efficiency of the motors will however more than offset the increased loss in conducting the current; hence, for such conditions the electric system is somewhat more economical in fuel than for elevated roads, switching or local suburban service, where the same fuel is used for both systems. On the other hand, the steam locomotive is also more economical during long continuous runs, and probably the average conditions for this class of work are such that the same weight of fuel would be used, in either case, per ton mile and it is only where the conditions demand a higher priced fuel for the steam locomotive than for the central station plant, that there would be any substantial saving in cost of fuel per ton mile by using the electric system at the present time. As to the advisability of changing the motive power of existing roads Mr. Barnes concluded that "only on short lines where the traffic is crowded is it now economical to substitute electric motors for steam locomotives. There will be no saving in cost of fuel where the same coal must be used in the stationary plant as is used for the steam locomotive, and a substantial saving in fuel cost will only be obtained where, as in elevated road work, the fuel is much more expensive for the steam locomotive than for the central station."

CHICAGO TROLLEY ORDINANCE PASSED.

Mayor Hopkins of Chicago this week vetoed the ordinance, referred to in the last issue, giving the West and North Chicago Street Railway Companies the right to introduce the trolley system. The mayor stated his objection to the introduction of the overhead railway wires except in the outskirts of the city, and expressed his belief that the grant was not hedged about with sufficient precautionary conditions. The city council at its last meeting took up the ordinance and after amending it passed it by a vote of 49 to 14. Instead of requiring the companies to maintain an electric system to light the streets on which cars were operated the ordinance provides that a certain sum be paid the city each year to aid in the extension of the municipal electric illumination scheme. Two of the interesting sections in ordinance are as follows:

Sec. 4. Said companies shall establish and maintain a metallic return circuit conductor independent of their rails upon all the lines of street railroad hereby authorized to be operated by electric overhead contact wires. Wherever other lines of wire cross the wires to be strung by virtue of this ordinance the latter wires shall be protected by guard wires or other suitable mechanical device as may be directed by the Commissioner of Public Works.

Sec. 6. That for and in consideration of the privileges herein granted by the City of Chicago to said companies the said North Chicago Street railroad company and the said West Chicago Street railroad company agree to jointly pay to the City of Chicago the sum of ten thousand dollars ($10,000) at expiration of the first year after the passage of this ordinance; the sum of fifteen thousand dollars ($15,000) at the expiration of the second year after the passage of this ordinance; the sum of twenty thousand dollars ($20,000) at the expiration of the third year after the passage of this ordinance, and the sum of twenty-five thousand dollars ($25,000) at the expiration of the fourth year, and also at the expiration of every following year, after the passage of this ordinance, said sums to be used by the City of Chicago for extending its electric light system.

STRIKE IN MILWAUKEE AVERTED.

The danger of a strike of the employes of the Milwaukee Street Railway Company has been averted by the agreement of the company to pay the men the same wages that they have been receiving—19 cents per hour. A strike to take place May 1 was first threatened but the employes fearing that new men would be engaged to take their places, decided to bring the controversy to an immediate settlement. They not only declared that they would accept no reduction, but they threatened to strike at once, instead of waiting for May 1, unless the company promised to continue the old wages. They could not afford to wait until the 1st of May, they said, because the company would have too much time in which to prepare for a strike. Speaking of the reasons for making the reductions, Henry C. Payne vice-president and general manager, is quoted as saying that for the first seventeen days of April the earnings of the company had decreased $5,334,65, an average falling off each day of $313,80. Since its organization, he said, the company had not been able to pay interest upon its bonds, and up to last December the persons interested in the road advanced the money with which to pay the interest. Owing to financial difficulties the owners of the road did not see their way clear to paying the interest which became due last December and a default was made. The interest was not paid at that time and it has not been paid since. It was far enough toward June, Mr. Payne stated, to assert with certainty that the interest due in the month would not be paid, not having been earned. Thus they could see, Mr. Payne told the men, that only the sufferance of creditors prevented the company from being forced into bankrupcy. So far as the stock was concerned, he said that the company had no hope of earning a dividend for some time. He himself had been drawing no salary since the first of January, having waived it. Nor was any New York official receiving a salary. The salaries of the superintendents, he said, were not any higher than those paid to superintendents in other cities.

Mr. Payne offered to compromise with the men. He said that from May 1 the company would pay 18 cents an hour, or it would submit to arbitration the question whether the wages should be 17½ cents an hour or 19 cents an hour. When the representatives of the men said that neither of these propostions could be accepted, the company, Mr. Payne stated, would either arbitrate as above proposed, or it would pay 19 cents an hour from May 1 to November 1, and 18 cents an hour from November 1 to May 1. Under the latter proposition the wages of the men would average 18½ cents. an hour the year around, only half a cent an hour less than they had been getting, but the men declared that they would not accept the offer. Mr. Payne finally determined to yield to the demands of the employes, rather than to run the risk of a strike.

TROLLEY CONTROVERSY IN CHICAGO.

The trolley question has been the subject of no little discussion in Chicago during the last few months. There is now no reason to doubt that within a comparatively brief time electric cars will be seen in considerable numbers in sections of the city outside the central business district. The trolley has now apparently won the day but the result has not been accomplished without a fight. The press of the city has generally been hostile to the introduction of the overhead system. The arguments which it has used in its campaign against the trolley have been ridiculous and would have been unworthy of notice were they not calculated to mislead those who were ignorant of the merits of the electric system. The McGuire Manufacturing Company of Chicago has proved to be one of the strong friends of those who sought to improve the transportation facilities by the introduction of electricity, and it has taken a vast deal of interest in the controversy. In its effort to aid the supporters of the trolley system it has furnished them with ammunition in the shape of letters from the managers of electric railways who testify in regard to the safety and reliability of operation of electric cars. Some of these letters, which were secured by M. G. Hubbard, Jr., chief engineer of the McGuire company, are reproduced herewith:

MILWAUKEE, January 25, 1894.

Dear Sir:—In reply to your letter of some days ago, in regard to accidents occurring in connection with the operation of trolley lines of the Milwaukee Street Railway Company, I beg to say it is clearly apparent that the facts have been greatly mis-stated in recent newspaper publications. If published statements were true it would seem that the trolley cars here were in a fair way to speedily depopulate the city, but these statements are not true. As a matter of fact, the writers of them have recorded about every accident from the most important to the most trivial that has occurred in a long series of years, during which time nearly all the street car lines of the city were operated by horse power, and charged them all up against the trolley system. It is a fact that a large portion of the accidents, fatal and otherwise, that have been attributed to trolley cars, as recently published in a Chicago paper, occurred where cars were operated with horses.

This company has in operation, regularly, 140 cars on 125 miles of track, all by the trolley system, the cars averaging 145 miles each day. During 1893 there were but five fatal accidents and in every case it was the result of gross carelessness on the part of the victim, such as stepping directly in front of a rapidly moving car. There have been about the same number of minor accidents and with but possibly one exception, all were the result of carelessness on the part of the injured. Children, persons intoxicated, and persons given to extremely careless acts seem to persist in running before street cars with trolley connections with about the same degree of negligence that they step in front of a railroad train or a runaway horse, and with about the same result, some fatally and some slightly injured.

As a matter of fact, the percentage of accidents, both fatal and otherwise, is much smaller on these lines in proportion to the mileage run and the number of passengers carried under the trolley system, than under the old-time horse car system. During 1893 the accidents to persons injured and death included, have not exceeded one to each one million miles covered by trolley cars, and come a long way short of one to each million passengers carried. It is but fair to add that under the increasing efficiency in handling cars by the operators, and a better observance of the laws of self-preservation on the part of the people, the percentage of accidents is rapidly decreasing.

A. W. LYNN,
Superintendent Milwaukee Street Railway Company.

DENVER, COLO., January 8, 1894.

Dear Sir: Referring to yours of the 14th inst., we are at present operating 99 miles of electric road on which we are operating about 70 motor cars and half as many trailers. They average about 135 miles each per day. We have had during the past year a number of slight accidents, probably averaging two or three a day, most of them the result of people getting on and off the cars while the same were in motion.

We have had two fatal accidents during the year, one of them being a man who under the influence of liquor, stepped from a moving car in front of another car running in the opposite direction; the other a small lad who attempted to pass in front of a rapidly moving car.

C. K. DURBIN, Superintendent,
Denver Tramway Company.

MEMPHIS, TENN., January 6, 1894.

Dear Sir: Replying to yours of the 4th inst., we have 50 miles of track on which we run an average of 50 cars per day and about 6,500 miles per day. We have never had since my taking charge of this line any accident that has been in any way connected with the trolley or overhead wires. Have had a few personal injury cases with our cars but none serious.

F. C. JONES, Gen. Manager,
The Citizens Street Railroad Company.

TOLEDO, O., January 6, 1894.

Gentlemen:—I have yours of the 3rd, inst. We operate on an average 70 cars per day, each car averaging from 140 to 145 miles per day. Our roads have been in operation by electricity for about four years. During this period six or seven persons have been killed or died from the results of injuries received. The principal cause of accidents for the first two years was owing to careless drivers of vehicles, driving in front of cars, but since they have been accustomed to the greater speed of electric cars, the accidents from this source have diminished. The next most prolific cause was from persons stepping off, or trying to get onto cars while in motion. The increased speed of electric cars over horse cars misled many persons in their calculation, hence they were thrown. The number of accidents of all kinds during the past year has greatly diminished. Nothing would induce our people to return to horse car transit.

ALBION E. LANG, Gen. Manager,
Toledo Consolidated Street Railway Company.

ALLEGHENY, PA., January 6, 1894.

Dear Sir:—Replying to your letter of inquiry, dated January 4, I note that the Chicago papers are making a systematic attack upon electric railway lines, and that this is following a like attack that has been going on in New York for the past year. During December I noticed an item in the New York *Tribune* headed "Another Trolley Accident." The article stated that two young ladies were driving in a carriage in Washington, D. C., the horses became frightened at the cars and ran off. This sort of thing is repeated daily by New York papers, so as to make a favorable public prejudiced against electric propulsion. It is a well-known fact to persons familiar with New York and New York affairs, that all accidents occurring from the operation of the cable roads are never mentioned, or else but briefly stated, whereas, accidents occurring on roads electrically equipped, are published under exaggerated headings. I am very sorry to hear that the papers of your city are pursuing this same course, for the great benefits to be derived from electric railways will surely be missed in Chicago, if the papers continue to create this unnatural prejudice. On this road we run a daily average of 6,500 miles, with forty motor cars and ten trailers. For the year ending July 1, 1893, in this company's report to the auditor general, we gave as killed 5, as injured 4. The persons killed were, in most cases, children, between 6 and 15 years of age, and in no case was the method of propelling the cars to blame for these accidents.

I think if the records of any cable road of like size can be obtained, that we would see a very much larger death rate, and greater number of injuries. There are very few roads whose tracks are laid on as narrow streets and through as thickly populated district as ours, and if electric traction were as fatal as many papers have endeavored to show, this road would have probably as large a percentage of accidents as any in the country.

In regard to death from electrical current, I would say that there is only one that I know of that can be directly attributed to the electrical current, and the person who received this current was a person in the employ of the electric company in a car station whose health had been undermined by disease.

I would suggest a point, that a great many of the delays, accidents, and troubles on electric lines, which no doubt the public opposing them will bring up, are due entirely to the crude and hasty manner in which these lines have been built, and we can safely say that such annoyances as killing horses, charging poles, and the like have been eliminated by the modern construction of overhead lines.

GEO. F. GREENWOOD, Gen. Manager,
Pittsburg, Allegheny & Manchester Traction Company.

BOSTON, January 9, 1894.

Gentlemen:—In reply to yours of the 4th, I would state that we operate about 600 cars per day by electricity, the mileage of these cars for the fiscal year ending Sep. 30, 1893, being 14,220,-847. Electric mileage 14,220,847, horse mileage 4,448,962, total 18,669,809. Regarding the average number of accidents, both deaths and injuries, I beg to quote you a comparison which appeared in the Boston press, between accidents on steam roads having termini in Boston, as compared with the West End street railway, for the fiscal year ending June 30, 1893.

C. S. SERGEANT,
Manager, West End Street Railway Company.

The comparison to which Mr. Sergeant refers is as follows:

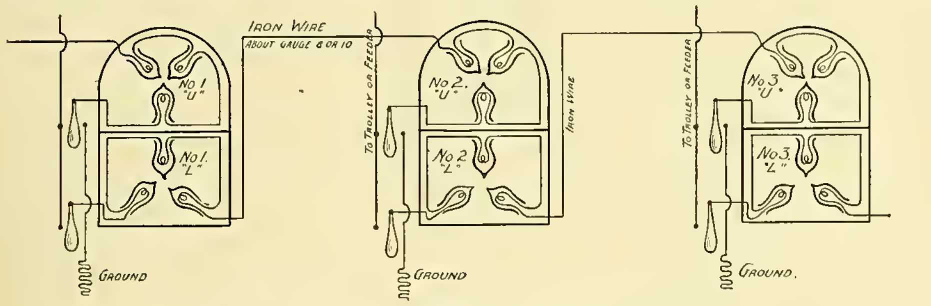
A COMPARATIVE REPORT OF MASSACHUSETTS RAILWAYS.

In glancing through the annual report of some of the Massachusetts railway companies some interesting facts are brought to light, and none more so than a comparison of the figures of steam and street railways. The reports are made up to June 30. The Boston & Maine, Boston & Albany, New York & New England and Fitchburg Railroads carried 91,077,130 passengers. The West End street railway carried 145,068,370 passengers, this including free transfers. On the steam railroads 362 fatal injuries are reported, and on the West End 20. Of this number 45 of those killed on the steam railroads were passengers, and on the West End, 1. Of those killed on the steam roads about 300 were employes.

On the steam roads 1,470 were injured, and on the West End 310. On the steam railroads one person was killed or injured to every 23,225 miles of run. On the West End one person was killed or injured to every 56,575 miles run. In this connection it should be noted that the cars of the West End railway run upon a thoroughfare. It is a significant fact that out of 145,068 370 passengers carried by the West End road but one was killed, and there was but one injured to every 858,392 carried. On the steam railroads there was one fatal injury to every 3,794,840 carried, and one injury in every 427,592 carried. The steam roads ran 18,864,235 passenger miles, and the West End 18,669,809 passenger miles.

TURNOUT SIGNALS FOR SINGLE TRACK ROADS.

The accompanying illustration shows the system of signals designed by W. M. Ramsey, superintendent of the Federal Street and Pleasant Valley street railway of Pittsburg. The system is now being installed on the line of the Youngstown Street Railway Company of Youngstown, Ohio. All the lines of this company are single track, with turnouts placed at the necessary points, and on account of the numerous curves and grades, these switches cannot be seen from each other. On a pole placed opposite and convenient to each switch, is a waterproof box with a glass front, having two compartments, an upper and a lower, in each of which three incandescent lamps are placed These lamps are wired with six in series, and the boxes on each route are connected by a No. 8 iron wire. The lamps are placed in series, so that the candle power may be so reduced that the lamps will last almost indefinitely. The lamps are of 16 candle power each,



SWITCH SIGNALS FOR A SINGLE TRACK ELECTRIC RAILWAY.

and are made for 100 volt circuits. When six of them, together with the iron wire of the circuit are placed in series on a 500 volt system, it will be seen that the candle power and consumption of current are considerably reduced. Only one connecting wire is needed between the signal boxes, and this is run as shown in the illustration.

When switch No. 1 L is thrown to the right, and switch No. 2 U is thrown to the left, the lamps will burn, or when No. 1 L is thrown to the left and No. 2 U is thrown to the right, the lamps will burn. When both switches, however, are thrown to the right or both to the left, the circuit is not closed and the lamps will not burn. The rule adopted when lines are operated by means of these signals, is that the car which makes the lamps burn first, has the right of way. The signals are so connected up that all the cars going one way (say north) use the three lamps in the upper half of the box, and all cars going south will then use the lower signals.

EFFICIENCY OF THE MONT SALEVE ELECTRIC RACK RAILWAY.

Writing upon the subject in London *Engineering* C. S. Preller says of this line, which has been described in recent issues of the STREET RAILWAY GAZETTE:

The guaranteed load is four motor cars ascending separately and simultaneously the steepest (25 per cent.) grade at a speed of 1.5 meter (5 ft.) per second. Taking the coefficient of traction at 5 kilogrammes (11 lbs.) per ton, the required total effective power is, for the average load of 12 tons per car,

$$4 \times \left\{ \frac{12 \times (250 + 5) \times 1.5}{75} \right\} = 245 \text{ horse power, or}$$

180 kilowatts. The current taken from the conductor by a 12-ton car on the steepest grade is 115 amperes at a mean pressure of 530 volts, or 61 kilowatts, equal to 244 kilowatts or 332 horse power for the four cars, so that the loss between the conductor rail and the rack pinions, viz., in the motors and the gearing, is 26 per cent. of which fully 16 per cent. must be set down to the gearing alone. At the termini of the three sections the mean tension of 530 volts, (12 per cent.) drops to 510 volts, equal to a loss of 15 per cent., so that, more especially on the summit section, where the steepest grade coincides with sharp curves, the speed at times drops below 1.5 meters per second, particularly when cars are run in duplicate. In the dynamos of the central station the various losses due to armature reaction, hysteresis, and eddy currents, amount in Thury machines to 10 per cent., and the total loss of energy between the turbine shaft and the line, is, therefore:

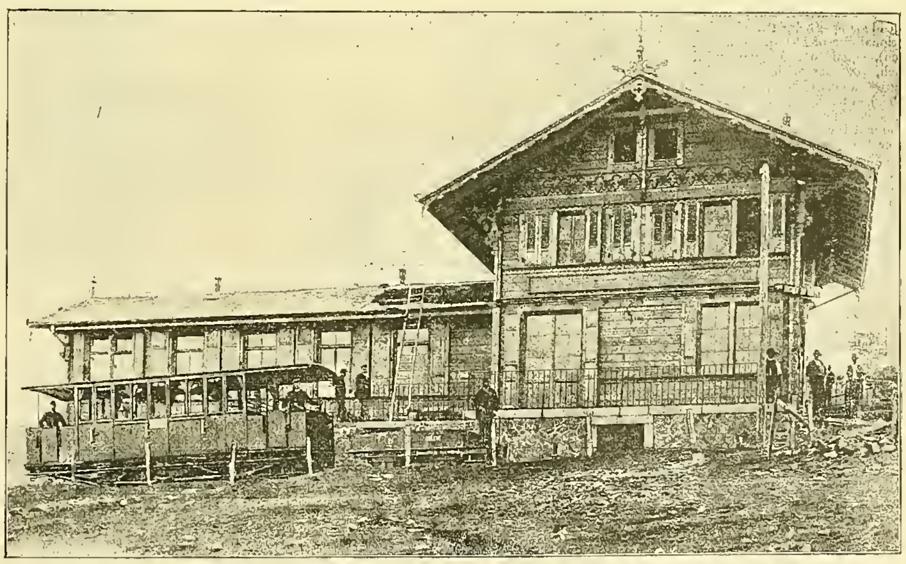
	Per cent.
In generators..............	...10
In transmission and conductor rail.	...12
In motors and gearing	...26
Total	48

Hence the mean efficiency is 52 per cent., this low percentage being mainly due to the unfavorable arrangement of the motors and gearing. The average grade being 12.7 per cent., and the average speed 8 kilometers (5 miles) per hour, or 2.2 meters per second, the effective power on the line and the corresponding power at the central station for the average and maximum car loads of 12 and 14 tons respectively, work out as follows:

Car Load.	Mean Effective Power.	Central Station.
Tons.	Horse Power.	Horse Power.
12	47	90
14	54	100

The extra energy in starting must be taken at least at 100 per cent., having regard to the inertia of the heavy gearing. The requisite torque on the maximum starting grade in stations (viz., 16 per cent.) is 4.5 tons under favorable conditions, but may rise to over 6 tons, equal to 160 horse power at the central station.

One of the terminal stations of the Mont Saleve Electric rack railway is shown in the accompanying illustration. Its appearance is decidedly characteristic of the country over which the route runs and of the people who are daily carried over the route.



TERMINAL STATION OF THE MT. SALEVE ELECTRIC RACK RAILWAY.

Jersey City, N. J.—The Consolidated Traction Company is planning to organize an electric freight service between Newark and Jersey City.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Seventeenth Article.)

We have seen (Fig. 10) that if an electric current is passed through a coil of wire it sets up lines of force which have a definite direction within the coil and give the coil a distinct polarity. Now if this coil while traversed by a current of electricity be brought into a magnetic field, viz: be placed between the poles of a magnet,

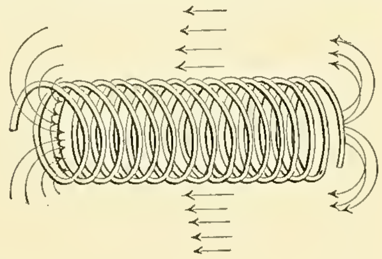


FIG. 10.

it will tend to take up such a position that the lines of force generated within its own coils shall have the same direction as those of the magnetic field in which it is placed. That is, it will tend to place its own axis directly on the line joining the north and south poles of the field magnet with the south pole of the coil facing the north pole of the magnet and the north pole of the coil facing the south pole of the magnet. In this position the coil presents the least obstruction to the passage of the lines of force between the two poles of the magnet, because it presents the greatest area for their passage and in fact assists the passage of these lines by the magneto-motive force which its own current adds to that of the magnet between whose poles it is placed. When the coil is in the position shown in Fig. 23 with a current traversing it in such a direction as to assist the lines of force across from N to S we have this condition fulfilled, and this is the position which any coil traversed by a current will take up if free to move, when placed between the poles of a magnet. The usual way of expressing this fact is to say that a closed electric circuit when placed in a magnetic field tends to take up such a position as to enable it to embrace the greatest possible number of lines of force. Clearly this condition is best fulfilled when the plane of the coil is at right angles to the lines of force as in Fig. 23, and least fulfilled when it is in the position shown in Fig. 22, because in the latter the plane of the coil is parallel to the lines of force passing from N to S and it can embrace no lines of force unless by some means they may be diverted from a direct line so as to thread themselves through the loop in curved lines. This they are induced to do by the current in the coil which sucks them in, as it were, either from the upper side or the lower side of the coil according to the direction of the current in the coil. With the current flowing as indicated by the arrows in Fig. 22—in the direction of the hands of a clock as we look down upon the coil—the upper surface will have a south polarity, that is, its own lines of force will enter the coil from that side and emerge from the lower side which will have north polarity. In like manner, some of the lines of force which extend in straight lines from N to S will be bent out of the direct line so as to thread themselves through the loop in the same way. Other lines will crowd through and in doing so and in trying at the same time to straighten themselves out again will pry the loop around from its present position in a direction contrary to that indicated by the arrow. As the angle through which the loop is thus turned increases, it permits still more lines to thread it and there add their prying effort until the plane of the loop is at right angles to the lines which permits the lines to pass through without bending, and therefore without further tendency to rotate the coil.

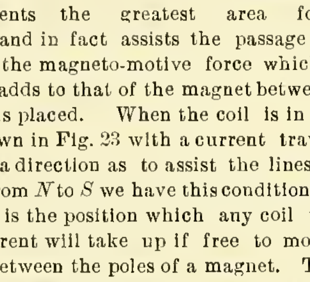


FIG. 22.

We may note right here one peculiar fact. We found that when we revolved the coil between the poles $N S$ from left to right in the direction indicated by the arrow, it produced a current in the direction $A\ B\ G\ C\ D\ A$. Now, if we pass a current through the coil in the same direction as it took when the coil was mechanically revolved, viz: $D\ A\ B\ G\ C\ B$, it tends to cause the coil to revolve in the *opposite* direction. That is to say, the current which is generated by revolving a coil in a magnetic field is in such a direction as would cause the same coil to revolve in the opposite direction—the action of the elec-

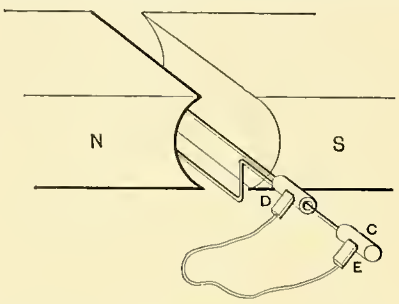


FIG. 23.

trical current generated in a coil is to directly oppose that of the motion which produced it. This is a fundamental law of electrics and explains why as the current increases in a circuit, it requires more force to drive the armature of the dynamo. It is because the larger the current traversing the coils of the armature, the greater the effort on the part of that current to revolve the armature in the opposite direction, and it is the energy that is absorbed in overcoming this tendency that reappears in the armature coils as electricity.

But to go back a little ways. If with the coil in the position shown in Fig. 22 we should pass the

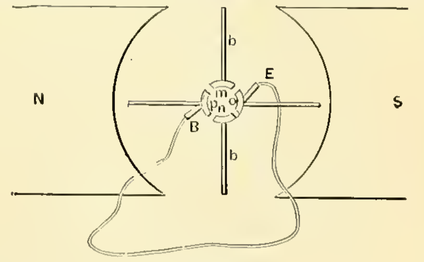
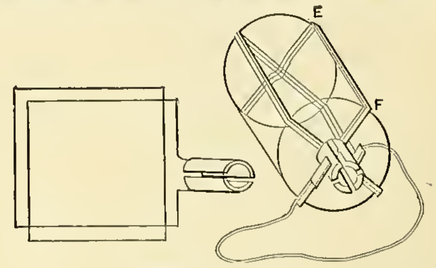


FIG. 30.

current in the opposite direction to that indicated by the arrows, the lines would thread through the loops from the under side and come out on the upper side, thus prying the loop over in the opposite direction. If at the same time that we change the direction of the current in the loop we also change the direction of the lines of force in our field, by making the right-hand field north and the left-hand field south, we see that the lines will enter the coil on the right hand from below and emerge on the left hand from above, and in the effort to straighten themselves out would again tend to pry the loop in the same direction as in the first case. We therefore see that reversing both the magnetism of our fields and the direction of the current in the armature has no effect upon the direction of rotation of the armature. The direction of rotation will be changed, however, if either of them alone be changed.

If we place a single coil of wire traversed by a current in a magnetic field it will tend to revolve about its axis until the plane of the coil is at right angles to the lines of force of the field in which it is placed and the direction of its rotation will be determined by the direction of the current which flows through the coil. No matter how strong the current or how powerful the field, the coil will not tend to revolve further than 90 degrees from the direction of the lines of force. This is entirely similar to the action of the compass needle when a current-carrying wire is placed over it. We remember that under these conditions the needle was deviated in one direc-



FIGS. 31 AND 32.

tion or the other according to the direction of the current in the wire, and tended to take up a position at right angles to the wire. It would be a more general statement, but equally true, that the wire had an equal tendency to place itself at right angles to the needle. The action was more apparent in the needle, however, because that was readily movable, while the coil was not.

But suppose we have two coils of wire with their planes, say at right angles to each other, as in Figs. 30, 32 and 33. If the current, diverted from that coil which has already been revolved to a position at right angles to the lines of force of the field to the other coil, which is now parallel to those lines, as may be automatically accomplished by a commutator of four parts, the rotation will be continued in the same direction, and we have at once an elementary electric motor. Or if we have but a single coil, as in the first case, whose ends terminate in a two-part commutator and the direction of the current in the coil be reversed when it has reached a position at right angles to the field, its own lines of force will be reversed in direction and cause the field lines to seek a passage by a circuitous route from the opposite side of the coil, and these, as before stated, in their endeavor to straighten themselves out, will pry the coil over still further and cause it to make another half revolution.

In an electric motor advantage is taken of both of these actions where there are many coils at various angles to each other, and as each coil comes to the position where the threading of the lines of force through it in one direction exerts no further tendency to cause it to rotate, the current in that coil is reversed in direction so as to cause the lines to enter from the opposite side and continue to exert an effort at rotation. Thus by changing the direction of the current in the coil at the proper time twice in each revolution, a single coil may be kept in continuous rotation.

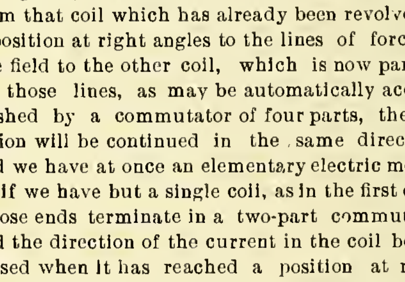


FIG. 33.

But the effort which will be exerted will vary widely with different positions of the coil with respect to the field. Twice in every revolution, viz: when the coil is at right angles to the field the effort will be nothing, and twice viz: when the coil is parallel to the field it will be a maximum. We find that these positions correspond with the positions of minimum and maximum activities of the coil when used to generate current. We remember that in describing the dynamo with two coils at right angles to each other, it was stated that the current would be more uniform if there were two coils at right angles to each other, for in that case when one coil was in its neutral position and cutting no lines of force, the other one would be in the position where it would be cutting the lines of force at a maximum rate. So with the motor. If we have two coils at right angles to each other, one of these will be exerting its greatest effort at rotation, while the other one is exerting none. Thus by increasing the number of coils at small angles with each other the effort to turn the armature will not only be increased but become more uniform. The effort exerted by the armature to revolve is termed its "torque" and is dependent upon the number of lines of force that can be induced to thread themselves through the coil and this is dependent, as we know, upon the current. The "torque" of a motor, or the effort which it exerts to turn against a resistance, is therefore said to be dependent upon the amount of current passing through the armature coils. It is also, of course, dependent upon the strength of the field, but if that be constant, it is proportional always to the current.

CHICAGO AND ST. LOUIS ELECTRIC RAILROAD.

As we stated in our last issue, the actual work on this line has again been undertaken. During the week workmen have begun grading at Alpine, a small suburb 20 miles southwest of Chicago. Since the company's plans were interrupted about a year ago by the financial depression, some changes have been made in its original designs. The capital stock has been increased from $7,000,000 to $10,000,000 and a like increase has been considered necessary in the bond issue. From a statement just issued by the company we extract the following details of the proposed line:

The road will be double track, standard gauge of standard steam construction, with 72 pounds Bessemer steel rails, laid upon standard hard wood ties placed twenty-four inches apart from center to center, with rock ballasted foundation. All bridges and culverts will be of standard steam railroad construction, adapted to carry two one-hundred-ton steam locomotives and their trains, the bridges being of steel of the plate-girder type.

The grading will be twenty-four feet wide at the surface, with a gradient limit of fifty feet per mile. The rails will have mitred joints of special design, provided with extra long and heavy six-bolt angle fish plates. The line of the road will be practically straight. The road is to be provided with Wharton switches and spring frogs for spurs, sidings and terminals, so as to present an unbroken main line rail for high-speed trains.

There will be no railroad or country road crossings at grade. The line will pass over all intersecting railroads upon one-hundred-foot-span, steel plate-girder bridges of standard steam construction, with earth approaches. The country roads will be thrown up over the tracks by means of wooden bridges, having approaches not to exceed eight per cent. grade.

The road will be operated from four electric power stations; these will consist of substantial brick structures, each located at the mouth of a coal mine belonging to the railroad company, and situated along the line of its road. They will be so located that the coal can from the company's mines be dumped directly from the hoist of the mine into the boiler house. From each of these power stations a high-pressure alternating electric current of ten thousand volts will be sent out each way, a distance varying from thirty to forty miles, to supply from three to four transformer stations. Every ten miles along the line of the road there will be a transformer switch-station, from which the current, after having been reduced to two thousand volts, will be sent out each way over a section of five miles of trolley wire. The road will be electrically divided up into fifty sections of five miles each. Behind each live section or section having a car upon it, there will be a dead section of five miles, on which it will be impossible for any car to run, so long as a car is upon the preceding section, there being no current by means of which to propel the car on such sections. Only those sections which should have cars running upon them will be supplied with current.

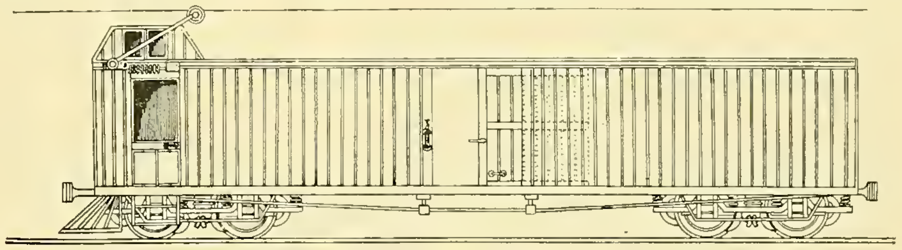


FIG. 2. PROPOSED FREIGHT CAR OF THE CHICAGO & ST. LOUIS ELECTRIC ROAD.

There is thus constituted a complete block power system which will render it impossible for any two cars to run upon any single section at the same time, unless specially desired. In other words, the cars will be normally kept at least five miles apart, with at least one dead section of five miles between them.

The character of the high speed motor passenger cars that are designed to be run for through service at 100 miles per hour is shown in Fig. 1. It is a long, low car of steel framing, having four pairs of drive wheels. Each of these cars will have two bogie motor trucks, one at each end, upon which the car body will be swung in such a way that its center of gravity will lie below the plane of the axles. The car will have an entrance for passengers in the center of one side. A smoking room is provided at one end of the passenger compartment, and at the other end there are two toilet rooms. Immediately behind, and extending over the forward truck there is a compartment for the motorman; over the rear truck there is a compartment for a limited amount of baggage, mail and express. The top of the car stands only nine feet from the rails. The front of the car is semi-wedge shaped to minimize the atmospheric resistance.

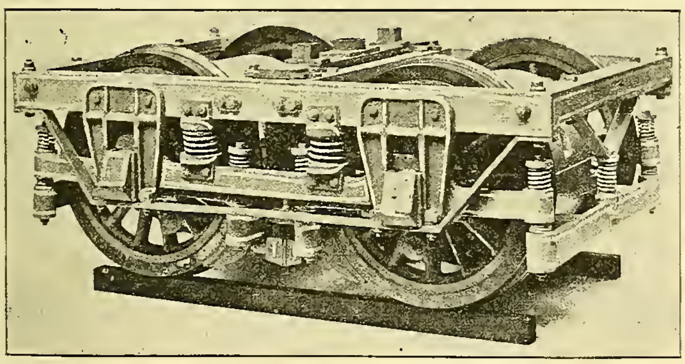


FIG. 3. PASSENGER CAR TRUCK.

FIG. 1. PROPOSED PASSENGER CAR.

These cars with their motors will weigh, loaded, sixty thousand pounds. The whole of this weight will come upon the four pairs of driving wheels, and will be distributed over approximately, forty feet of track way. The entire weight of the car, motor and passengers will, therefore, be available for adhesion between the rails and the wheels. The axle of each of the four pairs of driving wheels is provided with a directly connected electric motor. These cars are designed to be generally run singly, but they may also be used to haul trailing cars without motors; or two motor-cars may be coupled together. Other passenger cars for lower speeds and for local traffic are to be constructed after the general plan of the passenger car now in use upon steam railroads. Some of them will be provided with motors and used as motor-cars to haul other trail cars without motors. The equipment for hauling freight will consist of freight motor-cars and ordinary freight cars of the various types. The freight motor-cars will take the place of the ordinary steam locomotive, and will be employed to haul trains of trailing freight cars, the weight required to give the necessary adhesion being supplied by a paying load of freight. As will appear from the accompanying illustration Fig. 2 the freight motor-cars will be made by taking an ordinary freight car and equipping it with four 60 H. P. electric motors, one upon each axle. A small part of one end of the car is partitioned off as a compartment for the motorman. The total weight, including motors and load is estimated at 58,000 pounds.

The motor trucks are of two kinds, one for freight and the other for passenger cars. The former will have motors connected with the axles by means of single reduction spur-gearing, completely closed-in and running in oil. The latter will have motors connected directly with the axles, without gearing. The car body is supported through elliptical springs upon a swinging bolster, and then upon the axles through nest coil springs and equalizing bars. The motors are mounted concentrically upon the axles through springs, and directly connected with such axles through flexible or link couplings. The motors are held against the torque or turning moment by separate torque springs. Each individual axle is provided with a separate motor, and each axle with its motor is entirely free to move independently. There are, therefore, two motors to each truck, or four motors to each car. Each truck is provided with regular toggle-lever, locomotive air brakes. The driving wheels are four feet in diameter. The construction of the motor trucks for the high speed cars is shown in Fig. 3.

The overhead construction will consist of the high pressure feed-wires for conveying the current from the power houses to the different transformer stations, and of trolley wires for conveying the current to the cars. The trolley wire will be held in place by being swung from a longitudinal steel wire provided with short, flexible steel cords every twenty-five feet. This will permit of the trolley wire being made practically parallel to the track-way, so that the trolley wheel upon the car may travel in a plane of practically uniform height from the track-way. The trolley wire will hang about one foot above and one foot to the side of the car.

Lancaster, Pa.—The Pennsylvania Traction Company has made another important purchase, the Lancaster and Lititz turnpike, which passes through one of the most populous districts of Lancaster county. By securing this turnpike the traction company obtains a fine route to Lititz, and now has the way open for extending an important line through to Ephrata and Manheim. The terms on which the turnpike was secured are that the stockholders of the turnpike company are assured an annual dividend of 12 per cent. on their stock, which is what the tolls over the road have brought them. As the electric railway will extend along the side of the turnpike, which will still be used for teams, the tolls alone will enable the traction company to meet their obligation. The railway line will be built without delay.

Washington, D. C.—The Widener-Elkins Syndicate having been unsuccessful in obtaining an amended charter for the proposed boulevard and electric railway between Baltimore and Washington, have, it is announced, secured the rights of the Baltimore & Columbia Railway Company, with its elastic charter, permitting the building of either an electric or steam railroad from Washington to the state line.

PRESENT UTILITY OF ELECTRIC MOTORS ON RAILROADS.*

BY DAVID L. BARNES.

Plain current motors are more efficient at high speed than at low speed, and without the controller the efficiency commences at zero and finally reaches about 85 per cent. at the highest speed. The curve of variation of efficiency without the controller is shown by Fig. 1. The variation in the horse power at the central station without the use of the controllers is about as shown by Fig. 2.

With the controller the efficiency commences at zero and finally reaches about 85 per cent, but the variation between these limits is quite different from what it is without the controller, as is shown by comparison of Figs. 1 and 3. A comparison of the horse power required at the central station is furnished by Figs. 2 and 4.

Fig. 3 shows the efficiency of a plain current motor from a start to full speed for elevated railroad work. The maximum is about 85 per cent. and the minimum is zero. The average is about 60 per cent. but in this work it is safe only to assume 50 per cent. as the average efficiency. This is about the same efficiency as would be obtained in switching and suburban service. Elevated railroad and suburban steam locomotives are generally required to accelerate a train from a standstill to a speed of 30 miles an hour about as shown by Fig. 5. This curve was taken by a Boyer steam recorder from an actual train in regular service.

Curves of this kind have the general form

$$V^2=aS-bS^2$$

in which V is the velocity in feet per second, S the distance from the starting point in feet and a and b are constants depending on conditions.

From this formula by some considerable deduction, is obtained the time t in seconds to travel a given distance from the starting point, as follows.

$$t=\frac{1}{\sqrt{b}}$$

multiplied by the length of an arc having a cotangent

$$\sqrt{\left\{\frac{a}{b}\cdot\frac{1}{S}\right\}-1}$$

The arc having a radius of one foot.

The total drawbar pull p in tons of 2,000 pounds is found for any distance from the starting point; and for any weight of total train and locomotive W in tons:

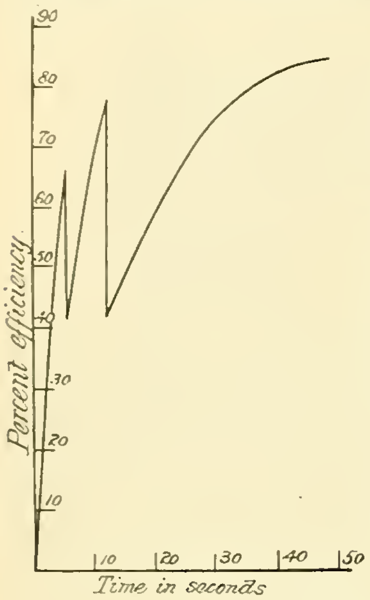
$$p=\frac{W}{32\ 2}\left\{\frac{a}{2}-bS\right\}$$

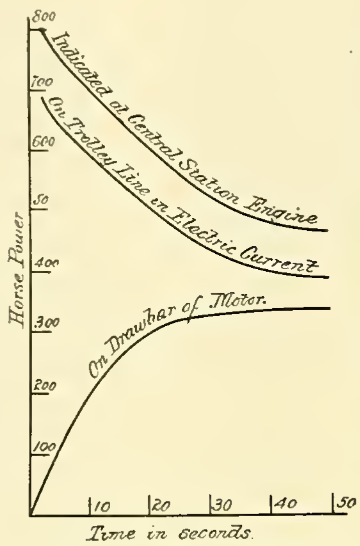
For the curve shown by Fig. 5 the value of a is 1.88 and the value of b is .00024. From these formulas the time diagram is found to be as shown by Fig. 6. The drawbar pull diagram for a 130-ton train is given by Fig. 7. The line from A to B shows the line of decrease in pull as the speed increases; for this class of acceleration it is generally a straight line. The area aa is the work done to overcome the friction of the axles and wheels, etc. The area $A\ B\ C\ D$ is the work done to accelerate the train.

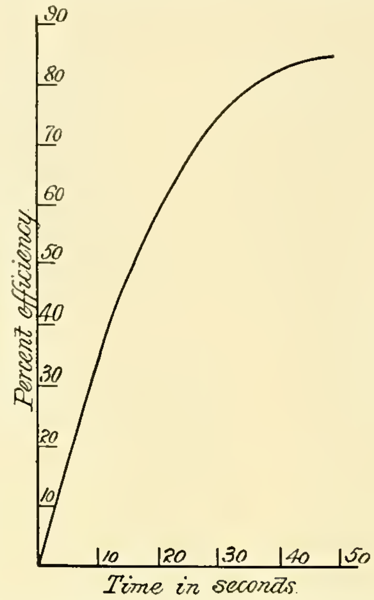
At the point B the brakes are applied and the steam is shut off. During the stop the area bb is the retarding effect of the friction of the axles, wheels, etc., and the area $C\ E\ F$ is the retarding effect of the brake shoes. The curve of stopping, that is the change of velocity during a stop, has the same general form as the curve of acceleration and may be taken as having that form for all practical purposes. In this case the values of a and b during the stop by reckoning s backwards from the end of the stop are $a=5.98$; $b=.0046$ (see Fig. 5).

The area $C\ E\ F$ of Fig. 7 shows the enormous amount of work lost in the brake shoes. All day long, year after year, the locomotives of any elevated or suburban road, whether operated by electricity or steam, go on putting energy into the train as shown by the area $A\ B\ C\ D$ and immediately thereafter it is taken out by the brake shoes and wasted as shown by the area $C\ E\ F$. The small amount of power required to keep the train in motion continuously, if it did not stop, is shown by the areas $a\ a$ and $b\ b$. It is this loss that has led to the movable sidewalk scheme and has stirred our best inventors to look for a storage system. It has been proposed in stopping to turn the energy in the train into electricity by using the motors as dynamos and put the electricity back into the line, but no one has yet devised a plan for doing this that is worth consideration from a practical standpoint.

For such work as shown by Fig. 7, the total horse power required at the drawbar for a 130-ton train is shown by Fig. 8, and the horse power required at the central station engine cylinders for an electric system to do this work is shown by Fig. 9, assuming the use of a controller. It is for this class of work that the electric motor is best adapted to give good commercial results.







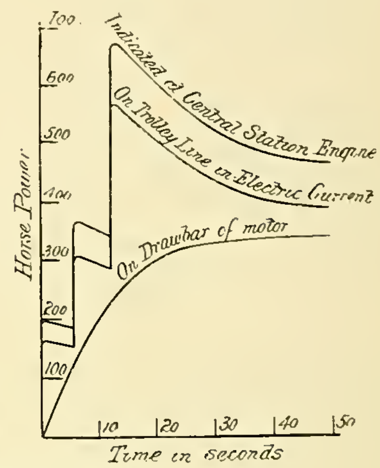


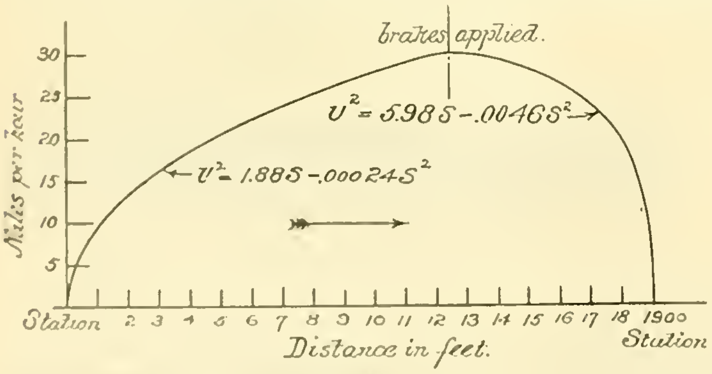
FIG. 1. EFFICIENCY OF PLAIN CURRENT MOTORS WITHOUT CONTROLLER IN STARTING A LIGHT SUBURBAN TRAIN.
FIG. 2. LOSS OF HORSE POWER BETWEEN CENTRAL STATION AND DRAWBAR WHEN CONTROLLER IS NOT USED.
FIG. 3. EFFICIENCY OF PLAIN CURRENT MOTORS WITH CONTROLLER IN STARTING A LIGHT SUBURBAN TRAIN.
FIG. 4 LOSS OF HORSE POWER BETWEEN CENTRAL STATION AND DRAWBAR WHEN CONTROLLER IS USED.

Fig. 10 shows the efficiency from a start, to the time the brakes are applied for stopping, on a line that has about 6 minutes from the start to the putting on of brakes, or about 8 minutes between stations on the time card; in this case there would be a run of about three miles at the maximum speed, when the maximum is 40 miles an hour. The minimum efficiency is zero as befoie and the maximum is 85 per cent., but the average is much higher than for short lines; that is, about 80 instead of 60 per cent. as in the case of elevated railroad work.

The efficiency of the line of conductors from the central station to the motors, where the plant is properly put in, ought to be 90 per cent., and the efficiency of the dynamos ought to be such as to give at the terminals of the dynamo a current that would represent 85 per cent. of the indicated power of the steam engine. The steam engines used ought to give a horse power for 15 pounds of steam per hour. Now, having this information, we are in a position to show the relative efficiencies of steam locomotives and electric motors so far as the cost of fuel is concerned, leaving aside for the moment all other costs that go to make up operating expenses, such as wages, repairs, interest on plant, etc.

If the same fuel is used on the steam locomotive as in the stationary boilers, and the fuel is assumed to be fair bituminous coal, then each pound of fuel will evaporate into steam about six pounds of water in the best steam locomotives, and 8½ pounds in a good stationary boiler.

The steam locomotive will generate a horse power for about 25 pounds of steam an hour when the locomotive is of the best type; hence, on this



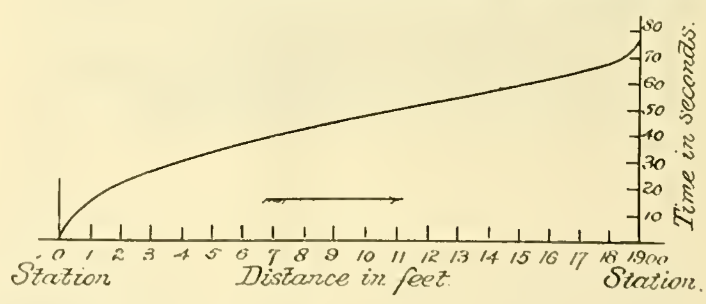


FIG. 5. DIAGRAM SHOWING THE CHANGE OF SPEED DURING THE ACCELERATION OF AN ELEVATED RAILROAD TRAIN, TAKEN FROM REGULAR SERVICE WITH BOYER SPEED RECORDER.

FIG. 6. TIME BETWEEN STATIONS, ELEVATED RAILROAD WORK.

*Abstract of a paper before the Western Railroad Club basis, a comparison of the economies of the two systems in the indicated power in the steam cylinder of both systems is 1.8 pounds of coal per horse power per hour in the stationary engines and 4.2 pounds of coal per horse power for the steam locomotive.

The steam locomotive uses the power directly; and there is no further loss that need be considered with this general comparison, but with the electric system there is a further loss of 15 per cent in the dynamo and connections, 10 per cent. in the line, and 50 per cent. in the motors for switching, suburban and elevated railroad work, or 20 per cent. in the motors for lines having about 8 minutes between stations. The final result is an efficiency of about 38 per cent. between the cylinders of the stationary engine and the drawbars of the motors for switching suburban and elevated railroad work, and 61 per cent. for the longer line assumed.

The result in the fuel used will then be 4.7 pounds of coal used an hour in the stationary engine to get one useful horse power on the drawbar of the electric motor for short lines, which is practically the same as that required for the steam locomotive. For the longer line assumed the fuel required is 3 pounds an hour per useful horse power. This is based upon an ordinary fuel; with a better class of fuel, such as anthracite burned on large grates, the locomotive will do better work in proportion, and the difference in economy in weight of fuel will be in favor of the steam locomotive on short lines.

For elevated railroad work, where anthracite coal is used, the locomotive, if of the compound type, will not require more than $3\frac{1}{2}$ pounds of coal per horse power an hour at the drawbar, and such fuel is better than the common bituminous coal that would be used in the stationary engines of the electric plant; hence, so far as the use of fuel is concerned in actual work on elevated railroads, there would be no saving in weight of fuel by using electricity, but when allowance is made for the loss of fuel while the engines are standing fired up during the day and night, it is probable that the weight of fuel per ton per mile would be very nearly the same for the steam locomotive as for the electric motor when the same fuel is used, and somewhat less for the steam locomotive when anthracite fuel is used for the steam locomotive and cheap bituminous coal for the stationary boilers of the electric plant.

The conditions as to the use of fuel and the kind of fuel vary so much that each case must be treated by itself, but for all practical purposes of comparison at the present time, it may be assumed that the same amount of fuel per ton mile would be used with the electric system as with the steam locomotives for short lines.

If the conditions are such that a cheaper class of fuel can be used in the central station than on the steam locomotive, there may be a considerable saving in cost of fuel, while there is no saving in weight of fuel. On the elevated railroads in Chicago, where the fuel costs about $7 a ton on the tenders, and the fuel for a central staton could be purchased for $1.75, a saving in cost of fuel of 63 per cent. is possible. In this case allowance should be made for the difference in quality of fuel, which would reduce the possible saving to about 50 per cent.

In local suburban work and for switching, where the same fuel could be used on the locomotive as in the central station, there will be no saving in the cost of fuel, and if it were found that the locomotive required a somewhat better quality than the stationary plant, and if the stationary plant could use bituminous slack, say at $1.50 a ton, while the steam locomotive coal cost $2.20 a ton, the saving in cost of fuel would be 22 per cent. This again shows how the conditions which regulate the price of fuel control almost completely the saving in cost of fuel incident to the use of electric motors.

For long lines, with considerable distances between stations, the efficiency of electric motors is very much greater, but the loss of energy in transmitting the current is also greater; the gain in efficiency of the motors will, however, more than offset the increased loss in conducting the current; hence, for such conditions the electric system is somewhat more economical in fuel than for elevated roads, switching or local suburban service, where the same fuel is used for both systems. On the other hand the steam locomotive is also more economical during long continuous runs, and probably the average conditions for this class of work are such that the same weight of fuel would be used in either case per ton mile, and it is only where the conditions demand a higher priced fuel for the steam locomotive than for the central station plant that there would be any substantial saving in cost of fuel per ton mile by using the electric system at the present time.

The first cost of central station plants and conductors for the long line work is so great per mile of track as to deter any steam railroad company from making an experiment of changing a large steam locomotive plant to an electric at present. The prices for this work are now so unsettled that it would be valueless to give any estimate of cost in this paper. Prices are dropping rapidly, and it would not be surprising if one year hence the cost of installing an electric plant for long distance work would be only about one-half of what it was a year ago.

Only on short lines, where the traffic is crowded is it now economical to substitute electric motors for steam locomotives. There will be no saving in cost of fuel where the same coal must be used in the stationary plant as was used for the steam locomotive, and a substantial saving in fuel cost will only be obtained where, as in elevated road work, the fuel is much more expensive for the steam locomotive than for the central station.

The repairs to the electric motors, the line conductors and the central station plant, added to the interest on the first cost, cannot be greater than the cost of repairs and interest on steam locomotives when there is heavy traffic, although the first cost of the electric motors is fully double. This will, perhaps, appear from the fact that less work is necessary to maintain the electrical apparatus than the steam locomotive under equally favorable conditions for both. Especially is this true where the feed water is bad and the locomotive boilers collect much mud and scale. On the other hand, if inferior electrical apparatus is used and some considerable experiment is required to get a safe insulation of the line conductors and to put the mechanism of the controllers and motors into good running shape, the cost of repairs and maintenance of electric motors for the first two years will be very much greater than for the steam locomotives. This has been the experience of street railroad lines that purchased electrical apparatus during the period of rapid development. One of the most prominent and largest street railroad systems of this country has had to renew more than half of the motors under the cars and make radical changes in the central station plant, mainly for the reason that a few years ago, at the time the apparatus was put in, the art was in a stage of rapid development, and when the more perfect and better apparatus was brought out the best interests of the company demanded that the devices first put in, although comparatively new, should be cast out.

For these and similar reasons estimates made as to the cost of maintenance and deterioration of electrical apparatus should include such changes as will probably be required in the apparatus due to the advance of the art. While it may be true, as sometimes claimed, that electrical apparatus of the best kind will last in good working order for a period of 50 years, yet it must be remembered that long before such a period is passed the apparatus will be out of date and will have to be replaced by more practical and economical mechanism.

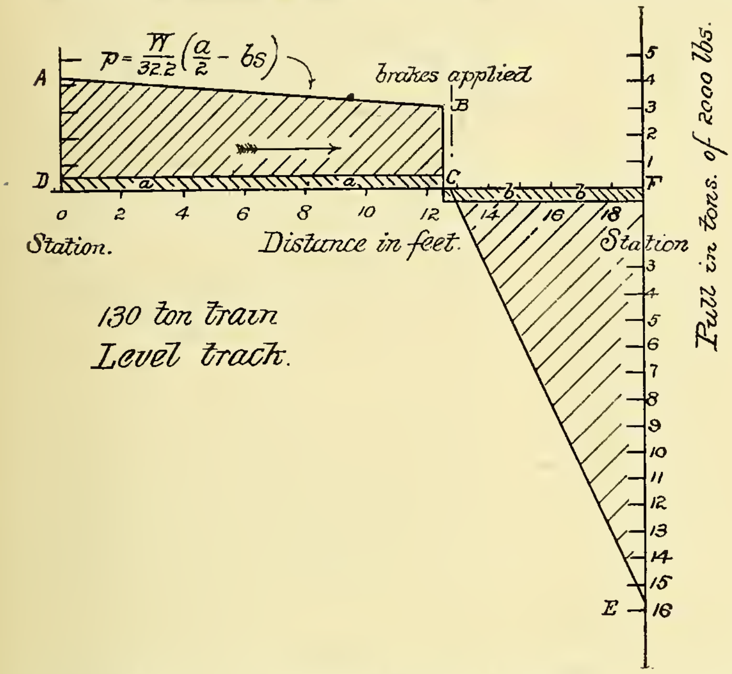


FIG. 7. DRAWBAR PULL AND RESISTANCE OF BRAKE SHOE FRICTION. TRAIN, 130 TONS.

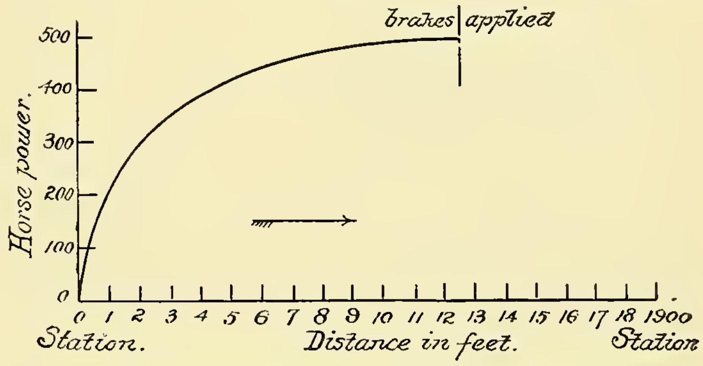


FIG. 8. HORSE POWER REQUIRED AT DRAWBAR. TRAIN, 130 TONS.

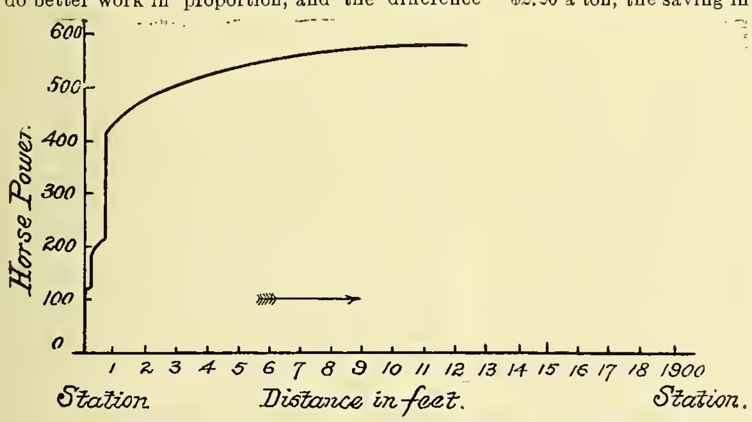


FIG. 9. HORSE POWER AT STATION TO HAUL TRAINS OF 130 TONS.

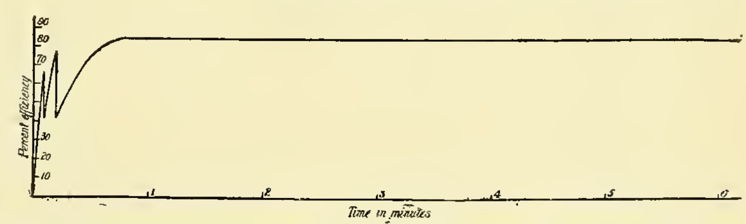


FIG. 10. EFFICIENCY OF ELECTRIC MOTOR—EIGHT MINUTES BETWEEN STATIONS.

It will appear from this, perhaps, that no railroad company should undertake the substitution of electric motors for steam locomotives without the most searching inquiry into all phases of the question. Each piece of apparatus should be carefully examined, not only as to its durability and efficiency, but also as to its stage of development. The difficulty with similar apparatus on street railroads should be considered, and in making the final comparison of relative costs of maintenance and operation a factor of 10 per cent. per annum should be added over and above interest cost and maintenance so as to include the cost of such changes as will probably be required on account of the progress in the art.

Railroads running through a thickly settled district and having to contend with complaints about noise and smoke may find it worth an additional expenditure to remove the cause thereof, and where a railroad company is compelled to use a high-priced fuel to get rid of smoke it will be found advantageous and probably cheaper to use electric motors at the present time.

It has been claimed that only one man is required on an electric motor at the head of a train, and therefore that there is a saving of one man per train when electricity is used, but this is only true when there is not a separate motor at the head of a train and where the cars are run as on the Intramural road and the conductor is on the rear platform of the front-motor car ready to give assistance in case anything happens to the motorman. Where the motors are separated from the train, it is not considered safe to use only a single man at the front end, for reasons that are too plain to require discussion here. It is probable that many railroad managers would decide always to use two men at the head of the train whether there was a motor car or a separate locomotive.

The trolley wire system of conductors has been proved to be practical, and it is safe to introduce it at the present time. The third or conducting rail system can be so insulated as to be made practicable, but the experience with it is much less. The service on the Intramural road was too slow and light to settle this point for heavy traffic on lines where passengers must in emergencies alight on the tracks and employes must travel to and fro in making repairs. Perhaps the trolley need not be overhead; it may be at the side and covered so it cannot be reached by passengers from the windows or steps of the car, but the fact remains that the overhead trolley is the only system of conductors that has been sufficiently well developed to enable one to pronounce upon its practicability with certainty.

The first steam railroad of any importance to take up seriously an investigation of a plan to use electricity in the place of steam was the Manhattan Elevated in New York City. The motor was too small and not powerful enough, then in use, and the design was also inefficient. The maximum drawbar pull of the steam locomotive was about 8,000 pounds while that of the electric was about 4 000 pounds. The failure was a certainty from the start, and although so evident at that time to those who were well informed in locomotive practice, yet this case of failure has been used unfairly since to show the impracticability of electric motor for railroad work. The trial was the result of a lack of appreciation of the real conditions, and to cite the results as showing anything useful so far as power, cost or efficiency is concerned, is practically malicious.

After the Manhattan fiasco but little was done in heavy work for a long time beyond the production of a multitude of designs. In 1891 the Thomson-Houston Company, now the General Electric Company, brought out a switching locomotive. This motor weighs 21 5 tons on drivers and has been used considerably with good results.

The next designs of any real importance are the electric locomotives of the City and South London Subway in London, designed by Messrs. Mather & Platt, engineers, of Manchester, England. The weight on drivers is 10 tons. These motors are now doing very good work.

A locomotive built by the General Electric Company for elevated railroad service and tried at Lynn in 1893 afterwards took part in the tug-of-war at the World's Fair, where it was so badly beaten by a steam locomotive of about its own weight as even to arouse the sympathy of steam locomotive advocates. The cause of the failure was neglect to study conditions and the results were so misleading as to need further mention here.

The weight of this locomotive on drivers is about 59,000 pounds The weight of the steam locomotive against which it was tested is about 62,000 pounds on drivers. The electric locomotive has a short wheel base and the drawbar is much above the center of the axle. When the pull came the weight on one pair of wheels was reduced by the tipping tendency, and that pair slipped and in slipping the motor on that axle revolved rapidly, and acted like a dynamo, and shut most of the current off from the other pair of wheels and the locomotive was practically without power. Had the motors been connected up so that the current divided and went through each separately, then the remaining motor on the other pair of wheels, after one pair had slipped, would have given a substantial pull but not enough to overcome the steam locomotive. If the wheels had been connected up with parallel rods the results would have been quite different and if some heavy weights had been added to hold down the electric locomotive on the opposite end from the point of pulling the electric locomotive would undoubtedly have pulled more than the steam locomotive for the reason that the power of the electric motor is applied evenly, while the steam power is applied irregularly. In a test of this kind both motors should have practically the same weight on drivers, and parallel rods should be used if it is desired to bring out the superiority of the even application of power by the electric motor. With equal weight on drivers and parallel rods on both, the electric will probably always pull more at very slow speeds than the steam locomotives of equal weight.

The electric locomotives on the Liverpool overhead road are very successful machines, and their practical operation shows great efficiency. The weight on drivers is 15.4 tons. The motors are placed directly on the axles and without gear.

The Northern Pacific terminal road in Chicago decided several years ago to make an experiment with electricity, and after a long investigation the firm of Sprague, Duncan & Hutchinson of New York city, now dissolved, was employed to make designs and construct an electric locomotive rated at 1,000 horse power. The construction of the frames was undertaken by the Baldwin Locomotive Works. The electric motors were to be of the Westinghouse design and make. Part of the construction has been done but the work has been abandoned for the present. This motor was expected to weigh about 60 tons on drivers.

The largest steam or electric locomotive ever ordered from any manufacturer is that adopted by the B. & O. railroad company. Six of this type have been ordered from the General Electric Company of Boston, for use in the Baltimore belt line tunnel. The weight on drivers is to be about 200,000 pounds. The work required is to move a 1,200 ton freight train over a grade a little less than 1 per cent. at the rate of 15 miles an hour, and in passenger service to move a 500 ton train over the same grade at 30 miles an hour. Each locomotive will also be required to act as a push engine when the regular steam locomotive is hauling a heavy freight train up a grade of 1½ per cent.

The electric motors and the method of control have been designed by W. H. Knight, member of the American Society of Civil Engineers, chief engineer of the railway department of the General Electric Company. These parts are being built at the General Electric Company shops at Schenectady. The frames, wheels and connections are being built at the Schenectady Locomotive Works from designs of the writer. The work on these motors is being rapidly pushed, and they will be ready for use before the tunnel is finished.

In a general way the foregoing gives the status of the electric locomotive question at the present time. In the future the most rapid introduction will be for elevated railroads and for suburban lines and switching were the smoke nuisance must be abolished. For exceedingly high speeds, say 100 to 150 miles an hour the electric locomotive has advantages that the steam locomotive can never have, but that there will be any real demand for any such speeds in the near future is doubtful. One derailment at one hundred miles an hour will dampen considerably the ardor of those who now clamor for the highest possible speeds. Even with the strongest wooden cars now built the loss of life in a collision or derailment at 100 miles an hour would be appalling. Metal cars and greater certainty of a safe clear track must be had before trains will be run at such high speeds as to require electric motors.

In the matter of men and tools for repairs, railroad companies will need but few changes to care for electric locomotives. The maintenance of the conductors and central stations will probably fall to the road department and electric locomotives differ so little in running gear from the steam locomotive and are so simple in construction as to require no special knowledge to care for them. With the assistance of a good mechanical engineer, posted in electrical work, our railroad master mechanics can care for the electric locomotive quite as easily as the steam locomotive and the experience gained with the steam locomotive is absolutely essential for the economical maintenance of the electric locomotive, which locomotive must have practically the same cabs, air brakes, wheels, springs, draft gear, headlight, running boards, pilots, axles, driving boxes, etc , as well as an equal corps of runners and assistants.

CITIES AND STREET RAILROAD COMPANIES: THEIR MUTUAL RELATIONS.

BY H. H. CARTER
Superintendent of Boston streets.

The change in the method of operating street railways, the substitution of electricity for horse power during the last five years, presents one of the most striking instances that can be cited of the revolution effected by the discovery of the application of electricity to motive power.

The recent report of the Massachusetts Railroad Commission gives some interesting details concerning this subject, and although they do not bear directly on the topic of this discussion, they are of sufficient interest to be cited.

It is found that the companies operating the street railways of this state in 1888, had a total mileage of 533 miles. This mileage was entirely operated by horse power. In 1889 the total mileage of street railways had increased to 574 miles, 50 miles of which were operated by electricity. From that time to the present, the electric mileage of street railways has increased enormously, so that in 1893, out of a total mileage of 874 miles, 711 miles are operated by electricity. The foregoing figures show that from 1888 to 1893, the total mileage of the street railways increased from 533 to 874 miles, a difference of 341 miles, while the electric mileage came up from nothing to 711 miles.

The report of the Railroad Commission goes extensively into the financial affairs of the electric companies and seems to upset the popular notion that the change from horse to electric power has been of great financial advantage. This financial question is summed up by the Commission in the statement that the most direct and conclusive test of the net earning capacity of the two systems is a comparison of the increase in the net earnings per mile of railway with the increase in cost of railway per mile, and that this test shows that, while the net earnings per mile are 57 per cent greater, the cost and capitalization per mile are respectively 60 and 65 per cent greater in 1893 than in 1888,—the odds being clearly in favor of the horse system.

Notwithstanding the above exhibit, the tremendous increase in mileage of the electric railways seems to show that their operators are satisfied with the financial results. The public, also, has been educated up to the electric railroad, and under no circumstances would it be willing to go back to the old horse system. It therefore being taken for granted that the electric railway has come to stay and that future roads will be built to be operated in this manner and that old roads will be gradually altered over to electricity, the city officials whose duties are in connection with highways must carefully consider the question of the relation of the electric railroad to the highways.

Of the companies operating by electricity in this state all use the overhead trolley system except one, which uses a storage battery.

In relation to the question as to what system is to be used in the operation of electric railway, I take it for granted that the charter of the road will give it the right to operate under some system to be designated by the incorporators, and that it will only be on rare occasions that a superintendent of streets will be called on to dictate as to whether a storage battery must be used, an overhead trolley system, or underground feed system.

In my opinion, while the storage battery system is theoretically one which should be used, the disadvantage of the trolley system is greatly exaggerated. Except in the congested business district of a populous city where the poles and wires interfere, to some extent, with transit, and may furthermore embarrass the work of the fire department, there can be but very little objection to the use of the overhead trolley system, and it seems to me that that system can be allowed without opposition from the city authorities.

The most important question that will come before the city or town officials is the question of how the railway company is to be allowed to construct its road, form of rail, kind of paving, and so forth.

As the charter granted by the state to the incorporators of a railway is usually drawn in some broad form and simply states that permission is granted to convey passengers between certain designated points and that the particular railway is to conform to all state laws relating to railways, the city or town officials have usually no hold on the railway company through the terms of the charter which will allow of any dictation concerning the way in which the road is to be constructed. It is only when the railway company applies to the city or town for a location in the highway that it then becomes possible for the city or town officials to stipulate the terms of construction.

For instance, a new location or extension of a railroad in Boston requires a petition to the board of aldermen, by the railway company, the granting of which makes the railroad agree to certain stipulations. These stipulations are as follows:

ORDERED: That in addition to the rights heretofore granted the ———— R. R. to lay down tracks in the streets of the City of Boston, said company shall have the right to lay down tracks in ———— streets, said track and turnouts being shown by red lines on a plan made by ———— dated ———— and deposited in the office of the superintendent of streets.

The right to lay down the track located by this order is upon the condition that the whole work of laying the same, the form of rail used and the kind and quality of material used in paving said tracks shall be under the direction and to the satisfaction of the superintendent of streets, and shall be approved by him. Also, upon condition that said ———— Railway Co., shall accept this order of location and shall agree in writing to comply with the condition herein contained, and shall file said acceptance and agreement with the city clerk within thirty days from the passage of this order; otherwise it shall be null and void.

In the case, therefore, of new railways the officials in charge of the highways have matters in their own hands, and as will be seen by the above, the restrictions specified leave but little to

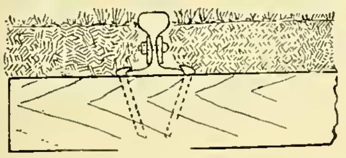


FIG. 1.

be desired; if a satisfactory piece of track work is not produced, the fault will be directly with the superintendent of streets.

As most of the cases which involve an agreement between city and railway officials apply to roads already built, extensions or renewals of which are desired, I will bring up a few cases which are apt to be called to the attention of superintendent of streets.

The first case is the question of what can be done with the railroad company in the case of the old locations where the track work is of such character as not to conform to modern requirements.

For instance, in some parts of the city, a piece of track may exist, built fifteen or twenty years ago. This track may have some antiquated form of rail such as the T rail; or the track may be paved with cobblestone, or, possibly, not paved at all. It is possible that the city authorities may desire to put this street in first-class condition with granite or asphalt paving, but the condition of the track is such that it would be absurd to spend much money unless the railroad company rebuild its track. How, then, is the company to be compelled to do this work? I regret that this matter is undecided, but it has been brought up by me in the case of the West End railroad in South Boston, and the matter will be decided by the courts.

The case was where a special appropriation had been made by the City Council to pave with granite block Eighth street, which street had a double track running through it. The rail was the old form of center bearing rail with cobblestone paving. As a strip of 13 feet of cobblestone in the center of a well paved street would have looked out of place, the railroad company were notified to replace the old center-bearing rail with a modern one and to repave with granite blocks. This the company refused to do, on the ground that the old rail and method of paving was satisfactory to the superintendent of streets at the time the work was done (twenty years ago) and that it could not be obliged to change its construction at the whim of each successive superintendent of streets, which succession, the president of the company intimated, occurred at quite short intervals. The position taken by the city was to

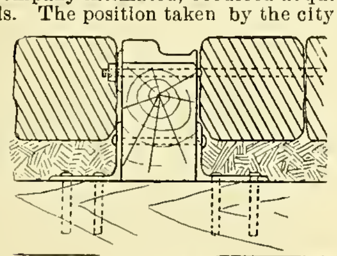


FIG. 2.

the effect that the railroad company was under the same obligation to the public as the city, viz.; to keep the highway "safe and convenient for public travel," and that a center bearing rail was not safe, and cobblestones were not convenient. This question will come up soon in the courts, and I trust my statement to the corporation counsel will be borne out, that I could produce a number of experts who would testify to the truth of both of these statements.

There is another question which is a frequent cause of dispute between railway and city officials, and that is, the question of the grade of the railway tracks. This question may come up in two ways:

1st. The railroad company may desire to rebuild or relocate a track on some old street where,

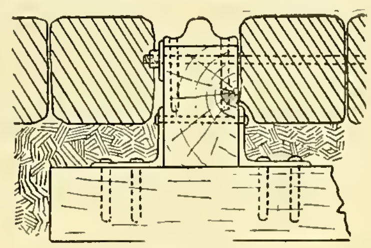


FIG. 3.

however, the city or town, owing to lack of appropriation, does not contemplate any work in the way of paving.

The railroad company applies to the superintendent of streets for a definite grade of track, and this official may then find himself in an unpleasant predicament. If he directs the railroad company to lay its rail to the theoretical grade shown on the city plans, he may find that the track will differ, possibly, five or six inches from the existing roadway, which has probably settled away or worn down from the theoretical grade. If the tracks go in on the theoretical grade, there is then required a large expenditure on the part of the town or city to bring up its street to conform to the railroad tracks and its own established grade. If an appropriation is available, this, of course, is the method to be pursued, even if it involves repaving the whole street. Suppose, on the other hand, no appropriation is available and the street is known to have settled several inches, perhaps a foot, from the established grade, at what grade is the railway company to put in its tracks? If told to follow the street surface as it exists (as the city contemplates no work on the street) a liability is incurred on the part of the city or town to allow the railroad company to keep its tracks at this grade, and in case of a future appropriation to repave the street, the railroad company can justly claim that it received directions to follow the existing grade of the street and if the town or city now desires to rebuild its street according to an established

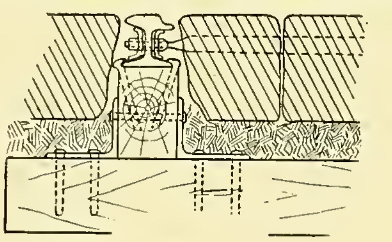


FIG 4.

grade, it must bear the expense of changing the railroad company's tracks to the new grade required.

As this question is liable to arise at any time, it may be of interest to the members of the association that on receiving a letter from a railway company requesting grades for track on some street (the street in question not being at the established city grade and no work being contemplated there by the city authorities) the railway authorities were written to as follows:

BOSTON, July 5, 1892.

Dear Sir:—In regard to the directions which you desire for laying your tracks on Chambers street, I am unable to notify you to lay the track to the grade which would be required if we were about to repave the street, as your present tracks differ largely from the above mentioned grade. You will either have to lay your track to fit the existing pavement and run the risk of raising or lowering it when we repave the street, or, if you should deem it cheaper, you can lay the tracks to the theoretical grade, as shown on the plans on file in the city surveyor's office, and repave the street from your rails to the curb at your own expense.

Yours truly,

(Signed) H. H. CARTER, Supt. of Streets.

Directions, similar to the foregoing, protect the city from possible lawsuit in case a railway company is obliged to change a track when the city afterwards improves the street.

2nd. The city may desire to improve a street and consequently to change its grade where a railway company has a track in good condition, and, therefore contemplates no work. If the company can show that it received directions to put its track at the existing grade, it evidently devolves on the city or town to pay the expense of the change of grade of the track. If, on the other hand, it appears that the railway company went ahead either without definite instruction concerning the grade of the track, or after receiving instruction, such as contained in the letter above cited, the expense of the change of track should evidently fall on the company.

Where a town or city is doing a certain amount of paving annually and when the railway company is also annually renewing stretches of track it is of course advisable for the superintendent of streets to notify the company as to the streets to be repaved during the year and to have the superintendent of the railway also notify the superintendent of streets where he contemplates track renewals. In this way it may be possible to carry on simultaneously the city and railway work. It is safe to say that in Boston the full understanding between the railway company and the city concerning the work proposed to be done during the year has led to mutual concessions with the result that miles of streets have not only been paved but have been provided with modern track construction; and without this understanding, a botched job would have been left either by the failure of the company to rebuild tracks when the city paved or the failure to pave when the company relaid tracks.

Probably the most important question that the superintendent of streets will be called on to solve, is the form of rail and kind of paving to be

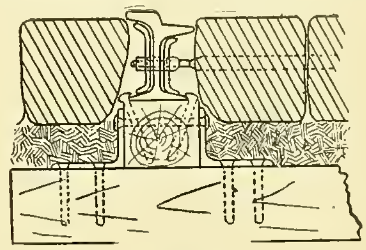


FIG. 5.

adopted by the railway company. In deciding such a question, several things must be kept in view. If a superintent of streets in a small town should insist that a new railway company, desiring to lay a tract on some unimportant street, should furnish the most improved form of grooved rail and pave its tracks with first-class granite blocks, he would, undoubtedly, succeed in putting a stop to the construction of railways in this town, and the public would be the sufferer thereby.

If, on the other hand, a superintendent of streets in a large city should allow some rich company to lay a center-bearing rail with a cobblestone pavement on some street destined to become an important boulevard, he would not be fulfilling his duty to the public who are entitled to be protected in the way their streets are used. Between these two extremes there is a wide path, and it is impossible to formulate any hard and fast rules that would apply to each individual case. The solution of such problems can be safely left, I think, in the hands of the town and city officials who have to deal with them.

In order to give some light on the subject, I have had prepared diagrams showing a number of rails in use or formerly used in this city by the West End street railway. The sketches and data here given are furnished by C. S. Sergeant, general manager of the West End Street Railway Company.

(Fig. 1.) This track is to be laid at the side of the street or in a reservation; on cross ties varying in distance from three to four feet apart; four feet apart being sufficiently near, on an average track with small size cars; and built in that way

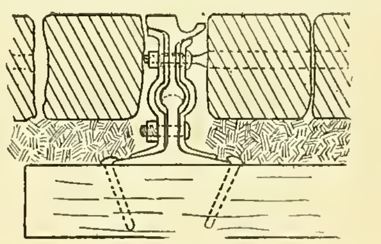


FIG. 6.

would cost about $5,000 per mile, which would include the cost of the average amount of special work and a rail weighing 35 pounds per yard.

This rail is only suitable for use in suburban streets having very little travel, where it may be laid on the side of the street, or in grass reservations in the middle of main boulevards where there is no carriage travel.

(Fig. 2.) This shows type of rail which was considered the best for horse cars, and used exclusively until within eight years. This rail is laid on a stringer 5x8 inches—stringers laid on ties about five feet apart, and with a ⅝ inch thick steel plate 16 inches long under the rail joint; spiked to the stringer with a common spike. This track including the average amount of special work would cost about $8,000 per mile not including paving. The rail would weigh 50 pounds per yard. This rail is unsuitable to lay, owing to the difficulty of keeping it in position on the stringer; the rail invariably becomes loose in a short time, owing to the rail fastenings drawing away from the stringer.

(Fig. 3.) The center bearing tram rail which about 15 years ago was considered the best on account of its durability, will weigh about 45 pounds to the yard. The sub-construction is the same as the common tram rail. This rail is not being rolled by any concern at the present time. This rail is unsuitable to use under any circumstances.

(Fig. 4.) This represents the earliest form of girder rail for street railroads. It is at once to be seen that the advantage of this type of rail over the common tram is in the fact that the fastenings are underneath the surface and not subjected to the wear of street travel. This rail is laid on a stringer 4x6 inches—stringers laid on ties four feet apart. The base of the rail is notched on the outside to admit the use of spikes, holding it to the stringer. The fastening for this type of rail was a small four-hole fish plate, and was the weak point in the rail. This track would cost about $9,000 per mile with the average amount of special work, not including paving. The rail is not being rolled at the present time. This rail is unsuitable to use where there is any heavy teaming, as it is impossible to keep the paving stone in position on the inside of the rail. The stones along the inside of the rail become tipped and worn, and a dangerous groove forms alongside the rail.

(Fig. 5.) This represents the next advance in girder rail track, which gives a tram three inches wide, and is considered by teamsters an advantage to heavy teaming. The rail is six inches high with a four-inch base; it is laid on a stringer 4½x5, and the stringer on ties four feet apart—fastened at first with a fish plate, but later with the thirty-six-inch girder joint and thirteen bolts. The West End Street Railway Company has put in some six thousand of these joints in the last two years, and so far as is known none of them have as yet given out. This form of track will cost, laid with the girder joint, about $11,000 per mile, exclusive of special work or paving. The rail will weigh 78 pounds per yard.

(Fig. 6) This represents a type of rail which has been laid in a few places in the congested district of Boston, ordered especially for these places by the superintendent of streets. The particular feature of this rail is the grooved form of head, which can be used only in streets kept scrupulously clean, and over which there is a large amount of car travel. In other places there would be great trouble from the groove filling up with ice and dirt. This rail is laid with a welded chair or foot, three feet apart on ties, with a channel bar joint which admits the use of two rows of bolts, eight in number. The base of this rail is not being rolled now. The estimated cost of construction per mile is $13,000 not including special work of paving. The weight of the rail is 86 pounds per yard.

While railroad officials are a very intelligent set of men, it must be remembered that they are looking out for the interest of their roads, and what they recommend takes into consideration the interest of the road only. To cite an instance: I was informed by an ex-official of the West End street railway that if I insisted on putting down on Washington street the grooved rail shown in Fig. 6 the West End Street Railway Company might as well shut up shop, as it could not run on such a rail in winter. Nevertheless, the rail was put down and gives the greatest satisfaction to the public, and no fault with the rail has since been found by the railway company.

As above stated, the question of rail and paving must be decided in each locality according to local circumstances. In Boston, it has come down to a comparatively simple matter. The railway, owing to its heavy cars, has, for its own protection, been obliged to adopt a deep girder rail, thus doing away with the various forms of patent rail invented by each successive manager of the road on his accession to office. The girder rail has a head, such as shown in Fig. 5, or else Fig. 6. Providing a street is a down-town business street, devoted to heavy teaming, the company is allowed to put in the rail shown in Fig. 5. This is on the theory that teamsters with heavy teams invariably prefer to travel with one wheel on the rail, and if they choose to seek the rail, it is their own fault if its form is not such as to be the most convenient to cross over. This rail is also allowed in wide suburban streets where carriage travel is amply accomodated on the side of the track. On such streets, if carriages persist in seeking the rails, it is their own fault if the form of the rail has not been designed for their use alone. On boulevards, or retail streets in the business section where there is not much heavy teaming, but where the travel is confined to light carriages, the form of rail shown in Fig. 6 is prescribed. This is the best form yet designed for the minimum obstruction to travel. Carriage wheels can cross this track with ease and the fact that the paving on the inside of the rail is at the same height as on the outside, which is not the case with the rail shown in Fig. 5, is a great advantage. It must be understood that the railway officials strongly object to the use of the grooved rail. This is not so much on account of the first extra cost as on account of the alleged extra wear on car wheels owing to the narrow groove, and also the increased power required to propel the car. It is also claimed by the railway officials that the rail is more difficult to clear of snow and ice.—*Good Roads.*

C. T. YERKES ON TRACK ELEVATION IN CHICAGO.

C. T. Yerkes, president of the North and West Chicago Street Railroad Companies, has addressed the following letter to Mayor Hopkins of Chicago expressing his readiness to coöperate in the latter's effort to secure the elevation of steam railroad tracks in Chicago:

Hon. John P. Hopkins, Mayor City of Chicago—*Dear Sir:* Referring to the subject of grade crossings, which you have so much at heart, I wish to assure you that I am in hearty sympathy with your efforts to elevate the numerous steam railroad tracks now crossing the streets and avenues of the city at many points, some of the said streets being occupied by street railroad tracks. I fully realize the necessity of a speedy abolition of the grade crossing, and every movement in that direction will have my hearty coöperation and all reasonable assistance on the part of the companies I represent. And if the project of elevating the steam railroad tracks crossing our tracks was sufficiently advanced to determine whether the crossings of our lines above grade will be accomplished with or without a depression of the streets, and in case of a depression what the probable character of the depth of the subways will be, I would readily consent to your proposition so to amend the ordinance now under consideration by you as to impose upon our companies a liberal payment towards costs to the city incident to the elevation of those tracks. But at the present time I am unable to judge to what extent our roads will be benefited by the proposed elevation, and to what inconvenience we may be exposed in the operation of our lines, and it appears also that you are unable to give me that information. It is, therefore, utterly impossible now to express in dollars and cents the amount which may fairly be expected from these companies. While I could not at this time accept any ordinance binding the companies to the payment of any fixed sum in the absence of any tangible data concerning the plan of elevation, and while I also cannot admit any legal liability on the part of the companies to make any payment whatever, I desire to assure you and through you the City Council of the City of Chicago that whenever the elevation of any of the steam railroad tracks now crossing our lines shall be accomplished, we shall voluntarily and cheerfully make liberal contributions in proportion to the benefits to be derived by us from the abolition of grade crossings.

Chicago, April 30, 1894.

SALE OF THE KEOKUK ELECTRIC RAILWAY.

The electric street railway of Keokuk Ia., was sold in accordance with an order of court on April 28. The purchaser was J. C. Hubinger who bid $10,000 for the property. The sale was made on the foreclosure of a mortgage for $85,000 held by the American Trust Company of Boston. The bid was not over one-fifth of the alleged value of the property, and was $500 less than the amount of preferred claims including taxes, receivership expenses etc. The bondholders will not realize anything.

The purchaser of the road states that if he is granted a favorable franchise by the city the operation of the road will be resumed immediately. Since the railway has been in the hands of the receiver it has not been operated.

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

Rail Welder.—The Thomson Electric Welding Company of Lynn, has recently shipped a motor dynamo car to Brooklyn, N. Y. It was built for the Johnson Company, of Johnstown, Pa., and will be used in Brooklyn by the electrical department of the Johnson Company for welding street car rails for the Nassau Electric Company. The Welding Company is working on other machines of the same type.

Underground Wires.—As we have previously announced, the board of aldermen of this city ordered the West End Railway Company to place all its feeder and return wires underground, and caused many loud comments to be heard as to the reason why all other electric wires should not go underground in like manner. Public opinion, adversely expressed about such unwarrantable discrimination, appears to have had weight with the aldermen for on Monday of this week they passed an order compelling the Boston Electric Company and the Western Union Telegraph Company to remove all their overhead wires throughout certain districts before November 15 next. A similar order was passed bearing upon the New England Telephone & Telegraph Company's wires. An amendment was attached to each of the above orders that the several companies shall construct one conduit for wires for the city of Boston departments free of charge.

The Rapid Transit Movement in this city, so far as its solution by the construction of a subway is concerned, appears to be about dead. Most elaborate plans had been prepared, several different styles of underground railways had been discussed, estimates had been prepared and the letting of contracts was being talked about. Monday of this week the question came up early in the day before the state legislative committee, and after being again discussed a vote was taken which proved a surprise to many. The result showed a majority against the subway project, and when the second vote was taken the majority again rejected the bill in favor of an elevated road. The votes stood 10 to 5. This result made the promoters of the Meigs elevated railway system quite jubilant. Of course the outcome of the voting by the legislative committee did not bind them to any particular elevated system. The Meigs people, however, secured a charter in 1884 for the construction of a road between Boston and Cambridge, and they have always felt sanguine that when the time arrived for finally deciding the question, their system would, without doubt, be the one selected. They claim to have unlimited capital available, and are in a position to begin the work of construction just as soon as a charter may be granted them. Meantime, however, the representatives of the Mack, White and Boynton systems are urging their claims and are equally sanguine of ultimate success.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

Increased Demand:—There is an enormous amount of capital lying idle at this center, and the results of its endeavors to find safe investment has resulted in keeping up the demand for for such traction stock and bonds as are of a purely investment character. But of recent days—in fact, ever since the Stock Exchange has lent recognition to this class of securities by listing some of them—a speculative tone has developed that must, in view of the vastness of the various traction companies, result in as great activity at this center as has marked the course of traction stock quotations in Chicago and Philadelphia. As a result of this new sentiment some attention has been given to the low priced specialties like Long Island traction, which prominent commission houses are buying largely in broken lots, New Orleans Traction, North Shore Traction and even the higher valued Metropolitan Traction securities.

Third Avenue Railroad stock continues the chief source of local interest and the demand from investment sources for stock of this company continues unabated, and the favor with which investment sources regard this stock is not ill-advised, as the company keeps on making arrangements in a way that promises further big increases in earnings. For instance, the road has just arranged with the Grand and Canal street lines to transfer passengers east and west from the crossings on the Bowery. Between Grand and Canal streets west of the Bowery is the heart of the importing and dry goods districts of New York, and any number of business men and clerks who are now obliged either to walk over from the Bowery to Broadway or pay an extra fare, will now take the cable car down Third Avenue and be enabled thereby to reach the business district without extra charge. The cable system is now getting into perfect running order and faster time is being made every day. The transfer books close May 1st, for dividend purposes; the Third Avenue Railroad Company never declares its dividends till after the books are closed, but rumor has it that 4 per cent. will be declared this time. The stock is now 175 bid, 178 asked.

The Listing on the New York Stock Exchange of $1,500,000 improvement mortgage 40-

year 5 per cent. bonds of the Atlantic Avenue Railroad Company enables one, by means of the statistics furnished by the company to the governors of the Stock Exchange, to obtain an insight into the financial status of the Brooklyn Traction Company which controls the Atlantic Avenue road. The directors first give a history of the road and its various alliances and consolidations. All this is a matter of record; suffice to say, the ten lines of railway owned and controlled by the Brooklyn Traction Company now consist of 55 miles of single track, all operated by electricity, with the exception of the Brooklyn and Jamaica road, which is leased to the Long Island Railroad Company on a basis that made a net return to the Brooklyn Traction Company for the fiscal year ending February 26, 1894, of $53,130.81. In the figures furnished to the Stock Exchange the real estate, including power houses, etc., is valued at $1,789,124, of which $400,000 worth is unencumbered and available for sale. The capital stock of the company is $2,000,000, shares being $50 par value. They are not quoted in the market, as they are practically all owned by the Brooklyn Traction Company. The bonded indebtedness of the company consists of $3,000,000 consolidated gold 5 per cent. mortgage bonds, due 1931, of which $1,405,000 are outstanding and $1,595,000 are retained by the Brooklyn Traction Company to take a similar amount of prior bonds falling due between May 1, 1894, and October 1, 1909. In addition to these $3,000,000 bonds are the $1,500,000 improvement bonds just listed, making the total bonded indebtedness $4,500,000. There are no real estate, equipment or other bonds except as just stated. Net earnings of the company for the six months ending December 31, 1893, were $142,375, and the surplus, after all charges, was $75,208. The balance sheet figures the roads, franchises, etc., at $2,871,718, cars and equipment at $757,152, materials and supplies at $16,514, stocks and bonds of other companies at $1,295,643, horses and harness at $7,478, real estate at $1,789,124, bills and accounts receivable at $81,868. This, with cash on hand of $263,904, makes the total assets as of April 1 $7,083,404. Leaving out capital stock and bonded indebtedness, liabilities consist of bills and accounts payable amounting to $274,392, real estate mortgages $109,500, interest payable $87,010, and profit and loss $112,501 The improvement bonds just listed sell at 95; the consolidated 5s bring 100.

Broadway and Seventh Avenue Bonds.—The Stock Exchange also listed this week $7,650,000 of the Broadway and Seventh Avenue Railroad Company's first consolidated mortgage 5 per cent. 50-year gold bonds, due 1943. The entire issue is $12,500,000, but the company has reserved $4,850,000 to take up and protect the underlying bonds of the Broadway and Seventh Avenue, Broadway Surface and South Ferry Railroad Companies. In making application to the Stock Exchange to have these bonds listed, the directors presented a balance wherein liabilities are figured as follows: Capital stock, $2,100,000; 5 per cent. first mortgage bonds, Broadway and Seventh Avenue, due January 1, 1904, $1,500,000; 5 per cent. second mortgage bonds, Broadway and Seventh Avenue, due July 1, 1914, $500,000; consolidated mortgage bonds, $7,650,000; accounts payable, $398,354; total, $12,148,354. Assets are calculated as follows: Roadbed and superstructure, $2,644,531; cable appliances, $3,700,000; real estate, $2,639,780; cable buildings, power plants, machine shops and fixtures, $1,350,000; all other buildings and fixtures, $1,152,616; horses, cars and all other equipment, $661,426; total, $12,148,354. Earnings over operations for 1893 were $835,185, and the surplus over taxes, rentals, etc, was $647,621. The new bonds sold to-day at 107.

Other Securities.—Outside of the companies treated of in the above paragraphs very little of value has developed the last ten days. So far as the local end of the Metropolitan Traction Company is concerned (its stock closed to-day 118 asked), some good buying is noticeable. Then there is a report that it has secured control of the Forty-second street line, but the report is so far only in the rumor stage. Work on the Lexington avenue cable line is progressing very rapidly. At the present rate the line will be laid before summer is over. The Columbus avenue cable line is finished from Fifty-ninth street to Ninety-third street, and horse cars are being run over the finished portion. Investment brokers also report a demand for securities of the Buffalo, Rochester and Columbus, O., street railway companies. These are concerns all furthered by Eastern capital. Inquiry is also made to some degree for Newark Traction, which is said to be doing an enormous business on its Jersey City-Newark line.

The Philadelphia Market has been comparatively dull. No new increases of capital nor of dividends nor further consolidations are talked of and stocks are for the moment quiet after the razzle-dazzle of the past three weeks. It is stated that Messrs. Widener and Elkins, of Metropolitan and Philadelphia Traction fame, are at the head of the Pennsylvania Traction Company, which threatens, to judge from the number of roads and franchises one hears it has obtained control of, to become one of the most gigantic consolidations of electric railway interests.

Quarterly Report.—For the quarter ending March 31, the Dry Dock, East Broadway and Battery Railroad Company of New York reports: Gross earnings $140,884; operating expenses $119,884; other income $1,709; fixed charges $32,035; loss from operations $9,326; cash on hand $16,407; profit and loss deficiency $38,897. The stock of the road is quoted at 120 bid, 125 asked.

Financial Notes.

Omaha, Neb.—The Sheriff levied upon the street cars of the Omaha Horse railway Company on April 27 to satisfy the judgment obtained by Matt Clair, now Postmaster of North Platt, for personal injuries. Clair sued for $25,000 and got a judgment for a little over $5,000. The case was appealed, and some weeks ago affirmed. All the cars in sight at the corner of Sixteenth and Farnam streets were attached and stopped, and as the corner is a crossing point for two of the main trolley lines in the city the blockade soon assumed serious proportions.

The Annual Meeting of the Westinghouse Electric & Manufacturing Company will be held at Pittsburgh on Wednesday, May 16 next. The transfer books close on May 7, and will re-open May 17.

NEWS OF THE WEEK.

Chicago, Ill.—The commissioner of public works has approved the plans of the Northwestern Elevated Railway Company and work may now be commenced on any part of the line from Monroe street to North avenue. The plans were found acceptable to the City Engineers. The structure is much lighter than that of the Alley "L" and more sightly. The posts are placed in the longitudinal direction 44 feet 7 inches, and in the cross section 12 feet apart. They are of steel bridge work construction and extend a clear distance of 14 feet before the lowest beam of the track structure is reached. This track structure extends nearly five feet further. The posts are placed in concrete foundation five feet deep. The structure will bear two tracks. It will be placed in position by the American Railway Construction Company. The route may not be changed except with permission of the council. If, therefore, the company fails to secure from the government the right to construct a bridge across the river between Wells and La Salle streets, it must appeal to the council to be allowed to change its route.

Kansas City, Mo.—The county commissioners of Wyandotte county, Kan , have granted a franchise for the construction of an electric road from the state line to Merriam Park, to the Kansas City, Rosedale & Merriam Park Electric Railway Company. The new road must be constructed within one year, and when completed, will connect with the Metropolitan system of Kansas City.

Easton, Pa.—A company has been organized at Bangor to build an electric railway between the Delaware Water Gap, Bangor, Pen Argyl, Wind Gap and Saylor's Lake. The parties interested in this enterprise are: A. O. Allen, of Portland, William Bray, of East Bangor, Chas. Shuman, Thomas Seem, William Winsboro, G. W. Mackey, of Bangor; Richard Jackson, Jr., and Wm. Turner, of Pen Argyl.

Lynn, Mass.—The report published about impending changes in the managment of the Lynn & Boston Street Railway Company is positively denied. General Manager Foster said there was no truth in the report that Mr. Breed is to retire from the presidency or that there are to be any changes in superintendents, general manager or other officials.

Oshkosh, Wis.—Indianapolis capitalists, acting through their agent, Mr. Allen, have bought the existing street car line, while Jas. K. Tillotson, of Toledo, has applied to the council for a franchise to build another line. Mr. Tillotson agrees to have ten miles of line completed by January 1, 1896. He also agrees to run cars from 6 A. M. to 11 P. M.

Worcester, Mass.—H. S. Matthews, division superintendent of the Worcester & Millbury Street Railway Company, has tendered his resignation, to take effect on April 28. He has accepted a position with the Worcester Construction Company, and will have charge of the overhead work for the concern during the coming season.

Ann Arbor, Mich.—No cars have been operated since the burning of the car barns last January. The bondholders of the Ann Arbor Electric Street Railway Company, represented by J. B. Corliss of Detroit, are making an effort to open the road once more for traffic. Unless some agreement is reached, a receiver will be asked for.

New York City.—The construction of the Metropolitan company's cable road extension on Lexington avenue is being vigorously pushed. A good deal of difficulty, however, has been met with, due to the large amount of blasting necessary in laying the conduit through the almost solid rock in that section of the city.

Portland, Ore.—The car barn of the City & Suburban Company of Portland, Ore., was burned last week and property valued at $5,500, was destroyed. Seven cars were in the building at the time but four were saved. The fire was said to have originated from a defective electric light wire.

Sioux City, Ia.—The Sioux City street railway property was sold to the bond holders April 30 under foreclosure to satisfy a judgment of $578,000. The purchasers are nearly all Philadelphians and will organize a company to operate the line at once.

Philadelphia, Pa.—The Tenth and Eleventh street line of the Electric Traction Company is now in operation. The company expects to start the Chestnut and Walnut street line in about five weeks.

Detroit, Mich.—At the last meeting of the city council another street railway ordinance was adopted, the leading feature of which was a clause providing that eight tickets should be sold for twenty-five cents.

San Diego, Cal.—The Electric Railway Company has been granted a franchise for an extension of the present horse-car line on D street to Twenty-second street. The work is to commence at once, the material and gauge to be such that electric cars can be used at some future day.

Springfield, Mass.—The stockholders of the Springfield Street Railway Company have voted in favor of extending the line through Longmeadow to meet the proposed Thompsonville line and north through Chicopee Falls to Willimansett

Springfield, Mass.—A new electric line is proposed from Thompsonville, Conn , to Holyoke, Mass., by way of Springfield. The Chicopee road is also constructing an extension to Holyoke.

New York, N. Y.—A resolution has been passed by the aldermen giving the Sixth Avenue Railroad Company the right to lay tracks on Lenox avenue from 110th street to the Harlem River.

Lancaster, Pa.—The employes of the street railway company have organized the Pennsylvania Traction Company Relief Association. The association has so far 56 members.

Duluth, Minn.—The new Bain motor manufactured by the Great Western Electrical Company, has been tested on the street railway and its work is said to be highly satisfactory.

Appleton, Wis.—An electric railway is to be built from Neenah to Kaukauna by way of Appleton. If the county board grants a franchise work will be begun within ninety days.

Tama, Ia.—Work on the electric railway is progressing rapidly and it is expected that the connection of Toledo and Tama by the electric line will be celebrated on July 4.

Fort Wayne, Ind.—A petition has been circulated of late asking the street railway company to construct a belt line on Huffman street, St. Mary's Avenue and Van Buren street.

Leavenworth, Kan.—The contract for the installation of engine and boilers in the street railway power house has been awarded to the Sioux City Engine & Iron Works.

Stroudsburg, Pa.—The Mt. Minsi Electric Railway Company has been incorporated with a capital stock of $125,000.

Ashland, Ky.—Work on the Ashland and Catlettsburg electric railway will be begun at once.

PERSONAL.

Alex Lewis, who has for some time been located in Chicago as the western representative of the Curtis Electric Manufacturing Company, has severed his connection with the Curtis company. He has located in Cincinnati, where he expects to handle street railway material for which, however, his plans are not yet definitely completed.

Charles V. Weston read a paper before the Western Society of Engineers on Wednesday of this week on the new tunnel of the West Chicago Street Railway Company The opening of this tunnel for regular traffic was noticed in our columns last week.

Elmer A. Sperry, of the Sperry Electric Railway Company, Cleveland, Ohio, was a visitor in Chicago this week.

B. E. Greene, of *Electricity*, spent several days in Chicago this week.

TRADE NOTES.

Annual Meeting.—As an evidence that times are not so deplorable as they are said to be, was the satisfactory meeting of the stockholders of the Joseph Dixon Crucible Company recently held at their fine offices in Jersey City, N. J. Out of 7,345 shares 7,215 votes were cast for the same board of managers that has conducted the affairs of the company through its years of prosperity. The vote was the largest ever cast and it was a decided compliment to the members of the board as were also the remarks of some of the largest stockholders. The board consists of E. F. C. Young, John A. Walker, Daniel T. Hoag, Richard Butler, William Murray, Joseph D. Bedle, Jerome D. Gillett. In the organization of the board E. F. C. Young was elected president, John A. Walker vice-president and treasurer, George E. Long secretary. The Dixon Company was founded by Joseph Dixon in 1827, and organized as a stock company in 1868. Its manufactures are graphite products of all kinds, consisting of plumbago crucibles for melting gold, silver, brass, etc., blacklead retorts, stove polish, graphite for lubricating, electrotypers' graphite, graphite lead pencils, graphite paint, and graphite prepared in hundreds of ways for as many different uses. Graphite is one of the principal forms of carbon. It is not affected by heat or cold, acids or alkalies and is therefore one of the most useful materials known to modern industry when rightly prepared.

Phœnix Poles.—The Phœnix Poles which are adapted for use on street railways for electric lighting, telegraph and telephone construction, and for signal towers on railroads, have already been adopted by a number of electric railways for their standard construction. Among these may be mentioned the Lancaster Traction Company, Lancaster, Pa., the Camden Horse Railway Company, Camden, N. J., and in a modified form, the poles have been used by Mellican Brothers in a great many places, notably at Pittsfield, Mass., Pittsburgh, Pa., and Newark, N. J. These poles are placed on the market by the Phœnix Bridge Company of Phœnixville, Pa. The company's Chicago office is at 931, The Rookery.

Kohler Brothers, who are well-known in Chicago and the West as the representatives of the Eddy Electric Manufacturing Company, have been appointed western representatives of the Walker Manufacturing Company, of Cleveland, Ohio. Their territory will comprise a number of western and northwestern states, and their headquarters will be in the Monadnock Block, Chicago. This is the territory in which the Walker Company's business would have been handled by J. L. Barclay, whose death has made the appointment of other representatives in Chicago necessary.

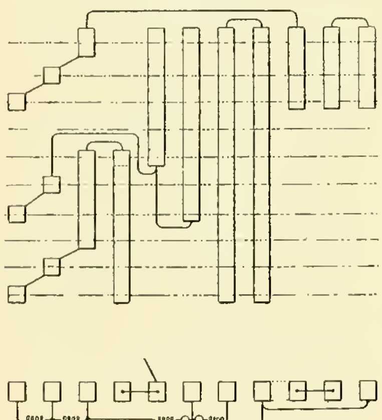
The Berlin Iron Bridge Company, of East Berlin, Conn., is putting up a new transfer station for the Washington & Georgetown Railroad Company, at Washington, D. C. The same company is putting up an iron and steel building seven stories high, for James Pettit of New York City. The Batopilas Mining Company of Chihauhau, Mexico, has placed an order for four iron buildings and four bridges with the Berlin Company. These buildings are to be shipped by steamer to Galveston, Tex., from there by rail to the interior of Mexico, where they must be carted a distance of 100 miles on mule back up into the mountains.

The Electrical Installation Company, of which L. E. Myers is general manager, has closed a contract for the complete overhead equipment of the Englewood & Chicago electric road. The track work on this line began last week. When completed, the entire system will comprise 47 miles of track.

RECORD OF STREET RAILWAY PATENTS.

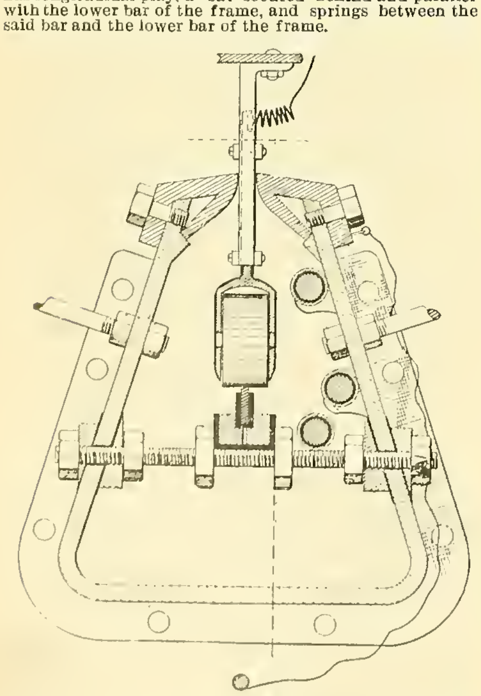
Patents Issued April 24, 1894.

518,642. Car-Wheel Fender. Sylvester A. Breen, Alexandria, Va. Filed November 23, 1893.



NO. 518,693.

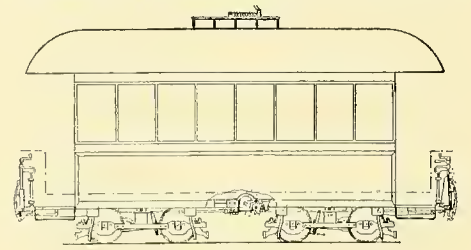
A wheel-fender and safety-attachment for cars, consisting of a frame extending the length of the car and having extensions running under the steps of the car; hinges to support the frame having hinge bars wherein the frame has longitudinal play, a bar secured behind and parallel with the lower bar of the frame, and springs between the said bar and the lower bar of the frame.



NO. 518,695.

518,693. Controlling Switch for Electric Railways. Philip Lange, Newark, N. J., and Benjamin G. Lamme, Pittsburgh, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed February 25, 1893.

This is a method of controlling electric vehicles provided with two motors, which consists in the following steps:—Connecting said motors in series; establishing a shu n



NO. 518,781.

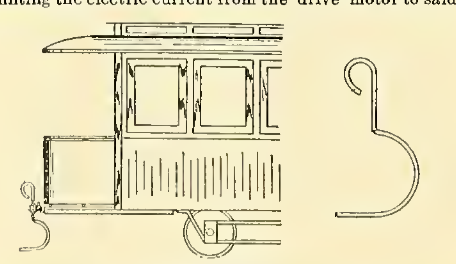
around one of said motors; decreasing the resistance in said shunt, until said motor is short-circuited; cutting out said short-circuited motor; and finally putting said motors in multiple arc with each other. (See illustration).

518,695. Conduit Electric Railway. Charles A. Maynard, Springfield, Mass. Filed February 9, 1894.

This consists of the combination with a metal conduit provided upon its inner wall with a longitudinal shelf of a metal cover having a triple bearing upon the conduit, and comprising a brace adapted to enter the mouth of the conduit and bear upon the shelf, a flange adapted to bear upon the outer wall of the conduit, a central portion integral with the brace and flange and adapted to be seated upon a top rim of the conduit; and screw bolts through flange and the wall of the conduit. (See illustration.)

518,781. Electric Operating Mechanism for Vehicles. Louis E. Freedley, Boston, Mass. Filed December 29, 1893.

This is the combination of a vehicle body, running gear therefor, a brake mechanism thereon, the shaft, the chain connecting the same with a bar for said brake mechanism, the supplemental motor geared to said shaft, means for shunting the electric current from the drive motor to said



NO. 518,796.

supplemental motor, whereby said shaft may be rotated to set the brake, and automatic mechanism for breaking said current when the brake becomes set. (See illustration.)

518,782. Distribution System for Electric Railways. James E. Goodhand, Baltimore, Md. Filed January 20, 1894.

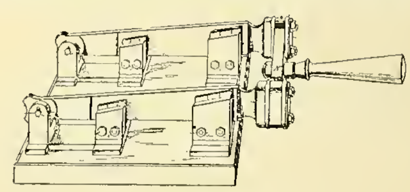
In a conduit electric railway, the combination of the feeder and working conduits: branch conduits arranged transversely to and connecting the feeder and working conduits: feeder wires in the feeder conduit, electrical conductors arranged in sections in the working conduits: a connecting block at the intersection of the branch and feeder conduits; and branch wires connecting the feeder wire with the working conductor.

518,796. Safety Car Fender. August W. Stiefel, Baltimore, Md. Filed January 31, 1894.

A safety fender for cars, comprising a number of spring-metal arms each having at its upper part a forward downcurved pendent end, which forms a spring-buffer, below said spring buffer a vertical part, and at the lower end of said vertical part a rearward semi-circular curve, the lower part of which terminates in a horizontal forward-pointing end, in combination with a cross bar, to which each spring-metal arm is secured by its said vertical part. (See illustration.)

518,813. Electric Switch. Warren S. Hill, Hyde Park, Mass. Filed October 31, 1893.

This comprises the combination with the contact pieces, of blades pivoted at one end and having their free ends broadened, said blades adapted to connect with said contact pieces to close the electric circuit, and a connecting



NO. 518,813.

yoke for joining said blades together, having its ends broadened to match the broadened ends of the blades, and secured at each end to said blades by two bolts, whereby movement of one upon the other is prevented. (See illustration).

518,904. Car Fender. Charles F. Thomas, Buckeystown, Md. Filed December 28, 1893.

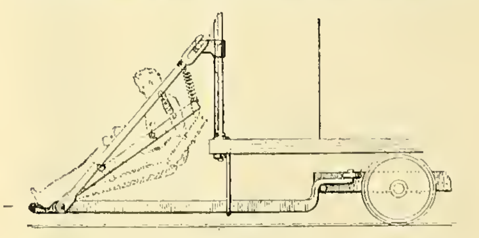
An improved car fender, comprising a main fender frame adapted to be connected to the truck frame and held rigid therewith, brace bars pivoted at their lower ends to the said main frame, and having their upper ends formed for a detachable and sliding connection with the car dash. (See illustration.)

518,913. Commutator Brush. George W. Brown, Deering, Me. Filed November 15, 1893.

A commutator brush composed of woven wire cloth folded together and the inner layers only of which are impregnated with a graphite compound left in a soft yielding condition and adapted to make contact at its end with a commutator.

518,925. Elevated Railway. Benjamin Roberts, Jacksonville, Fla. Filed September 14, 1891.

The combination with an overhead track and its support, of a frame having supporting wheels mounted for



NO. 518,904.

movement on the track, a wind wheel and its shaft supported in the frame, mechanism for communicating motion from the shaft to the supporting wheels, and a reversing mechanism connected with said mechanism.

518,926. Fender for Street Cars. Henry F. Rooney, Randolph, Mass. Filed September 12, 1893.

A car fender, comprising the hinged frame having its body or central portion entirely filled in with horizontally set spiral springs and the rigid vertical frame having its body or central portion filled in with similar horizontally set spiral springs, both said sets of springs being furnished with a sufficiently soft or elastic covering.

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VOL. X. CHICAGO, MAY 12, 1894. No. 19.

CONTENTS.

Detroit Street Railway Controversy. The last attempt to settle the street railway controversy at Detroit was a miserable failure. It seems scarcely possible that the city council passed in good faith the ordinance providing that eight tickets be sold for a quarter and that the railway should become the property of the city at the end of twenty-seven years. The rejection by the company of the franchise with such conditions was a matter of course, as its acceptance would probably simply involve the operation of the system at a loss for a period of years at the expiration of which the railway would pass into the city's hands. It is a great pity that the city of Detroit is unable to settle the controversy upon any sort of an equitable basis. The company to a certain extent is bound to make concessions, but it is not likely to be simple enough to assist the city in attempts to confiscate its property. Detroit badly needs rapid transit, but it has been too stupid to seem to realize the fact.

New Charge Against the Trolley. The daily papers have lately discovered a new danger in the trolley wire. They have reported several cases in which persons have been mysteriously blinded, as they say, by flashes from the electrical conductors. Several explanations may be offered for these curious incidents, but it appears to be most likely that the stories of the blinding of persons near the railway tracks are pure fabrications. This view is the more satisfactory for the reason that while the electric flash on the trolley wire may be brilliant, its intensity is never so great as the arc light whose brightness has not proved injurious to the healthy eye. If, however, the main points in the stories prove true it will probably be safe to assume that when the victim became suddenly blind his proximity to the trolley wire was merely a coincidence. The electrical explanation is doubtless assumed for just the same reason that all mysterious fires in cities are presumed to be due to electricity, and those in the country districts are always of incendiary origin. Some sort of a reason must be given, and an electrical cause being the most mysterious is found to be the most sensational and presumably therefore the most satisfactory to the public, for whose entertainment these incidents are described. Only one case of this kind has been investigated so far as we are aware, and in this instance a young man's blindness which was ascribed to a flash on the trolley wire was found to be due to some sort of an hysterical attack. The flash on the wire had absolutely nothing to do with it. The trolley system is not perfect perhaps, but the charge that it may at any time afflict a person with blindness should not be added to its sins.

Street Railway Accidents. It would be difficult to name a locality where a greater number of street railway accidents might be expected to occur than in that part of Boston known as the congested area. The conditions all seem to be such as would naturally lead to accidents. The cars are as a rule unusually heavy, while the pedestrians crowded off the cramped sidewalks throng the narrow streets, and apparently in utter disregard of their personal safety run recklessly to and fro in front of the cars. An observer who watches the movement of the crowds on Washington street will witness a score of seemingly hair-breadth escapes from death or mutilation every hour. Despite the unfavorable combination of conditions it is the fact that few, very few, accidents occur in the congested district. The cars run slowly in this section, to be sure, but this of itself is not sufficient to explain the relative freedom from accidents of this part of the city. There are other cities which have not enjoyed the same immunity despite the fact that their business centers are not covered by so perplexing a network of tracks as are to be found in Boston. It is interesting to note the explanation which one of the officials of the West End Company recently gave. He ascribes the insignificant accident record in the congested area solely to the excellence of the discipline among the motormen. They have been taught the necessity of extreme caution as they thread their way through the crowds, and as this matter is continually insisted upon the men have become alert to prevent casualties; they keep their cars under control and while they keep pushing ahead all the time as they must, they take no risks, which would involve injury to pedestrians. Good discipline, he maintains, offers the most available means for decreasing the number of accidents, and when it is allowed to grow lax the casualties may be expected to increase.

Edison-Field Litigation. Some months ago we gave an outline of the points at issue in the case brought by the Electric Railway Company of the United States, owner of Stephen D. Field's early electric railway patent, against the Jamaica & Brooklyn Electric Railway Company, for alleged infringement of the Field patent. The suit was brought some time ago, but was argued only in November last. The decision of the case has just been handed down by Judge Townsend, dismissing the suit. The result is a victory for the General Electric Company, the real defendant in the case, since the Jamaica & Brooklyn road was one of its customers. The case is an interesting one, and the decision is of great importance to all electric railway companies. Elsewhere in our columns will be found a reprint of the fundamental claim of the Field patent, under which the suit was brought. The Edison and Field interests were originally joint owners of the Field patent, and the appearance of the Edison interests in this suit has been brought about through the absorption of the old Sprague company by the Edison, and finally the General Electric companies. Judge Townsend in his decision held that an English patent issued to one Clark in 1864 anticipated in almost every particular the Field patent, except perhaps the method of controlling the motor, and this, he maintained, could not be considered as adding the character of an invention to the combination as claimed in the Field patent. The point was made by the complainant that the Clark patent named a magneto-electric machine, while the Field patent included a modern dynamo-electric machine or motor, but the Court maintained that if such an argument were to prevail, the inventor of the modern machine and not the Field interest should be the beneficiary. These points have a wide bearing upon pending and prospective electric railway patent litigation, as they would seem to indicate that the courts look with disfavor upon extremely broad and comprehensive claims for various combinations made up of separate inventions already in use, as single or individual pieces of apparatus. The remarks also have a bearing on the claims made for the invention of various parts of street railway systems now in use.

Conduit Road in New York. Elsewhere in our columns is published the statement of John D. Crimmins for the Metropolitan Traction Company of New York City, that the construction of a conduit electric road is being seriously considered by his company. The project contemplates the laying down of a conduit in Lenox avenue over a line for which the company has just received the necessary franchise. A statement is further made that consultations have been held with the engineers of two prominent companies for the purpose of securing their estimates on the cost of construction, and the statement of what they were ready to do in the way of constructing an experimental line of say five miles in length. What two companies Mr. Crimmins had in mind is not stated, although it is announced that one of these is the Siemens & Halske company which has been negotitating for the construction of a line similar to that which has for some time been in operation in Budapest. This company is prepared, it is said, to build at its own expense, three miles of road, and if this is accepted, four miles more will be built at the joint expense of the constructing and operating companies. The Budapest line has been in operation since 1889. The conduit is of extremely simple construction, and contact is made with the two conductors by means of shuttle-shaped sliders. Sixty cars are now run over the lines at an average speed of twelve miles per hour, at a cost, according to the reports, of five and one-half cents per car mile. In 1893, a total of 14,000,000 passengers were carried, and a dividend of seven per cent. was paid for that year. The difference in climatic conditions must be taken into consideration when the construction of a similar road is contemplated for an American city, but there is very little doubt that American inventors will be perfectly competent to overcome any obstacles that may be due to the climate, since these would certainly be no more difficult to provide against than those which have been encountered in the operation of overhead trolley roads, with the single exception, perhaps, of the interference due to the appearance of water in the conduit or on insulators separating the conductors. It is not at all likely that the General Electric and the Westinghouse companies will long remain behind the Siemens & Halske company in the competition for the production of a successful working conduit road. Indeed the Westinghouse company has for some months been experimenting with a short piece of line constructed near its factories in Pittsburg, and there are indications that the General Electric Company has also been carefully considering the adoption of a system embodying the most advanced ideas regarding conduit roads.

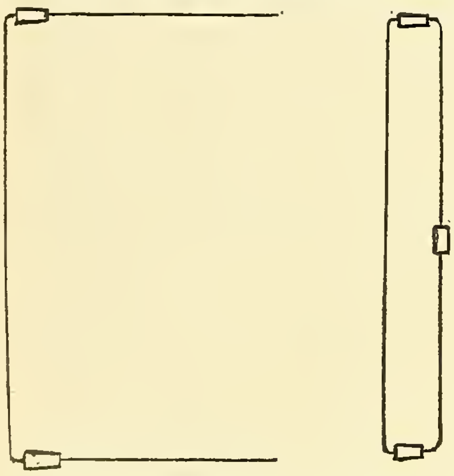
NOTES FROM BOSTON.

(Editorial Correspondence.)

The West End Company does not regard the electric welding of rail joints as successful so far as it has been applied in Boston. Trouble has been constantly experienced with the breaking of the joints. The company however seems to consider its test of welded joints insufficient to justify any unfavorable conclusions, and within a short time the Johnson Company will make a new experiment. In this case a different style of weld will be tested which, it is believed, will prove far stronger and therefore much more successful. With the heavy rolling stock owned by the West End the best joints available are urgently needed.

The West End Company is steadily increasing its electrical equipment. In October last of its 268 miles of track, 168 were equipped for electrical operation. Next winter according to the present estimate, 250 miles of track will be traversed by motor cars. Its rolling stock equipment now consists of 731 box cars, 700 open cars, 103 electric plows, and 75 horse plows and scrapers. This equipment will be somewhat increased during the next few months and by winter 784 box cars will be ready for service, and seven new electric plows will be added.

About 600 cars now take power from the trolley wires during the hour of ordinary service. It requires a total of about 14,500 amperes to operate the cars at the busiest hour of the day. Of this total about 10,000 amperes are delivered by the central power station and the remainder by the stations at Cambridge and Allston. It is found



RAIL BOND USED ON WEST END ROAD.

that during the winter months the motor cars on the average require from 28 to 30 amperes, but in summer this is decreased to 19 amperes. Within the last few weeks the company has equipped its single truck motor cars for summer service by furnishing them with single instead of double motors.

Unless one side of an open car is screened by a wire it is ordinarily difficult to prevent passengers from alighting on the wrong side of the car. The wire screen is not popular, and is only tolerated on the score of safety. The West End Company of Boston this year will experiment with a new plan for preventing entrance and exit on the wrong side. The plan is designed so to change the position of the foot board that it cannot be used by anyone in leaving or jumping on the car. This is accomplished by making the footboard of two strips instead of one, which are hinged together in such a way that the two hinged boards may be turned up against the side of the car when it is desired to prevent ingress or egress on that side. The surface is then made so sloping that no one of ordinary intelligence would feel inclined to try to secure a foothold upon it. This arrangement has not yet been tested, but it is hoped that it will prove to be fully as effective in protecting one side of the car as a wire guard.

The West End Company is not hearing much complaint of the electrolysis of buried cables and pipes, as I. H. Farnham of the Telephone Company of Boston intimated in his recent paper read before the American Institute of Electrical Engineers. The avoidance of trouble is ascribed in a very great measure to the vast amount of overhead copper returns that have been utilized. It is likely, however, that the company will not now introduce any more copper for feeders or returns than may be found absolutely essential, for the reason that within the next few years it is more than likely that much of this copper must go under ground. Both the legislature and the aldermen seem determined to adopt measures ordering the burial of wires. The bond which the company is now using is giving entire satisfaction. A cut of it is presented herewith. The bond which is about five feet long, has two taper steel sleeves which are sweated on. Holes to receive these are drilled into the web of the rail and the tapers sharply driven in, making an excellent steel to steel contact which may be depended upon to stay in place. The two ends are then bent over and are united by a sleeve which is soldered on. It is said that the bond is giving better satisfaction than any type which the company has tried.

It not infrequently happens that the trolley rope is not securely fastened and is blown to the side of the bonnet out of the convenent reach of the conductor. To prevent the occurrence of this annoyance the company has equipped quite a number of its cars with a little rope guard formed of bent wire This keeps the rope in place and conductors testify that it is an excellent device, and frequently saves them the bother of reaching out two or three times to grasp the cord.

STREET RAILWAY ACCIDENTS.

The monthly records of street railway accidents for April is presented herewith. The number of accidents is materially less than during March when 188 accidents were noted. Among the cities where several accidents occurred were the following: Philadelphia 16, New York 16, Chicago 9, St. Louis 6, Minneapolis 4, Detroit 3, Cincinnati 3. The April record is as follow:

Number of places in which accidents were noted	55
Total number of accidents	126
Number of accidents to electric cars	96
Number of accidents to cable cars	28
Number of accidents to horse cars	2
Number of fatalities	34
Fatalities due to electric cars	27
Fatalities due to cable cars	6
Fatalities due to horse cars	1
Number of persons injured	108
Persons seriously injured by electric cars	31
Persons seriously injured by cable cars	10
Persons seriously injured by horse cars	1
Persons slightly injured by electric cars	51
Persons slightly injured by cable cars	15
Persons slightly injured by horse cars	None
Number of passengers injured	28
Number of employes injured	8

CAUSES OF ACCIDENTS.

Attempting to cross in front of cars	43
Collisions with vehicles	32
Collisions of cars	2
Attempting to board cars	8
Alighting from cars	6
Fell from cars	3
Platform gate gave way	1
Defective grip	1
Falling trolley wire	1
Broken trolley pole	1

ERASTUS WIMAN'S LAND AND ELECTRIC RAILWAY PROJECT.

The New York legislature passed the Hobbie bill amending the railroad law so as to give electric light and power companies the right to build electric railways not exceeding 20 miles in length and not more than four miles in a city, and to purchase and sell land not exceeding 2,000 acres. A bill of this kind was vetoed last year, but this year the bill was amended so as to meet the Governor's objections. Mr. Wiman, who has urging the matter personally, believes the governor will sign the bill. It is Mr. Wiman's intention to develop the back hill country of Staten Island, and he thinks this can only be done by allowing the electric light and power companies both to build railroads and own land as land improvement companies, and thus unite harmoniously in the development of particular sections. Mr. Wiman's article advocating this plan was recently published in the STREET RAILWAY GAZETTE.

STEPHEN D. FIELD'S ELECTRIC RAILWAY PATENT DECLARED INVALID.

On May 3 Judge Townsend, of the U. S. Circuit Court for the Eastern District of New York, rendered a decision in the case of the Electric Railway Company of the United States against the Jamaica and Brooklyn Railway Company in favor of the defendants. This suit was brought alleging infringement of the now famous patent granted to Stephen D. Field, July 16, 1889, No. 407,188, the principal claim of which reads as follows:

The combination of a stationary dynamo electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle moving upon and along said insulated section of track, an electromagnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit controlling device placed upon said vehicle.

Judge Townsend holds that the evidence shows that the elements of the combination were not new to the art, and that they were embodied in a prior patent issued to Clark. The decision is a victory for the General Electric Company, which defended the suit, as the Jamaica and Brooklyn Company was one of its customers.

UNDERGROUND ROADS FOR NEW YORK CITY.

In speaking of the $50,000 prize offered by the Metropolitan company some time ago, Mr. Crimmins said last week:

"Our $50,000 offer brought forth three or four thousand methods of operating cars by electricity. They came from France, Germany, Austria and Italy, and even members of Parliament communicated with us and said they proposed to take the first steamer over here to elucidate their ideas. We had hard work to stop them by cable. Nothing having been accomplished by February 1, and as our $50,000 offer no longer held good, we have simply started on a new tack.

"We employed the most expert engineers and set them at work to bring out all that was best in the way of an underground trolley system. We began a series of important conferences with several of the large electric companies. Construction as well as electrical engineers were employed, and the former recommended almost the same system of construction for the underground trolley as for a cable, with a conduit 14½ inches wide by 27 inches deep.

"As a result of our conferences, two of the big electrical companies made us offers, in which they express their willingness to equip a five mile section of our roads with the electrical machinery necessary to run our cars by the underground trolley system free of all cost to us. The conditions are that having been allowed to do this, and failing at the end of a year to show that the underground trolley is a success as a motive power, and also to establish that by its use the traffic of the road can be conducted at a certain cost per mile, they must take out their apparatus at their own expense.

"What the cost per mile of operating the road which has been discussed is, I would rather not say just now. But if they fulfill the conditions placed upon them we are to buy their equipment outright at a sum fixed upon between us."

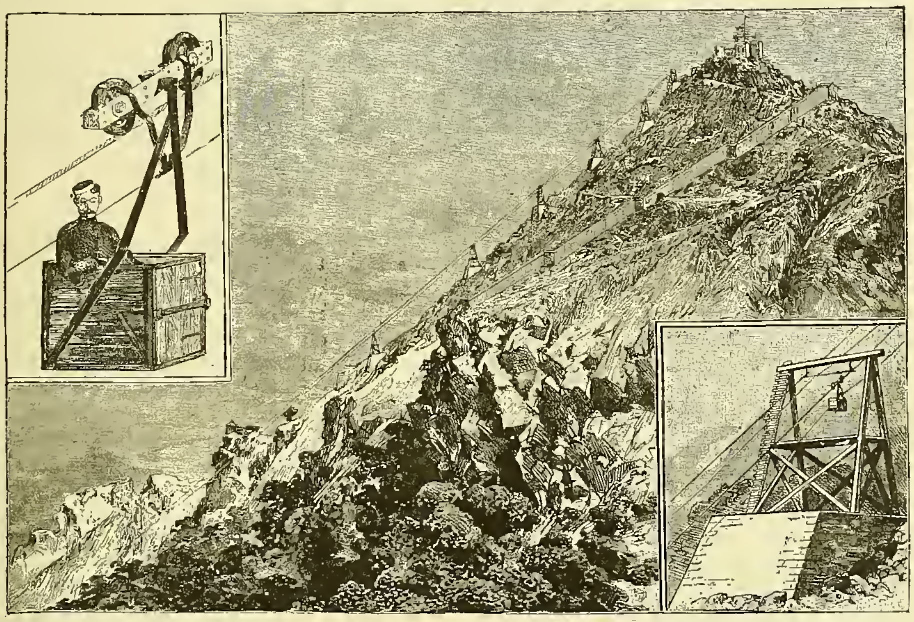
Mr. Crimmins thought the first underground trolley would be laid along Lenox avenue, but could not say how soon.

LEVYING ON STREET CARS WHEN IN SERVICE.

In the last issue mention was made of the fact that a sheriff recently levied upon cars of the Omaha Horse Railway Company to satisfy a judgment obtained by Matthew W. Clair. Cars that were in service were stopped and attached with the result that the system was tied up for a time. The company complained bitterly of such treatment, alleging that it was wholly unnecessary to interfere with the service inasmuch as it had plenty of cars in the barns which might have been attached. The matter was brought into court, but before a decision was reached the attorneys agreed to compromise the case. The company agreed to satisfy the judgment against it, while the representatives of Mr. Clair agreed to pay $210.95 as damages for causing a suspension of the street car service. When the case was presented to the court, Judge Ambrose remarked that the sheriff had gone farther than he had the right to do. It was not proper, he said, to stop cars when the company was a public servant and a solvent corporation.

THE ELEVATED RAILWAY AT GIBRALTAR.

Ever since Gibraltar was conquered by the English Admiral Rocke in the year 1703, engineers have been constantly at work reinforcing the natural means of defence of this great fortress. One of the most important innovations in this direction is an elevated railway recently constructed, which connects the signal station located on the top of the rock with the south end of the city. By means of this line materials of all kinds can be sent to the fortress in less than five minutes, which it was formerly necessary to send in wagons by a slow journey up a steep path.



THE ELEVATED RAILWAY AT GIBRALTAR.

On the north end of the Alameda is located the engine house from which two cables of 300 yards in length lead up the mountain. From there on the shape of the rock necessitates large and strong trestle work to support the two cables the requisite distance and at the proper elevation. A powerful engine transmits motion to the cables which carry the wagons, one ascending while the other descends. Any possible danger which might occur from parting of the cables is totally prevented, for although they are capable of withstanding a load of more than 70 tons, they are never called upon to carry more than one twelfth of that weight.

Hannibal, Mo.—It is proposed to extend the Hannibal electric line to McMastine's Pasture, a park, about two miles from the city.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

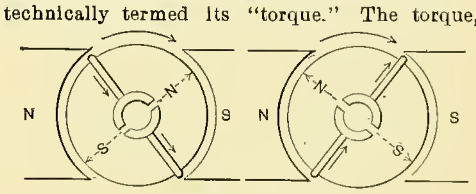
BY NELSON W. PERRY.

(Eighteenth Article.)

Another way of explaining the action of an electric motor, which is simpler but in most cases not so correct, is the following. Let us suppose for the moment that there is but a single coil on our armature (Figs. 55 and 56). If in looking at the commutator end of the armature the current passes through the coil as it passes over the end of the armature coil in the direction of the arrow (Fig. 55) which would be clockwise in the coil if we look at the coil from the north pole of the magnet, and anti-clockwise if viewed from the south pole, it will make of the armature core, an electromagnet, whose south pole is near the north pole and whose north pole is near the south pole of the field magnets. Since unlike poles attract each other the armature will tend to revolve until these unlike poles are as near together as they can get, or until the axis joining the two poles of the armature is in a straight line with or parallel to the axis joining the field magnet poles. If nothing more were done the armature would simply oscillate back and forth a few times on either side of this line and finally come to rest in the position stated, just as a compass needle does when a magnetic pole is brought near it, and the attractive action of the unlike poles upon each other would oppose any effort to move the armature in either direction. But we have seen that when these four poles are in line, the coil on the armature is in its neutral position, viz: In that position where in the dynamo the direction of the electromotive force generated in the coils changes direction and where by means of the commutator it is rectified for the exterior circuit. If, therefore, a direct current enter the armature coil through the branches and commutator, its direction in the coil will be reversed at this point. Figs. 55 and 56 represent the coil just before and after it has occupied this neutral position, and the arrows show the directions of the currents under these conditions. It will be noted that just at the moment when the south and north poles of the armature have reached the point beyond which the mutual *attractions* between them and the north and south poles of the field magnets would no longer tend to cause the armature to revolve, the direction of the current is reversed by the commutator, and what were the south and north poles of the armature become the north and south poles, and like poles of the machine are brought into proximity, and *repulsion* occurs, and rotation is continued. Thus by properly arranging the coils and commutating the directions of their coils, a continuous effort, first of attraction and then of repulsion, is exerted upon the armature which causes it to keep in continuous rotation and enables it to do more or less work as this pull and push is large or small.

TORQUE.

Now we know that the strength of a magnet—viz.: the ability which it exerts either to attract an unlike pole or to repel a like pole—depends, other things being equal, upon the number of ampere turns upon the magnet. In the case of the motor or dynamo, the number of turns on both the field magnet and the armature is fixed, so that the only way in which we can vary the strength of these magnets is by increasing the current (remembering that the ampere turns=number of turns of the wire×current in amperes). We can therefore increase the turning effort of the armature by increasing the current and thus increasing the strength of the poles. This effort to revolve which the armature is able to exert is technically termed its "torque." The torque,



FIGS. 55 AND 56.

therefore, is dependent, among other things, upon the current, being greater or less as the current in the armature is greater or less.

But everyone knows that in turning a capstan or in winding up a heavy weight attached to a rope, on a windlass, it can be moved much more easily if the crank arm or lever is long than if it is short. In fact, to give a concrete example, if our windlass drum have a diameter of 1 foot and the load on the rope be 100 pounds, this can be exactly balanced by hanging on the end of the crank arm a weight of 10 pounds if that crank arm be 10 feet long, and 11 pounds so placed would draw the heavier weight of 100 pounds up. In this case the torque due to the force of 10 pounds acting on the end of a lever arm 10 feet long is exactly equal to the torque due to a weight of 100 pounds acting at the end of a lever arm but one foot long. Thus we see that while we can increase the pull and push on the armature by increasing the current, we can increase the effect of this pull or push, or in other words make a machine which will have still greater torque by increasing the length of lever arm upon which the torque due to current acts. As an example parallel to the one cited of the windlass, an armature 10 feet in diameter

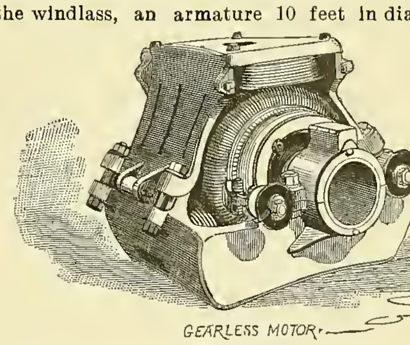


FIG. 57.

would, with the same current have ten times the torque that one but a foot in diameter would have. But in street car motors our space is limited and we cannot far increase the torque of our motor in this way. Our armature must necessarily be of small diameter so that our leverage is small. Nor can we increase our current indefinitely, so other means must be resorted to to give the motor sufficient torque to start a loaded car from rest or propel it up a steep grade.

It is a law of mechanics that what is termed "work" is equal to the product of the force (torque) into the space described by it in its direction while overcoming the resistance, and "horse power," is the rate at which this work is done. Thus if we have an armature of small diameter and small torque, it may be able to do considerable work at a rapid rate if with this small torque it be caused to revolve very fast. If this were attached directly to the axle of a car, its torque would not be sufficient to start it, but if we geared it down through one or more gears so that for every revolution of the axle, the motor would in the same time have made say 50 revolutions, the torque on the car axle would be magnified 50 times, and the car would easily start or go up hill. It must not be imagined that by gearing down, a motor is enabled to do more work in a given time or that its horse power is in any way increased thereby, for by the definition of work it is the product of the force into the space through which it acts. If we exert a small force through a very long distance in a given time, as is the case with the rapidly running armature, the same horse power is expended as if we exerted 50 times as much force through a space one fiftieth as long.

Thus in street car motors with the small armatures and bipolar fields the necessary torque on the car axle is gained at the expense of speed by gearing down. At first all street car motors were double geared, but the wear of these gears and the loss of power occasioned by them indicated the desirability of doing away with them either partially or wholly. This could only be done by increasing in some way the torque on the armature. Neither the diameter of the armature nor the current used could be much increased, so resort was had to the multipolar fields. It is very clear that with a four-pole field each of the fields may be made to exert the same pulling or pushing force on the armature, with the same current as is exerted by each of the bipolar fields before referred to. With four poles, therefore, the armature will have double the torque and may therefore run at half the speed with the same mechanical advantage. This would enable us to do away with one of the two reduction gears of which we have spoken, and if we had six poles and could slightly increase the diameter of our armature or slightly increase the amount of current, or both, we could put the armature directly on the axle and do away with both gears and have the same axle torque as we originally had with our double gears. We would have then a single reduction and gearless motor respectively. It was argued that whatever excess of current might be required for the gearless motor, for instance, would be more than compensated for by the saving of the loss in the gears. As an illustration of the gearless motor, reference is made to the subjoined cut of the Short gearless motor. It will be observed that its field frame is triangular in section and has but three pole pieces. It is, however, a six-pole machine, since the fields are so wound as to produce consequent poles in the centers of each of the three parts of the frame connecting the three pole pieces together.

RAILS PILED IN THE STREET.

The suit of William A. Hollar against the Philadelphia Traction Company has been dismissed. The plaintiff tripped on a pile of rails belonging to the defendant corporation lying in a street and fell sustaining injuries for which he claimed damages from the company. In granting a non-suit the court said: "They had an unquestionable right to put the rails on the street. They cannot relay their tracks without doing so. I suppose there are twenty miles of those rails on the streets at this moment. I do not know how else they can lay those tracks without putting the rails on the streets. I do not know where they can be placed in a safer position than alongside of the curb in the street. In depositing those rails it is not possible to adjust each rail by plumb and compass.

"If they are resonably safe that is all the company is bound to do. This accident occurred in the daytime; the rails were there; the plaintiff chose to cross there; he took the risk of doing so. The company being lawfully there, it being indispensable to the exercise of their rights to put the rails there preparatory to their being laid in the track, I cannot see that there is any negligence here upon which they can be made responsible."

RELATIVE COST OF STEAM, COMPRESSED AIR AND ELECTRICITY FOR THE OPERATION OF RAILROADS.

BY GENERAL H. HAUPT, C. E.

I have received a copy of the *Street Railway Review* for April and have read with much interest and some surprise the criticism of my article by General Manager W. E. Baker of the Intramural railway. When I was consulted professionally in reference to the plans of construction and operation of the proposed new rapid transit lines in New York City the question of motive power came up for consideration. There were good reasons for believing that cable was not suitable, but it was thought that either electricity or compressed air might be advantageously substituted for steam.

I happened to be well posted in regard to what had been accomplished with compressed air and had sufficient data at hand to guide me in forming my conclusions relative thereto, but had to obtain from others most of my information regarding electricity. I therefore sought what may be considered the chief source of light on the subjected, the General Electric Company, being favored with a letter of introduction to Capt. Eugene Griffin, the general manager. That gentleman received me courteously, and having stated to him the object of my visit, he requested me to await the arrival of Mr. W. E. Baker, who was familiar with every detail from his experience in connection with the Intramural railway, and who could furnish reliable facts and figures. Mr. Baker met me by appointment three days later at the office of Mr. Henry Belden, New York City, and in the presence of that gentleman made answer to written questions that were submitted to him, which answers were noted at the time and furnished the data for the comparative estimate subsequently made. There was no disposition to present any other than a perfectly fair and impartial estimate, and if the comparison was unfavorable to electricity, it was simply because the figures, which were not expected to lie, gave that result.

I felt under great obligations to Mr. Baker, and do yet, for the valuable information furnished, and am naturally surprised at some of the criticisms in his article, as the gentleman seems to have forgotten the conditions of the problem presented to him.

It must be remembered that the information sought was in connection with rapid transit in New York City. That it was proposed to construct two four track elevated roads, one on each side of the city. That on each of these roads two of the tracks were to be used for rapid transit with an average speed of 20 miles an hour, and few stops; and the others for local travel, low average speed and many stops. It was scarcely necessary to enter into an argument to prove the self-evident proposition that 20 miles an hour, with three stops per mile, was impracticable, and the chief force of the article in question is directed against this assumed and purely imaginary condition.

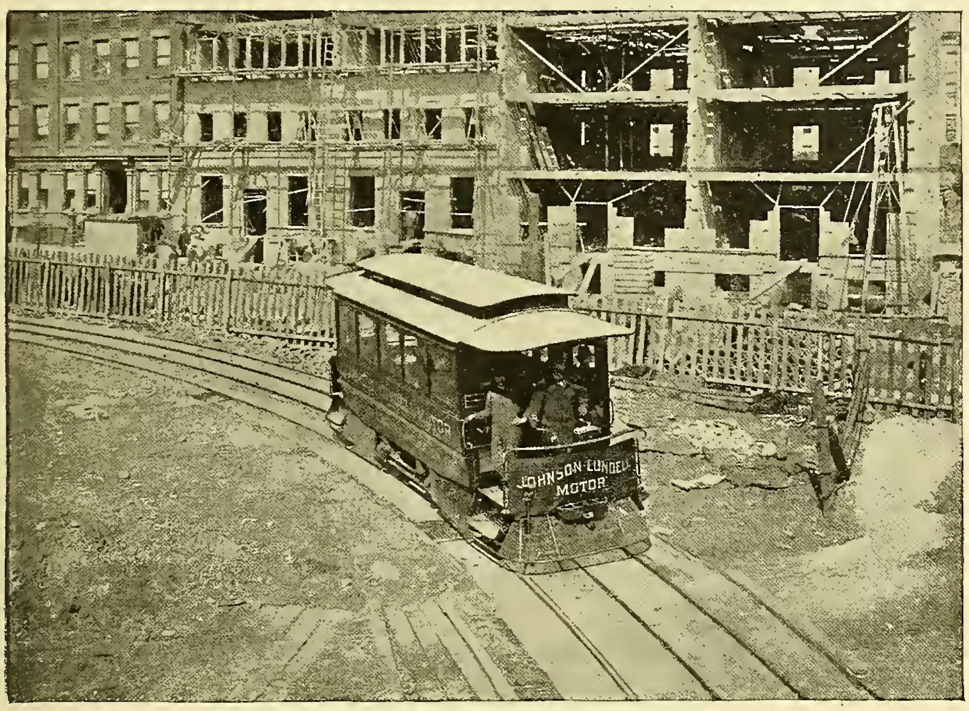
If Mr. Baker will reflect he must perceive that the cost of equipping and operating a line of road, where the stations are far enough apart to admit of an average speed of 20 miles an hour will be less than where they are so close as to limit the speed to 12 miles an hour, hence he cannot consistently complain that the comparison was unfair. It is surprising that he should have overlooked this fact, as well as have forgotten the conditions of the problem presented and discussed. He seemed to understand it during our interview in Mr. Belden's office, when he furnished the data referred to. He then did state in the presence of Mr. Belden that "the same power would be required to operate Manhattan trains as was used at the Intramural, which was 600 horse power and the cost of equipping each train would be $10,000." He also stated that "the same power would operate the proposed new line." Now he states that careful tests made in the Intramural power house gave 42 horse power per train. Allowing for the 35 per cent. loss between power house and trains, this leaves only 27 horse power per train. Yet he allows "75 horse power as a basis of present comparison." I have information from a reliable source that indicator and dynamometer tests made on the Manhattan with an 11x16 inch cylinder engine gave an average of 185 horse power for all the time the engine was under steam, which I have reason to believe is considerably more than 50 per cent. of the total time of the trip. Here again Mr. Baker seems to be badly mixed, for in one part of his article he gives the average time between stations as 100 seconds—53 under steam, 30 coming to rest and 17 standing in station. In another part he gives it as 87 seconds—38 under steam, 32 coming to rest and 17 standing in station. This was for the purpose of showing that my allowance of 20 trains out of 120, "using no current," was not sufficient. Considering that his figures tally so badly, and that my allowance was made for a road with long intervals between stations, it is probably nearer the truth than he tries to show, and anyhow it only affects my original estimate, which was already subjected to revision by the General Electric Company.

It is strange, in view of all the facts presented and after the statements made by Mr. Baker during our New York interview, that now, as if the subject were new to him, he should profess to believe that I intended the proposed line to be operated at 20 miles per hour with three stops per mile; and with this as a text write a two page article. How can he reconcile his statements then made with the following in his article? "A calculation, which it is not necessary to enter into, will show that to make an approximation to the average speed of 20 miles an hour, 600 horse power will be found not sufficient to do the work." Of course not, and yet further on we read, "600 horse power * * * is true only if the trains are to make 20 miles an hour," as if remembering his statements at the New York interview.

Being anxious to get at the facts and the truth, and to eliminate all possible errors and misunderstandings my original estimate deduced from Mr. Baker's figures was submitted, as stated in my article, to the General Electric Company for revision. They placed the matter in the hands of one of their experts (Mr. Blood if I remember correctly) who cut down the horse power over 50 per cent. and put the cost of installation at 6,000,000 dollars. There could have been no misunderstanding on his part as to the trains making three stops per mile, for he did not enter into any calculation to show that "600 horse power would not be sufficient," but stated that my estimate was "excessive," being based on maximum, instead of average resistances. I accepted his explanation, and his revised estimate, of 42,000 horse power and 6,000,000 dollars; but in view of the self evident fact that it costs less to equip and operate a line of road with stations at long intervals than one with stations at short intervals, it is very much at variance with the final estimate given in Mr. Baker's article of 15,000 horse power and 2,550,000 dollars, on the supposition that stations would average three per mile.

There are some who believe that the resistance of trains is proportional to the cube of the speed. This is contrary to all experience and very far indeed from the truth. I can only advise those holding such belief to get better posted before committing themselves to such rash statements.

One thing appears self evident, that a given amount of power will overcome the same resistance, whether the agent be steam, compressed air, electricity or any other power notwithstanding Mr. Baker's assertion that, "the accelerations secured on the Intramural were superior to those obtained on any elevated road now being operated by steam" If such was the case it could only have been because of the 600 horse power with which the trains were equipped, and as seen from the ground there was a frightful amount of "sparking" as the trains started.



TRACK OF THE JOHNSON-LUNDELL ELECTRIC RAILWAY.

Mr. Baker goes on to say that 210 trains would be required instead of 120 to operate the proposed road. This is possibly so. I stated that 120 trains would be in operation at one time, making 4 800 miles in two hours, on the assumption that they were one minute apart, and making an average speed of 20 miles an hour. This is probably closer than they could be run in practice, and was intended as an extreme case for purposes of safe calculation. Mr. Baker evidently overlooked my statement that, "It may be noted that 120 motors would not be sufficient for such a service, as there are always a number of engines in relays, in reserve, and undergoing repairs." By what stretch of imagination does he manage to get all the 210 trains running at once, under the above conditions, so as to cover 8,000 miles in two hours? Yet he uses this as a basis for figuring the coal consumption of the steam engines. A revision of his figures will show him that I put the number of miles correctly at 4,800 in two hours.

Following this is an assertion that 8,000,000 dollars would be saved in the construction of the road. This must be a typographical error for 20x40,000=$800,000. The wisdom, or even possibility, of saving this amount is doubtful, in a structure that is to last for all time. The cost of maintaining the roadway and track of the Intramural during the six months of the fair was $4,281.28. This seems a good deal for a new track and roadway, and is doubtless due to the flimsy construction which he advocates.

The subject of compressed air is dismissed with the remark, "No experiment has been carried on in this direction on a large enough scale to demonstrate its availability, to say nothing of the expense."

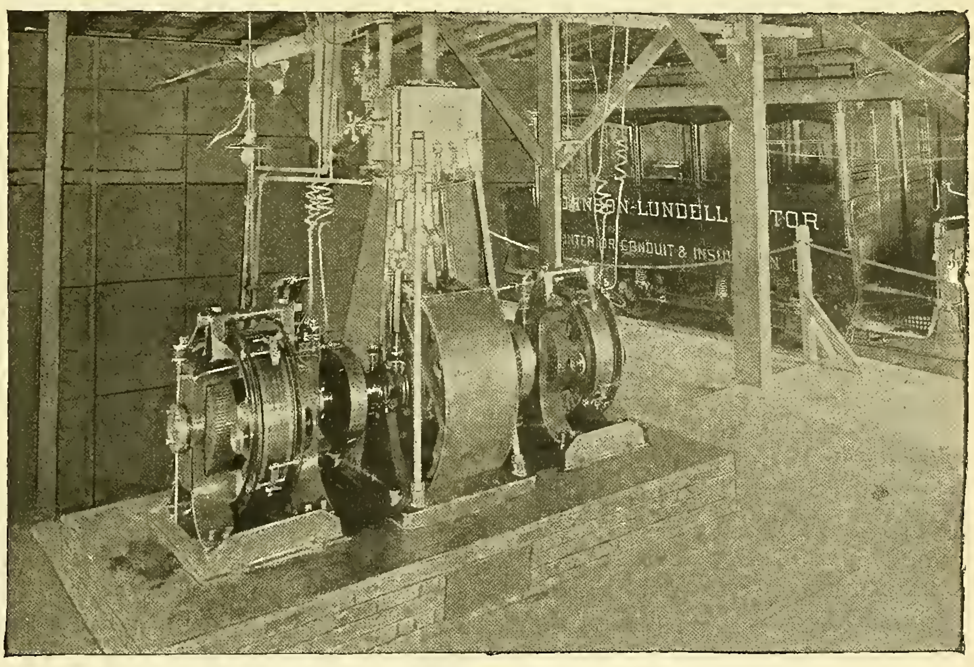
If one air motor accomplished all that was stated in my article, it is fair to assume that any number could be built like it, and it is even fair to assume that it may be improved upon. To prove that the motor referred to did accomplish all that was stated, the most unexceptionable testimonials can be exhibited. The record of air consumption furnishes all necessary data as to expense of operation, and parties are ready to quote prices for the equipment of motors and air compressing plant. Good reasons have already been given why compressed air has not come more into use, and why the above successes were not followed up. To these I would add, that millions of invested capital usually block the way effectually against the introduction of improvements that will threaten dividends; even with a prospect of increased dividends in the near future, a change that requires present expenditures, is resisted. The Traction Company of Philadelphia, killed the elevated road there. The West End Company in Boston did the same; Tammany and Manhattan have closed New York against rapid transit efforts. Is it necessary to explain further why compressed air has not been universally adopted? Everywhere somebody's interests have placed obstructions on the track to block the wheels of progress.

Washington, D. C., May 5, 1894.

THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

A new system of electric traction by means of a combination of the closed conduit and storage battery methods has been designed by Messrs. Edward H. Johnson, president of the Interior Conduit and Insulation Company, and Robert Lundell, the inventor of the Lundell dynamos and motors.

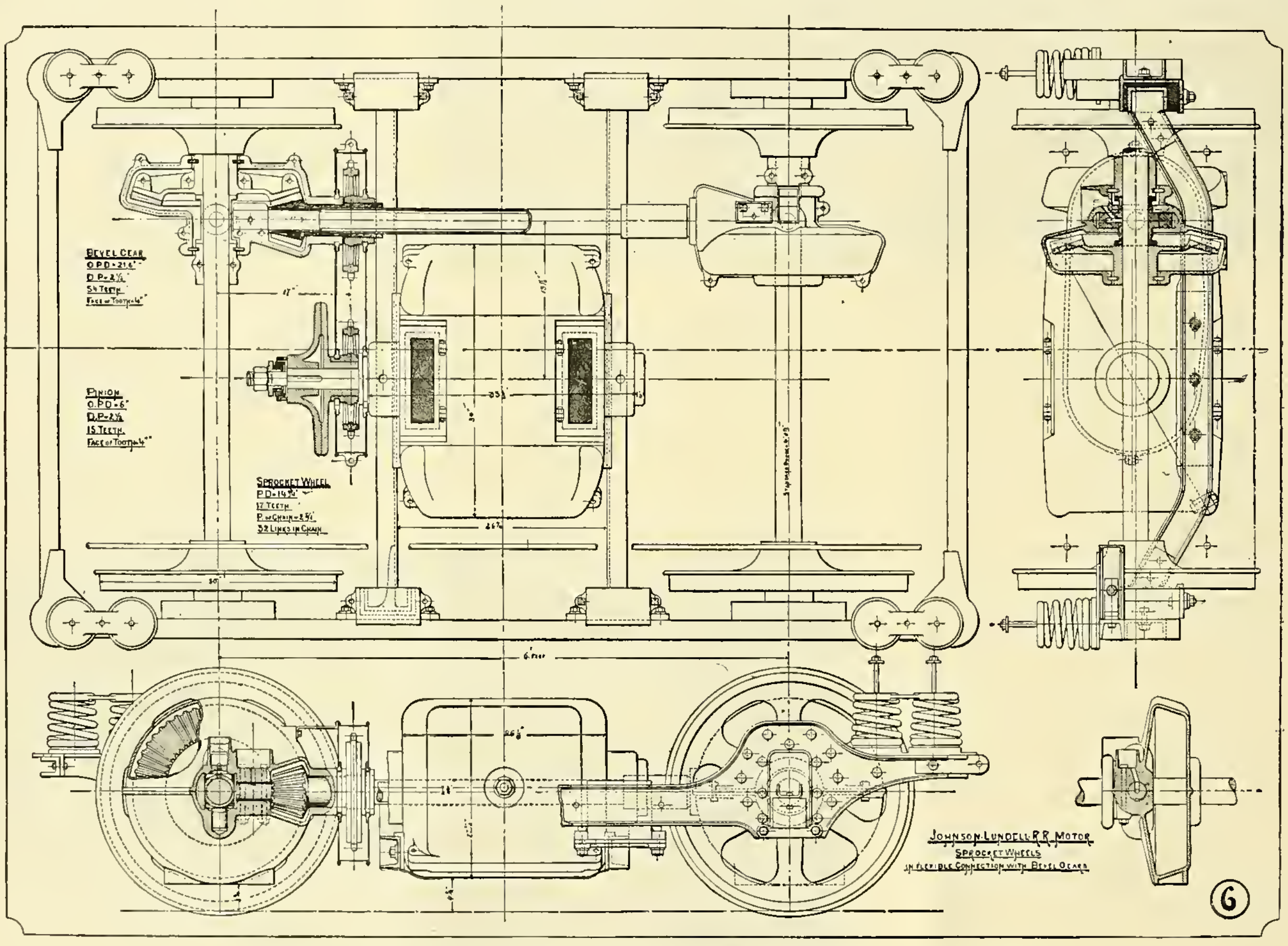
We illustrate herewith the experimental road in New York City upon which the Johnson-Lundell system has been tested. The track runs around a whole city block, with rather heavy grades and with difficult curves of necessarily short radius. The power house is at the foot of the hill and at the center of that section of the track or circuit. The generating plant comprises a vertical engine driving directly a pair of Lundell dynamos, the unit being such that it could be enlarged on exactly the same proportions up to any size for any road. Its capacity here is far beyond the need, but it serves to illustrate the manner in which the generating part of the Johnson-Lundell system is provided for. By means of the Interior Conduit telescopic iron tube, current is carried to the track at the proper points of feeding, and is distributed, the inventors claim, without any loss due to leakage or conduction, owing to the high insulation of the ducts. The track itself, so far as the rails are concerned, is of ordinary construction. Between the rails it is asphalted or paved and paralleling the rails lies a conducting bar or strip of metal embedded in the asphalt. This bar is level with the surface, and is divided up into sections with insulating blocks of stone or other material between them. Just outside the single track, or midway between the double tracks, are plain boxes with iron covers flush with the street surface. In these boxes are substantial electromagnetic devices which deliver current to each section as the car comes along, and then lie quiet until the succeeding car approaches. These switch boxes are water tight. Each box governs its particular sections of track. The car carries a pick-up rubbing brush which leads the current into the motor and which takes the place, or fulfills the function of the trolley pole wheel.



POWER HOUSE EQUIPMENT OF THE JOHNSON-LUNDELL ELECTRIC RAILWAY.

The car has but one motor. This is central under the car and drives on each axle by means of bevel gear, and with sprocket wheels and link chain in flexible connection. Its suspension is flexible, the bevels are boxed, the sprocket wheels and links mesh noiselessly; and owing to the intervention of a bipartite screw coil in close relation to the armature shaft, it is claimed that the motor, though capable of instantaneous arrest or sudden starting, never moves off or starts with a jerk. The motor is iron-cased and protected against dirt, stones, moisture, etc.

Underneath the car is a steel brush which collects the current and conducts it to the motor, the return being as usual through the rails, which are obviously harmless, as the conducting strip between them is only alive when a car is right over it. But the car is not dependent merely upon the supply of current from the line. Under the seats are frames holding a very simple, elementary form of lead storage battery, enough to furnish the voltage at which the motor runs—300 volts—and with very few plates in each cell, giving considerable capacity. They render the car at once self-contained and dispense with the wiring at crossings, switches, steam railway tracks, etc. If the car has not sufficient headway to run over a crossing, the battery will furnish it, just as it will keep the car going should it be deprived of central station current.



DETAILS OF CAR EQUIPMENT OF THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

PRIZES FOR POWER STATION DESIGN.

The Chicago General Street Railway Company, whose office is at 1032 Lawndale avenue, Chicago, having the construction of a permanent plant in contemplation, invites outline drawings and general specifications of a model plant for the immediate use of twenty motor cars and twenty trail cars, with suitable construction to increase capacity to forty motor cars as occasion may require. The lot will have a street frontage on the south of 450 feet, on the east an alley frontage of 550 feet, on the west a street frontage of 300 feet, and on the north the diagonal frontage abuts a steam railway from which a switch may be extended to any portion of the lot where convenience or economical operation may require. The street railway tracks may enter the lot at the north east corner and will also extend along the entire south frontage. Water can be extended from a city water main to any portion of the lot. The drawings must show the location of all necessary buildings, the position of Corliss engines, boilers, machinery, coal tracks, pits and all other desirable features for a model plant. For the first plan selected $100 will be paid, $75 for the second, $50 for the third, and $25 for the fourth. C. L. Bonney, the vice president of the company reserves the right to reject any and all plans and he is to be the sole judge of the merits of each. The plans must be sent to Mr. Bonney on or before the first day of July, 1894. Each plan should be identified by the owner's mark; the name and address to be sent on separate paper.

DECISION AGAINST PHILADELPHIA ELEVATED ROADS.

The Supreme Court of Philadelphia has just handed down a decision which must bring to an end for the present all efforts to construct elevated railroads in the state. The case which was decided was that of the Quaker City Elevated Company of Philadelphia but the finding is so sweeping that no elevated road can be built until action has been taken by the legislature. The court makes this summary:

First. We have no statute in the state that authorizes the incorporation of elevated street passenger railroads, and no machinery for use in acquiring a right of way for an elevated railroad overhanging the streets and surface street railroads upon them.

Second. The appellant is not a street passenger railroad company, and cannot acquire the rights and franchises of such company without incorporation under our street railroad laws.

Third. The appellant is a steam railroad company, incorporated under the general railroad laws of the state, and, as a common carrier of persons and property, is possessed of the powers and is subject to the duties imposed upon steam railroads by the laws of the state.

Fourth. Among its powers is that of locating and acquiring title to a location or route for its railroad, in accordance with the provisions of the general railroad laws relating to that subject.

Fifth. It has not exercised this power, and, as a consequence, it has no route or right of way on which it can lawfully build a line of railroad.

Sixth. As it has no right of way on the surface on which it can build a line of railroad, it has no line to elevate or depress under the provisions of the act of 1887, and can take nothing whatever under that act.

Seventh. The contract between the appellant and the city of Philadelphia cannot change the corporate character or powers of the appellant company, nor can the permission of the city give to it the right to build and operate an elevated street passenger railroad overhanging the streets and the surface street railroad lines, in the absence of any legislation whatever authorizing or providing for such elevated structure and the ascertainment of the damages to be done to lot-owners thereby.

Eighth. The erection by the appellant of the structure complained of is thereby unauthorized. It was for this reason rightly enjoined by the Court below, and the decree appealed from is now affirmed, at the costs of the appellant.

English Lack of Progress in Traction.—While, then, we regret the want of progress in electric traction in this country, we cannot be blind to the reasons which have made tramway managers cautious. From the humanitarian point of view, horseflesh in traction work should be abolished; but nowhere in the world's history have commercial undertakings been carried out from this point of view. No one who understands horses can for a moment ignore the fact that traction work is perhaps the most killing that horseflesh is subjected to, and would gladly see inanimate materials used in its place. Those, like us, who have advocated and do advocate the use of electric traction, advocate such use because from figures put before us, from our knowledge or the possibilities of electricity, we firmly believe that its use would in most cases where it is proposed lead to increased returns, the increase being proportional to or even greater than indicated by the increased capital outlay. Only would this be the case, however, when the installation was properly designed and economically managed. —*London Electrical Engineer.*

Port Huron, Ont.—Residents of Port Huron are contemplating the building of an electric railway between their city and Lexington, along the lake shore, a distance of eighteen miles.

LIGHTNING ARRESTERS FOR STREET RAILWAY CIRCUITS.

Mr. Alexander Jay Wurts of the Westinghouse Electric and Manufacturing Company on Monday, April 30, read an interesting paper on non-arcing lightning arresters, with special reference to the protection of street railway circuits, before the Society of Arts, Massachusetts Institute of Technology, Boston. Current for the experiments was generated in the basement of the building and the table of the lecture room was filled with novel combinations of old forms of apparatus and the new devices described by the speaker. Mr. Wurts spoke for two hours with scarcely a reference to his notes in an easy and interesting manner. In substance Mr. Wurts said:

Last summer one superintendent of a small street railway said that lightning caused his plant a loss of $10,000 in one year. Many electric power plants in the west are inoperative in the after-

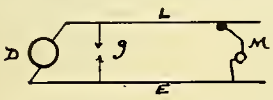


FIG. 1.

noons of summer due to the destructive effect of thunder storms. In the east there has been trouble from the same cause to electric railway plants. The correspondence we receive in regard to protection against lightning, the number of lightning arresters sold, and the patents taken out show the interest in this subject. Some means are needed to educate people in the use of apparatus for protection from lightning. The simplest form of lightning arrester is a spark gap, that is, two electrodes separated by an air space.

The so-called lightning is supposed to cross the gap *g*, but the lightning does not always do that, and there are good reasons why. In my opinion overhead wires are not struck by lightning. Some of the ramifications of a lightning stroke may get into them. Last summer one of these ramifications struck a wooden pole supporting a span wire; the discharge shattered the top of the pole and the span wire, but there was no mark on the pole below the span wire. A mica bell insulator supporting the trolley wire from the span wire was split into three pieces. The current went 50 feet on the trolley wire to a lightning arrester and then to earth. There was no evidence of heat other than the blackening of the mica insulator. The main stroke of lightning would have developed more heat. I cannot conceive of lightning getting into a wire without fusion.

An overhead wire becomes charged in one of three ways or a combination of them: (1) by static induction from the clouds; (2) by dynamic induction, *i. e.*, by a discharge between two clouds; (3) by conduction, by actual conduction from the surrounding atmosphere. This, I think, is the usual case.

The potential of the atmosphere becomes higher at increased elevations. At the top of the Washington, D. C., monument in thunder storms it is 3,000 volts. Between the top of the Eiffel tower and the base it is 10,000 volts. At the tops of our poles the potential is not dangerous to insulation.

As commonly accepted a lightning discharge is oscillatory. It may be that the charge of the

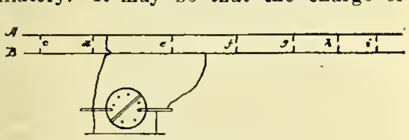


FIG. 2.

atmosphere also partakes of these oscillations and during a lightning discharge the potential of the whole atmosphere may also rapidly oscillate. If a wire becomes charged to the potential of the surrounding atmosphere, there may be surgings set up in this wire when the potential of the atmosphere varies. Dr. Lodge has investigated this subject fully. I am quite convinced that the charges take place from conduction. Many circuits in the west become charged in a cloudless day from 100 to 150 times an hour, when there is no lightning flash at all. During thunder storms the discharge of lightning arresters occurs at the same time as the flash due to the surgings set up in the lines. These surgings are important though the danger is not immediate. There are points of reflection in a system, in the translating devices, in the armature, in the converters, where the surgings meet with high self-induction, and are either reflected or they punch out the insulation. The nearest analogy is that of an hydraulic wave in a closed pipe. The wave either bursts out the end or is reflected. Although the live wire may not be charged to a high potential, a heavy strain is put upon those points of reflection and the insulation perforated with a small hole. The puncture may not occur the first time. Another thing of importance is that with these surgings there are nodal points formed where there is no tendency to discharge. The distances of these points are determined by the conditions existing at the instant of discharge. To recapitulate: The wire becomes charged; there is a sudden

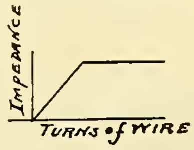


FIG. 3.

letting go; surgings are set up; points of reflection and nodal points are formed.

The so-called lightning arresters conduct to earth and do not arrest, they are lightning *conductors*. Such an arrester or conductor as is shown in Fig. 1, answers for the taking of discharges of telegraph and telephone lines, but with a dynamo current of several horse power, the current will follow across the gap grounding the line. Most arresters differ in the means of interrupting the dynamo current. As far as the lightning charge is concerned, they do not arrest it and superintendents of electric light plants do not understand this point. One spark gap will take the discharge as well as another. A discharge goes along past a spark gap to the dynamo because the discharge did not like the gap. When this happens the managers of a station throw away the lightning arrester and get another. The nodal points are to blame, not the arresters. Two conductors *A* and *B*, Fig. 2, one representing the overhead wire, the other the ground, were connected with the terminals of a Holtz machine kept continuously running by a motor; *c*, *d*, *e*, *f*, *g*, *h*, *i* were spark gaps or lightning arresters so-called.

By varying the spark gaps on the Holtz machine, the discharge on the line will pass sometimes by one, sometimes by another gap. The discharge is as likely to pass at *i* as at *j* nearer the charging source; *c*, *d* and *e* are nothing more than simple opportunities for the discharge to pass from one side to the other. Suppose there is a motor at *i*; that motor is a lightning arrester as it offers an opportunity for the discharge to pass from *H* to *B*, from one side of the circuit to the

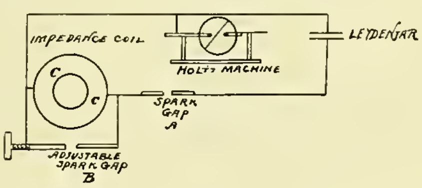


FIG 4.

other, in this case from the wire to the earth; and the discharge may pass unless the insulation be so strong that it cannot be punctured. What we want is good insulation in our motors and plenty of opportunities on the line for the charge to pass to earth. The discharges do not like to go far. Superintendents put a lightning arrester on each feeder in their station and think they have insured their apparatus. The discharge should have an opportunity to get to ground where the charging occurs, and the lightning can be kept entirely out of the station by liberally distributing lightning arresters along the line. I am going to equip an entire system at every 100 feet and find out where the discharge takes place most frequently, whether in elevated places (the system runs up 600 feet) or in the woods, or in the city. I can do this by inserting tissue paper in series with non-arcing lightning arresters. [Specimens of paper punctured in Colorado were here shown. The holes were from the size of a prick of a pin to the pin itself.] Lightning arresters do not protect. Choke coils do. They alone can stand guard over armature insulation. The form of the coil is very important. Dr. Dodge says that flat coils give maximum impedance. A curious thing I found was that the impedance increases with the number of turns of wire up to a certain point and then stops, giving a curve like that in Fig. 3. Another curious thing is that the impedance decreases when we insert iron. Dr. Dodge distinctly states that he could not find any difference. I find it may decrease it 20 per cent.

If the spark appears at *A* alone, Fig. 4, then the discharge is through the coil. Adjust until the spark appears occasionally at *B*, then insert a bundle of iron wires in the opening of the coil *C* and the gap must be decreased at *B*, showing that the impedance of the coil *C* has been decreased. The iron wire inserted lights up. The iron wire acts as a short-circuited secondary. For lightning arrester purposes we do not want any iron in the coil. To sum up again: Lightning arresters afford opportunities for the discharge to pass but they do not protect; coils protect.

Two or three years ago I discovered a non-arcing metal which is generally supposed to be a compound. There is no secret about it, for it is not a combination. I found that electrodes of zinc under certain conditions would not keep an arc. Small zinc electrodes placed near together were connected with tinfoil which melted without holding an arc. The non-arcing metals are zinc, cadmium, bismuth, antimony and mercury. The latter was experimented upon by dipping copper electrodes in mercury and was the best of all for a few experiments. Then I took cylinders of the various non-arcing metals 1 inch in diameter, 1¼ inches long, separated them by small air spaces, bridged across by crumbs of tinfoil, which melted with no arc and no damage. In the case of mercury there was no flicker of the voltmeter needle, and no fusion was noticed. In the case of zinc a hole was dug in. If a certain percentage of copper is added the non-arcing property is not destroyed. In no instance does the space bead over, and the smaller you make the air space, the

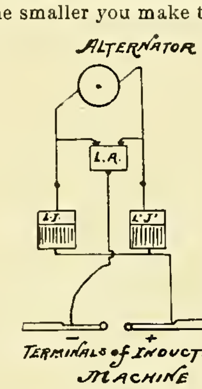


FIG. 5.

smaller the arc. [One of the non-arcing lightning arresters for alternating currents was shown in operation.]

The arrester consists of seven cylinders of zinc, copper and a bit of lead in composition. There are six air spaces. This makes a double pole lightning arrester taking the two sides of the circuit at the ends and a ground on the middle cylinder. The cylinders are placed $\frac{1}{32}$ inch apart or as close as possible. I think the action of this metal is due to vapors formed when the dynamo current passes. It seems natural that there should be non-conducting vapors as well as non-conducting substances. There are three air gaps for the arc to hold between the line and the ground. With our make of toothed armature we need four air gaps to break the arc. Two air gaps are enough on a 1,000 volt alternating circuit. There are five or six thousand arresters in use and only two failures. These were not failures of the metal but due to the construction. It was found that when the arc, following a discharge, takes place near the marble, the non-arcing power of the metal is destroyed, sheets of mica were inserted in the ends of the cylinders of an arrester and the non-arcing properties completely destroyed. The first cylinders were made with the ends connected close to the marble, and although the chances of a discharge passing there are very small, still it did occur probably in the two recorded failures. The cylinders are now made with rounded ends.

Both legs of a dynamo circuit, Fig. 5, are charged to the same potential, the charge passing to the middle leg of arrester and there right and and left, sparking across the air gaps between the cylinders, to the wires on the right and left and charging the Leyden jars until a disruptive discharge follows. As the discharge catches the

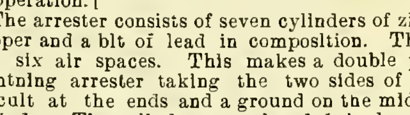


FIG. 6.

dynamo on the crest of a wave, the noise and disturbance is greater than when it occurs at a point in the curve when the current is less than maximum. [The dynamo circuit had eleven 100-volt lamps in series with five 5-ampere strands of wire in parallel, and whether the discharge seemed heavy or light the lamps did not flash nor the fuse melt. The fuse was reduced to one strand when it sagged under several discharges and finally gave way. It was very interesting to notice that the volume of dynamo current following each discharge was not the same, some failing to cause the single strand fuse (5 amperes) to sag at all. This was due, as stated above, to the fact that the discharge occurred on the trough of a wave.]

I have short-circuited a dynamo circuit by one of this form of lightning arrester 2,000 times, once every six seconds. The cylinders became hot, but you could still see the knurling. This arrester is not discriminating, but the dynamo current does not persist after a discharge passes. It is no better than a spark gap, but you can trust it and there are no swinging arms and no burning out. [The slowness of the charging by the Holtz machine was excused by Mr. Wurts on account of the dampness of the room. His own expermental laboratory among many improvements has no windows whatever].

These non-arcing metals and the arrester composed of cylinders of metal are non-arcing only on alternating currents. They cannot be used on direct current circuits except the Brush and Schuyler arc machines, in which the current is pulsating. So many letters were received asking if the arrester would work on street railway circuits that an attempt was made to devise some form that would operate on direct circuits. It is well known that a disruptive discharge will go over a non-conducting surface rather than to bore through air. By adding a pencil mark the discharge becomes easier. Now taking two small pieces of marble rubbing a lead pencil over the surface, and placing them face to face with strips of aluminum foil between, and the foil separated 1½ inches, the dynamo current did not follow the disruptive discharge. The foil was brought to within ¼ inch, when the fuse was blown. There was a tendency for the upper marble to lift off. A groove was then made in the marble, the groove filled with pencil dust and the top tied on. The next form was a lignum vitæ block with a rectangular groove.

In this groove are the terminals and between them are burned-out little grooves with a burning tool. If leather and many other things are used in this part the film after a short time is torn off. The conducting film formed by the charred lignum vitæ does not form a high resistance leap to ground. By the conducting film the dielectric is simply split, electrically split, and so the discharge can go more easily than to bore its way through the dielectric as a bullet has to do when it bores its way through a pane of glass. The finished form has a cap. To form and hold a dynamo arc we must have metallic vapors and such are not formed in the arrester. This form of non-arcing lightning arrester is discriminating, that is, disruptive discharges pass and the dynamo current does not. Last summer in Colorado an arrester was sealed up with plaster of Paris. It blew to pieces as there was no room for displacement of the air. [An arrester was then connected in series with a direct current dynamo and a fine fuse. On charging the current a disruptive charge passed again and again without short-circuiting the dynamo so as to blow the fine fuse. In this experiment the cover of the arrester was split so that the discharge could be seen. In this as in the previous experiment the result was greeted by loud applause.]

That arrester will wear out. One has stood 5,000 discharges and is still good. The average take 2,000 discharges and are then short-circuited. The disruptive discharge wears a hole and then the metallic vapors formed therein make and hold an arc.

The lightning arrester must be connected to earth by a straight wire. One economical superintendent put in a wire to connect a lightning arrester to the ground a lot of old kinks that made a good choke coil. In another case $500 worth of apparatus was protected by a ground costing less than five cents. It consisted of a ½ by 6-inch iron bolt. The wire was wound around the head and two nails were driven in for good contact.

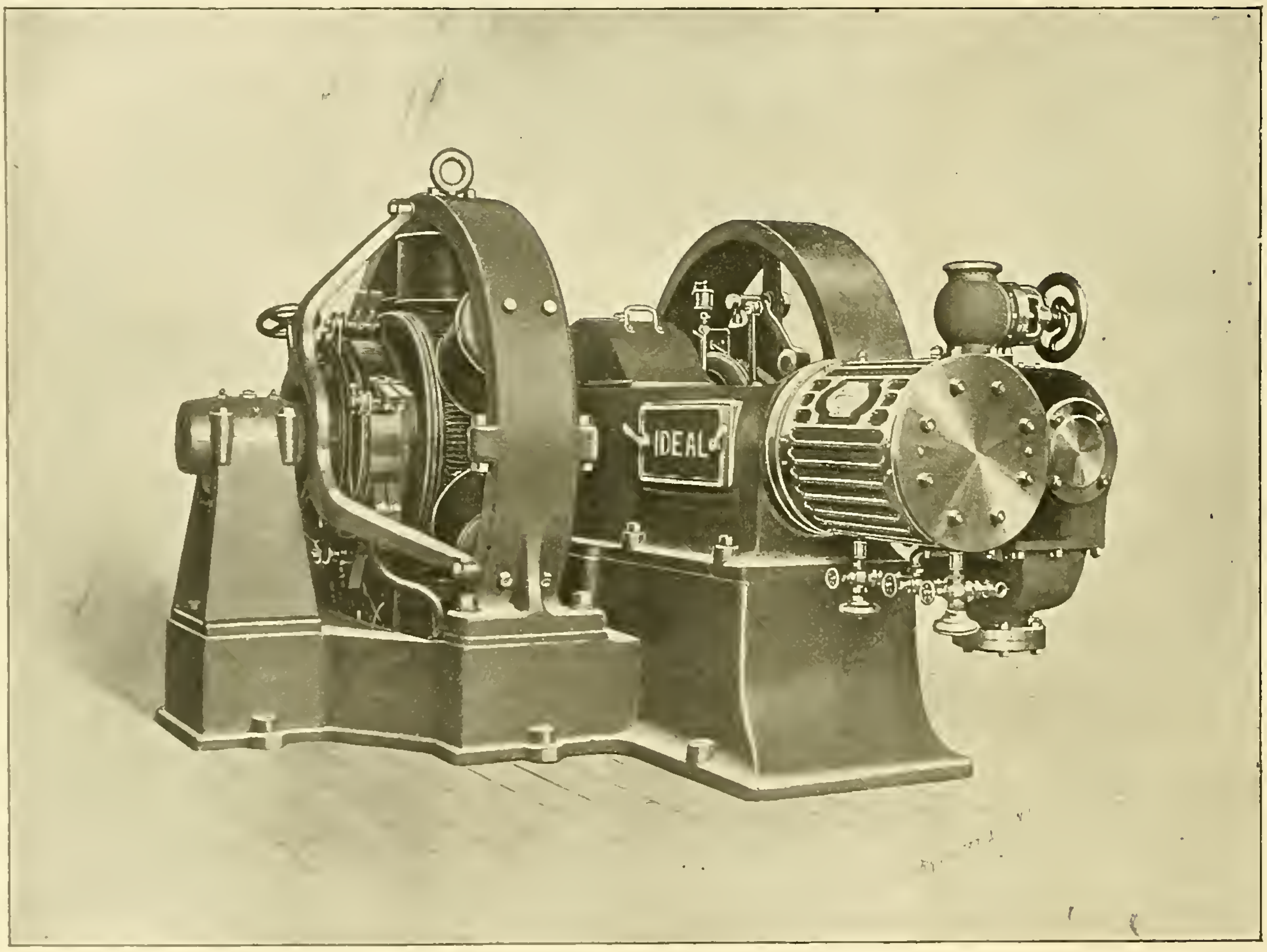
The aim in making these arresters is to have them non-arcing and so cheap that enough may be used to thoroughly protect a line. I am afraid that as they are new, superintendents will take them apart. I have tried to prevent this. The arresters are sealed and instruction given not to touch them. There is no necessity to take them apart. Circumstances demand that they be non-arcing so that they may be put out on the line and not frequently inspected. Last Summer in Telluride (Colo.) a 3,000 volt power plant which had been shut down every afternoon on account of thunder storms was protected in the following manner:

Outside the power houses in a lightning arrester house over damp ground were installed the arresters and all the lines were taken to that house. Four choke coils were inserted in each leg of each circuit. Between the choke coils there were formed at intermediate points, *G*, *G* and *G*, Fig. 6, artificial points of reflection where the spark gaps, the non-arcing arresters were placed. If a discharge passed one spark gap it would perhaps take the second or third to the ground and not hit the dynamo. In the plant described not a discharge got by the arresters, which were favored in the following order: 2nd, 3rd, 1st, 4th, counting the number of discharges in each. In Denver I tried two choke coils in series in place of four, on the trolley system. The coils were 0000 wire and 40 per cent. of the discharges passed them. Four coils would suffice in the majority of cases. Such coils are expensive on account of their size. It was easy to employ them at Telluride because there are no translating devices there and the ends of the line alone had to be protected. In any system with translating devices the only way is to put many opportunities on the line.

The kind of insulations is important. Wrapped insulations cut no figure at all. Disruptive discharges pass between the convolutions farther than they would in air. A continuous tube must be used so that a discharge will have to bore a hole through solid insulation.

HARRISBURG IDEAL ENGINE AND DYNAMO COMBINATION.

The "Harrisburg Ideal" self-oiling engine, manufactured by the Harrisburg Foundry and Machine Works, of Harrisburg, Pa., is shown in the accompanying illustration. The dynamo connected to it was built by the General Electric Company, and has a capacity of 50 K. W. with a speed of 275 revolutions per minute. The engine cylinders are 12x12 inches.



HARRISBURG IDEAL ENGINE AND GENERAL ELECTRIC DYNAMO

The self-oiling out-board bearing feature, as shown in this engine, is designed on a generous model, and has the latest arrangement of movable sleeve with ring oilers, being except for the increased weight and size, of almost the same construction as the standard Edison bipolar bearings which are now so familiar to users of those machines.

The results of a test of the Ideal-General Electric combination made recently in New York City will be of interest. The engine and dynamo were started in the usual manner under steam, and when running at the desired speed, 275 revolutions per minute, the brushes were adjusted, and engine and dynamo prepared for taking the load.

The switchboard was also arranged so that the entire amount of power generated would pass through two switches side by side. A nickel five-cent piece was balanced on edge on the outer end of the cylinder head, with the engine running at friction load. The two switches were then taken in hand and thrown in instantly, the ammeter showing 340 amperes. The switches were thrown out in seven seconds, then in and out again, thus throwing upon the engine practically the full load

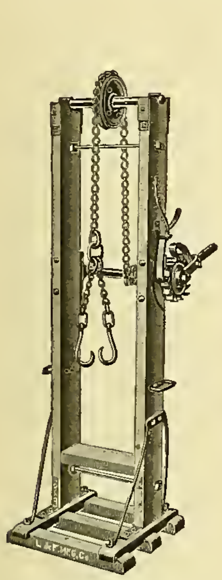


FIG. 1. CAR JACK.

of the dynamo twice within fourteen seconds, during which the five-cent piece remained balanced on the cylinder head, showing the combination to be operating without noticeable vibration.

There are now between 30 and 40 Harrisburg Ideal direct connected electric combinations in successful operation, nearly everyone of which was installed by the New York representatives of the Harrisburg Foundry and Machine Works, W. R. Fleming & Co., 203 Broadway, New York, and 620 Atlantic avenue, Boston.

THE ACME CAR JACK.

The accompanying illustrations show the new car jack designed and manufactured by the Lewis & Fowler Manufacturing Company of Brooklyn, N. Y. Fig. 1 shows a single jack and its construction, while Fig. 2 shows very clearly the method of using the jack in raising car bodies from their tracks. These jacks are equally well adapted for use in shops or anywhere along the

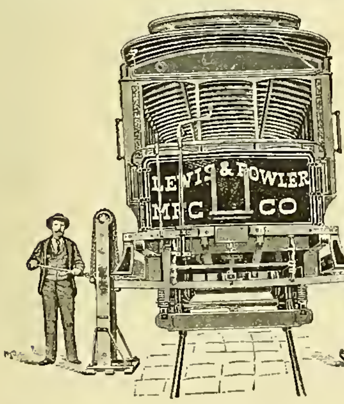
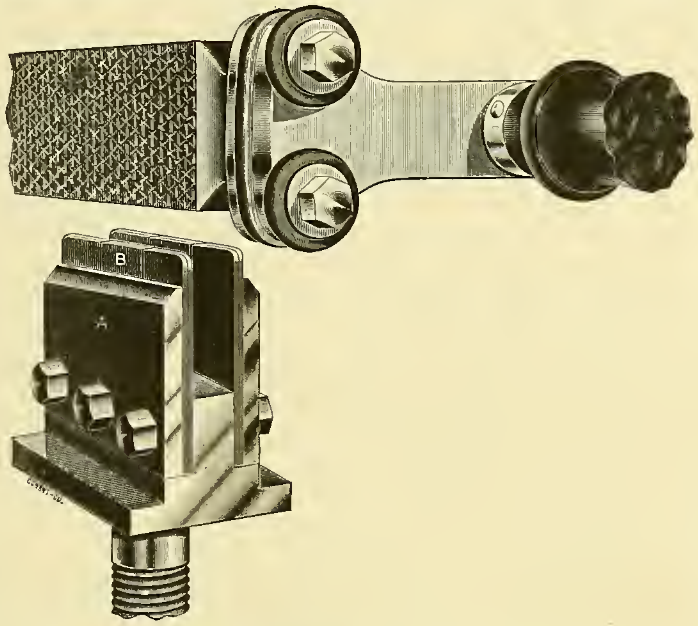


FIG. 2. THE ACME CAR JACK.

line. They are capable of quick adjustment and quick action. They are sufficiently powerful to lift the heaviest cars, yet are very easily operated. Two men can raise a car quickly and safely with a very slight effort, and when once raised, the jacks will hold the car firmly for any length of time required. The construction is simple, and there are no parts liable to get out of order.

NEW SWITCH OF THE W. S. HILL ELECTRIC COMPANY.

The accompanying illustration shows one of the latest improvements in the switch line by the W. S. Hill Electric Company, of Boston. A brief notice of this switch was given in our patent record of last week. The leading feature in the invention is the manner in which the two or more blades are secured to the yoke so as to obtain



THE HILL SWITCH.

rigidity, and keep all of the blades in proper alignment while the switch is being operated. By the old method of securing the blades to the yoke (to which the handle is attached) by a single bolt or screw in each blade, there was nothing to prevent the twisting of the blades, thus allowing one to move in advance of the other, and as the two or more poles would not break in unison, excessive flashing would result. To overcome this defect and produce a more mechanical and substantial device, the outer ends of the blades and yoke have been broadened, and two screws or bolts inserted, thus securing the parts so rigidly that the blades must at all times move in unison, and all the blades leave the contacts at the same instant.

The second important feature consists in backing up the regular flexible contacts *B* by what are termed reinforcing plates, shown at *A*. It has heretofore been the custom to use nothing but the copper strips *B*, and these of a necessity being flexible were liable to spring apart by constant usage, thus impairing the contact and causing the parts to heat. By the method shown the flexibility is maintained, and on account of the reinforcing plates the flexible contacts are always held in proper position, consequently the electrical connection between blade and contact is always kept perfect.

It will be seen that the carrying capacity of the flexible copper plates *B* are increased by the reinforcing plate *A* to the maximum of any other part of the circuit, preventing loss of current in the switch and heating and destruction of its contacts.

La Salle, Ill.—The City Electric Railway Company has been compelled to stop running its cars, being unable to procure coal for fuel on account of the strike of the coal miners.

Levy's Car Truck.

In the accompanying illustrations Fig. 1 shows a side view of an improved form of street car truck designed by J. L. Levy of New York City, and Fig. 2 is an enlarged side elevation of the end of the truck showing the auxiliary spring used.

Among the specific improvements claimed in this design of truck is a nest, or series of springs located between an extension of the truck frame and the car body, or a like extension of the upper chord (if one is used). This nest of springs comprises those which are adapted to come into play successively as the car body sinks down; that is to say, these graduated springs are intended to supplement the usual car springs which are gen-

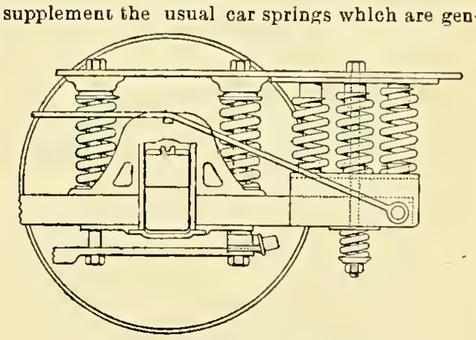


FIG. 2. LEVY'S CAR TRUCK.

erally located about the axle boxes so as to permit of a car extending beyond the truck frame or overhanging the truck being used, the nest of springs also acting in a measure as a buffer to retard the oscillation, or end vibration, of the car upon the truck.

The design also includes the location of a leaf or elliptical spring between the ordinary and usual car springs, and this is adapted to come into play after the car springs have begun to be compressed, at which time the elliptical spring begins to assist the axle box frames in resisting the downward movement of the car.

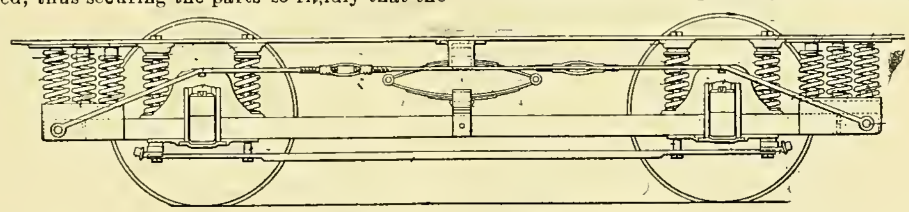


FIG. 1. LEVY'S CAR TRUCK.

STREET RAILWAY AFFAIRS IN ENGLAND.

(From Our Special Correspondent.)

BOARD OF TRADE REGULATIONS.—The electric traction people cannot say any longer that they 'dunno where they are," for now that the standard regulations for equipping and working an electric street railway have been issued by the Board of Trade, it is possible and even easy to gauge their exact influence on traction developments. The general opinion seems to be that, though the draft rules when first published last year were absurdly strict, to such an extent, indeed, as to make electric traction impossible, yet in their final form as amended, after discussion with all the parties interested—telephone companies, railway companies, telegraph department of the general postoffice, electrical firms and street railway men, etc., etc.—they offer no real restrictions whatever to the proper development of electric lines when designed and built upon the best principles. At any rate, government interference—so far as it has gone—is decidedly of the "indulgent parent" order, so much so that more than one prophet has speculated upon the probability of street railways—as well as trunk lines—being eventually nationalized. Time enough for that yet, however.

MUNICIPALIZED TRAMWAYS.—It is more likely that street railways will first of all be taken over by the local authorities—at any rate will be owned, if not worked by them. It cannot be said at present, however, that the results of municipalization have proved highly favorable. Take for instance the Plymouth Corporation lines. The last available reports show that 1,030,552 passengers were carried at a cost of $21,040, while the receipts were only about $400 in excess of this amount. Then there is Huddersfield, where the lines are all owned and worked by the Corporation, steam engines being chiefly employed on account of the steep grades. An apparent gross profit of $31,495 is shown on the year's working; but when interest amortization and depreciation are taken into account, with cost of renewing permanent way the gross profit is turned into a loss of $47,390. One would say that Huddersfield would do better by adopting a cable system, and Plymouth be wiser if horses were replaced by electric motors.

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

CAR FENDERS INVENTED IN BOSTON.—There will soon be several new types of electric car life fenders on the market, the inventions of Boston men, each possessing merits peculiarly its own. Ever since the West End Street Railway Company advertised for samples and the aldermanic commission was appointed to investigate this subject, inventors have been at work devising an apparatus that would prove a real lifesaver. From what we have seen of these new devices they certainly appear to have that merit. It is not that inventors fail to invent the right device, but the real difficulty is in inducing street railway companies to adopt it.

EXTENSION OF THE QUINCY & BOSTON.—At a meeting of the Quincy city council, Monday evening, the Quincy & Boston Railway Company asked for authority to extend its electric system to the town of Braintree, where it will join the road that has been constructed and equipped from Brockton, via Holbrook and Randolph. There was some slight opposition offered by one or two maiden ladies, owners of property along the intended line, who urged that what was good enough for their grandames was good enough for them in the way of travel, even though they might take half a day instead of half an hour to reach Boston. The authority asked for will be granted.

ELEVATED ROADS.—Now that the subject of rapid transit in this city has reached that point where the public is beginning to inquire which one of several systems of elevated railways now being examined, will finally be adopted, things are becoming lively among the inventors and promoters of these various systems themselves. The Hon. E. Moody Boynton, inventor of the electric bicycle railway, that is running in Brooklyn, N. Y., has been expressing himself pretty warmly on the merits or rather the demerits of the Meigs system, which is the system most in favor up to date. Mr. Boynton, of course, makes out that Captain Joe Meigs and his system can never solve the problem, and the latter is equally sanguine he can not only give the city of Boston rapid transit, but most luxurious travel as well. Mayor Matthews, too, is quite wrought up over the subject, and on more than one occasion recently at meetings of the legislative committee or city council, language has been used that was more expressive than polite. It is a question now, whether any system will be adopted after all.

UNDERGROUND WIRES.—It seems, after all, that as the West End Street Railway Company has been ordered by the city government to place its wires underground, that the electric light, telephone and telegraph companies will have to do the same thing. The mayor has expressed it as his opinion that they must all go and the council and aldermen have about arrived at the same decision. Whatever work is attempted in that direction, however, the companies have been notified, will have to be approved by the city fathers before being allowed to pass.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

THE FINANCIAL AIR this week has been rife with rumors and reports of consolidations, extensions and capital stock increases, and consequently a little tinge of excitement has been lent to the trading in traction stocks.

SECOND AVENUE STOCKS.—That something is going on in Second avenue stock cannot be any longer doubted. For some months certain people have been eagerly picking up every share that has come into the open market and recently orders to buy large blocks of the stock on the quiet have been given to commission houses that are prominent in traction stock dealings. These orders have not been placed directly. They come to the brokers from banks and other indirect sources and it is therefore not an easy matter to ascertain the identity of the syndicate that is after the control of the road. Even two or three large holders of Second avenue stock who have been approached by the emissaries of the syndicate were left in ignorance of the names of the real parties that wanted to purchase their stock. But the overtures are being made and a change in control of the Second avenue railroad company is looked for as the next development in local street railway history. Current quotations for the stock are 130 bid, 134 asked.

THE THIRD AVENUE RAILROAD COMPANY so the STREET RAILWAY GAZETTE correspondent learns from sources of the utmost reliability—is to increase its capital stock $1,000,000 in order to pay for proposed extensions on St Nicholas and Manhattan avenues from One Hundredth and Twenty-fifth street to Kingsbridge and back. It is now $4,000,000, the bonded issue outstanding being $5,000,000. There seems now to be no doubt that the board of aldermen will grant the company what it desires in the way of the contemplated additions to its system. In Lawyer Edward Lauterbach the company possesses an attorney without an equal in this city as a wire puller and diplomatist. A Republican ostensibly in politics he is hand in glove with the influential interests in Tammany Hall and is shrewd enough not to abuse a power that comes in handily at critical moments like this. This is well illustrated by the present condition of affairs in the local street railway situation. The Metropolitan Traction Company has always been noted for its Tammany Hall affiliations, and it is through its connection with the Fourteenth street wigwam that it has so readily obtained the valuable concessions already secured to it. Mr. Richard Croker is understood to have made most of his money through the kind assistance of Messrs. Thomas Ryan, John D. Crimmins and ex-Secretaries Whitney and Elkins and other magnates of the big traction company, and the favor has been reciprocated in the shape of the big franchises granted to the Metropolitan Traction Company in New York. The Traction Company in Sunday's papers published a map showing the extensions of their system contemplated in the near future. One of the routes projected was up St. Nicholas avenue and down Manhattan avenue exactly where the Third Avenue people had already filed application to build. The Third Avenue people being asked about this made answer that both companies had recognized the value of the line in question, and that both had made propositions to the board of aldermen. The property owners, however, had all been induced to favor the Third Avenue road's scheme and they are now confident that their plan will be carried out as originally outlined.

OTHER TRACTION STOCKS have been neglected for the most part. Some small trades have been made in North Shore Traction stock, now quoted at 15 bid, on the showing made for the six months ending March 31, when net earnings were $119,709, an increase over the same period a year ago of $80,824. This was largely due to the big decrease in operating expenses. In the same way the net earnings of the Columbus (Ohio) Street Railway Company, whose stock is largely held East, shows an increase in net earnings for April of 30 per cent., and for the period from January 1 to April 30 of 56½ per cent. Brooklyn street railway stocks have not been in much request either. The Brooklyn City and Newtown Railroad reports a net income, after paying all fixed charges, of $12,699, and the stock holds very steady around 200. Otherwise there is nothing of moment at present in the local street railway field.

KANSAS CITY CONSOLIDATION.—Boston has been devoting most of its attention to the surprising condition of affairs which has just come to the surface in connection with the Kansas City street railway consolidation recently predicted in these columns. The call for deposits of the shares of the Kansas City Cable Railway and Grand Avenue Railway Company of Kansas City for the purpose of bringing into court an alleged consolidation with the Kansas City and Independence Rapid Transit Company, of Kansas City, gives some hint as to the trouble. As the story is made public it appears that certain directors of the three companies, taking advantage of obsolete bylaws, voted to consolidate without notifying stockholders and increased the bonded indebtedness of the three companies from $3,380,000 to $4,660,000 and the capital stocks from $3,875,000 to $4,700,000 of which $2,300,000 was made preferred. The so-called syndicate that "promoted" the deal received for its presumed services $212,500 in bonds, $567,500 in preferred stock and $630,000 in common stock, besides selling to the company for $175,000 preferred stock and $250,000 common stock Washington Park already mortgaged for $100,000 which is alleged to be its full value. The Boston security holders are wild at these revelations and promise to make things interesting for the self-philanthropic promoters.

WEST END STOCK.—Boston has also been buying a little West End railway stock. It is reported that the April income, both gross and net, was the best in many months. The gains over last year were unusually large as compared with recent months. The stock is being picked up in small quantities.

SPECULATION IN PHILADELPHIA has been chiefly confined to Philadelphia Traction stock, but a decision just rendered by the Supreme Court of Pennsylvania in the elevated railroad case has led to a revival of bull feeling on the traction stocks that must soon manifest itself in another movement toward higher prices. The decision of the court is against both the Quaker City and Northeastern roads. The Supreme Court holds that there is no law for their construction, that they are steam roads and as such cannot be operated; that they cannot be built as street railways and their charters are practically void. This decision is regarded as the death blow of elevated railways in Philadelphia and is looked on as a special victory for the Philadelphia Traction Company over whose lines the elevated roads were projected to run. Notwithstanding this good news the stock broke on Tuesday 4½ per cent. The bulk of the selling was liquidation but there were lots of short contracts put out because of the belief that the new stock issue will amount to not less than $5,000,000. The directors have declared a semi-annual dividend of 4 per cent., $2 per share, which is an increase of 50 cents per share, or 1 per cent., in the semi-annual distribution. If this rate is kept up, Philadelphia Traction will be an 8 per cent. stock and 108¾, Tuesday's quotation, will look cheap in a few months. The increase in the dividend is made possible by the rapid growth in the company's receipts since the introduction of the trolley system on the several lines now operated by electricity.

Financial Notes.

Street Railway Stocks.—Valentine & McAvoy, bankers and brokers, 184 Dearborn street, Chicago, said yesterday: "Cable stocks have been dull and featureless and there is practically no change from prices of last week. There has been continued liquidation in the securities of the elevated roads, carrying them down to the lowest prices on record. Some talk about the Illinois Central making a five cent fare to Grand Crossing (but no official confirmation) has made inquries as to earnings of the City Railway Company which we believe are far from satisfactory. Most of traction stocks in Philadelphia have been quite active during the past week. Highest prices were recorded Monday. Metropolitan sold that day at 121 and Philadelphia 113. The Philadelphia Traction dividend was increased Tuesday from 6 per cent. per annum to 8 per cent. The former president of Baltimore resigned yesterday and Gov. Brown of Maryland was elected to succeed him. It is believed that the new president will be able to harmonize street car interests in Baltimore and will look toward a general consolidation of the several systems in that city. The market has been so dull that the last two or three days there is really nothing to write about."

Binghamton (N. Y., Roads Consolidate.—An agreement of consolidation between the Binghamton Railroad, the Court Street and East End Railroad Company, and the West Side Street Railroad Company, forming the Binghamton Railroad Company, has been filed with the Secretary of State at Albany. The directors of the new company are Jerome B. Landfield, G. Tracey Rogers, John Evans, Charles J. Knapp, Frederick E. Ross, George Whitney, Theo. S. Rogers and John P. E. Clark of Binghamton, and Arthur A. Beeves of New York City.

Receiver Appointed in Oakland, Cal.—J. C. Johnson of San Francisco has been appointed receiver of the East Oakland Street Railroad Company, on application of the California Safe Deposit and Trust Company. Mr. Johnson has qualified as receiver and is in possession of the road.

New Incorporations

Niagara Falls, Ont.—John Flett, Joseph Tait, M. P., Toronto; L. C. Raymond, of Welland; R. N. Campbell, of Niagara Falls, and G. W. Pound, of Lockport, are seeking incorporation as the Niagara River Tramway Company to build a cable tramway across Niagara River from either the County of Lincoln or Welland, to the American side of the river.

Bluefield, W. Va.—A charter has been issued to the Bluefield Electric Railway Company, composed of Philadelphia capitalists. The company proposes to build an electric railway about twenty miles in length to connect six towns in the Bluefield coal region of West Virginia. The railway will carry both freight and passengers.

The Co-Operative Electric Railway Company of Chicago has been organized with a capital stock of

$1,000,000, to operate electric railways and to manufacture and deal in electric equipment, etc. The incorporators are Morris S. Evinger, Charles E. Burnap and Isaac T. Dyer.

Summit Hill, Pa.—The Inter County Electric Street Railway Company has been incorporated with a capital of $200,000. Chas. E. Hague, of Philadelphia, is president. The line will connect Tamaqua, Lansford and Summit Hill in Carbon county.

NEWS OF THE WEEK.

Toronto Street Sprinkling.—President McKenzie, of the Toronto Street Railway Company, has made the following proposition for sprinkling the streets: "The Toronto Railway Company will be willing to enter into a contract for the street sprinkling with the city to sprinkle the track allowances, viz., 40 miles or thereabouts of streets, four times per day for 65 cents per mile of street per day, water to be supplied by the city free of charge, and the company not to pay any percentage to the city on this amount. In doing the work for this price it is understood that the whole of the tracks will be done. We would be willing to do some sections oftener and some a less number of times at a proportionate rate, as may be directed by the city engineer."

Raleigh N. C. Street Railway Sold.—The Raleigh street railway was sold for $4,000, May 2, to Dr. J. H. McAden, Col. A. B. Andrews, Maj. R. S. Tucker, the General Electric Company and others. It is stated that such other bondholders or creditors of the present company as may wish to contribute equally with the others to the purchase and re-establishment and operation of the road will be allowed to participate on the same terms as Dr. McAden and his associates. As soon as the sale is confirmed the purchasers state that they will at once begin work to put the road in first-class running order and that it will be operated as soon as this can be accomplished.

Wage Scale Restored in Grand Rapids.—The consolidated Street Railway Company of Grand Rapids, reduced wages on January 1, with the promise if business revived to restore them on May 1. In a recent circular to the employes Manager Chapman says there has been practically no improvement and the receipts of the cars are far below last year. However, as the reduction was made for four months, the scale was restored May 1 as agreed, but with the distinct understanding that the whole scale will have to be readjusted to meet the present conditions unless there is a marked improvement in business before fall.

Clearfield, Pa.—The Houtzdale & Suburban Electric Railway and the Philipsburg & Suburban Electric Railway companies have been recently chartered to operate in Clearfield county. The companies are capitalized at $100,000 each and both controlled by persons in Brooklyn, Philadelphia and Hazelton. The Philipsburg company extends to Morrisdale Mines, Allport, Kylertown, Winburne, Munsin's and Hawk Run, while at Oceola this line connects with the Houtzdale line which runs from there to Amesville, Maderia, Glen Hope, Irvona, Coalport and Janesville.

Chicago, Ill.—The ordinances granting to the North and West Chicago street railroad companies the right to introduce the trolley system were amended at the last meeting of the city council. That portion of the ordinance forbidding the companies to construct an electric road under an elevated structure was amended so that the company is allowed to build a line under the Lake Street Elevated railroad structure. The provision that policemen and firemen should be carried free was modified so that they shall be carried without payment of fares only when they shall be in uniform.

Brooklyn, N. Y.—The state railroad commission has given the Fulton Elevated Railroad Company the right to increase its capital stock from $300,000 to $1,500,000. The money is wanted for the purpose of extending the road to the city line. All that portion of the Kings County Elevated above Manhattan Junction is called the Fulton Elevated, but it is under the management of the Kings County road. When the Fulton is finished it will be consolidated with the Kings County, and as the capital stock of the Kings is $3,000,000 this new addition will make it $4,500,000.

Stillwater (Minn.) Electric Railway Sold.—The Stillwater Street Railway was sold at auction May 7th by Sheriff Marty in Stillwater. A. J. Jenks, a capitalist of the city, started with a bid of $10,000, which was raised to $69,254, this being the amount of indebtedness against the road and the costs. The property was struck off at that figure to Judge Nethaway, attorney for Allen G. Curtis, who is trustee for the bondholders. Receiver Hewitt will be immediately discharged and the road continued as heretofore.

Chicago, Ill.—The condemnation suit of the Metropolitan L road against the West Chicago Street Railroad Company, which was on trial more than a week before a jury in Judge Gibbons' court, ended May 8. The defendant claimed damages for something more than $600,000 for the L road's right of way across the mouth of the Van Buren street tunnel and for crossing certain property on Clinton street. The jury gave damages amounting to $307,236, of which $204,236 was for crossing the tunnel and $103,000 for running over the Clinton street property.

Minneapolis, Minn.—The Harvey ordinance, in accordance with which conductors issue transfer slips on cars, went into effect last week and it seems to give general satisfaction. Previously the transfer slips were issued at certain points by transfer agents. The system was not popular and the council passed the Harvey ordinance. The company claimed it had no right to impose such a condition on the company, and resisted its enforcement. Subsequently it withdrew its opposition and agreed to conform to the terms of the Harvey ordinance.

Philadelphia, Pa.—The Delaware County & Philadelphia Electric Railway Company put its trolley road in operation this week and cars are running regularly on Baltimore avenue between the city line at Cobb's creek, through Fernwood, Lansdowne and Clifton to Primos, a distance of nearly four miles. By the first of July it is expected that the road will be completed to Swarthmore, and eventually it will be extended to Media. Entrance into the city will be effected as soon as the Electric Traction Company builds its road out to Baltimore avenue.

Akron, O.—Meetings were held last week in the interest of the proposed electric railway from Cleveland to Akron. Among those interested in the project are Capt. T. K. Dissette, Hon. Martin Dodge, C. G. Canfield and F. N. Wilcox of Cleveland, and C. L. Dunbar of Brecksville. The proposed road is about twenty-nine miles in length and about $300,000 will be required to construct it. The farmers along the line, who are all anxious for the road will be asked to contribute $50,000 toward the enterprise payable in three installments.

Marion, O.—The Electric Street Railroad Company has been incorporated with a capital stock of $100,000, and the following directors elected: Gottfrey Leffler, Edward Durfee, S. E. Barlow, Charles Leffler, George Turney, Henry Streiltz and E. Huber, and they organized by electing Edward Durfee president and treasurer, Gottfrey Leffler vice-president, and George Turney secretary. Twenty-one thousand dollars of the capital stock has been paid, and the road will be a go.

St. Louis, Mo.—A bill has been introduced in the city council authorizing the Manchester Road Electric Railroad Company to construct tracks from Manchester road and Sarah street to Forest Park boulevard, to Grand avenue, to Chestnut, to Twentieth, to Pine, to Seventh street. The company is to pay $1,000 per year after five years and $2,000 per year for the ensuing five years, and then 3 per cent. of the gross earnings, not to be less than $3,000 per year. The franchise is asked for a period of forty years.

Chicago, Ill.—Residents of the suburb of Lake View have commenced injunction proceedings against the North Chicago City Railway Com- and the North Chicago Street Railroad Company. They seek to enjoin the defendants from constructing and operating a street railway upon Evanston avenue between Graceland avenue and Dewey court by "electric motive power" unless under an ordinance "based upon a petition giving the consent of the owners of a majority of frontage."

Leavenworth, Kans.—The board of county commissioners has granted the Leavenworth Electric Railway Company a franchise to build its Soldiers' Home and Mt. Muncie extension. The line will be built on the west side of the Kansas City road from Limit street to the south limits of the Soldiers' Home reservation and from that point north along the south side of the road, running north and south to Mt. Muncie. The franchise is for a period of twenty years.

Norwalk, O.—A number of gentlemen who are interested in building an electric railway from Norwalk to the southern part of Huron County made an inspection of the proposed route last week. Among those interested are: G. H. DeWitt, A. W. Prout, W. H. Gilcher and T. B. Taylor, of Sandusky, and Mayor Greene, S. E. Crawford, W. H. Price, H. H. Hoyt, C. H. Stewart and James G. Gibbs, of Norwalk.

Philadelphia, Pa.—The work of converting the Roxborough, Wissahickon and Manayunk Inclined Plane into a trolley line has been begun with the expectation that the road for a distance of five and a half miles will be ready for use in three months and at a cost of probably not more than $60-000. The power station will be constructed at Shawmont station. Westinghouse apparatus will be installed. The Brill Company will furnish the new cars.

Gettysburg, Pa.—The Government Commission has served notice on President Hoffer of the Gettysburg Electric Railway Company that the United States would condemn every portion of the railway that is on ground which was occupied by Federal or Confederate troops. This, it is announced, will remove the lines from the "Valley of Death," the side of "Little Round Top," and along "Hancock's Front."

Rochester, N. Y.—Work is progressing rapidly on the new power house of the Grand View Beach Railroad Company, which is to replace the station which was destroyed by fire about a year ago. The structure, which is 63 by 109 feet, is located at Rigney's Bluff half way between Charlotte and Manitou. General Electric multipolar generators and McIntosh & Seymour engines will be installed.

Brooklyn, N. Y.—The Brooklyn Heights Railroad Company, operating all the lines of the Brooklyn City and Broadway railroad companies, has divided its system into the Eastern and Southern districts. The latter will be in charge of J. C. Cameron, who has been general superintendent. W. N. Morrison has been made superintendent of the Eastern District system.

Davenport, Ia.—On May 5 the first electric car crossed the Mississippi on the government bridge connecting Davenport with Rock Island. For five years the Davenport and Rock Island Railway Company, composed of Chicago capitalists, has been working to this end. This is the only electric line across the river below St. Paul, aside from St. Louis.

Chicago, Ill.—Judge Stein has dissolved the injunction restraining the West and South Towns Street Railway Company from laying its tracks on Twenty-second street between Johnson and May streets. Within thirty days, it is said, the road will be in operation in Twenty-second street from Lawndale to the river.

Canandaigua, N. Y.—The trustees of the village of Canandaigua have granted the Canandaigua Electric Light & Street Railroad Company permission to operate an electric road in that village. It is expected that the road will be in operation within two months.

Dividend.—The Berlin Iron Bridge Company paid on April 14 its regular quarterly dividend of 1½ per cent. Considering the hard times in all branches of business, especially among manufacturers of structural iron, this is a good showing.

Washington, D. C.—An experimental consolidation of the Georgetown and Tennallytown road with the Bethesda line went into effect last week and will be continued for several weeks to ascertain if any beneficial results will accrue.

Youngstown, O.—Work has been commenced on the Youngstown Park and Falls railway.

PERSONAL.

Merged in the Manhattan New York.—There has been filed in the office of the Secretary of State at Albany a certificate of merger of the Metropolitan Elevated Railway Company with the Manhattan Railway Company. The certificate states that the Manhattan Company, being the lessees of the Metropolitan Company, has taken a surrender of the stock of the Metropiltan Company and issued in exchange therefor its stock at the rate of 110 shares of its own stock, for 100 shares of the stock of the Metropolitan Company in pursuance to an agreement dated August 1, 1884. The surrendered stock aggregates 65,000 shares.

Sale of Nashville United Electric Branch Lines.—The extension lines of the United Electric Railway Company of Nashville, Tenn., were bought last week at public sale by I. T. Rhea for $8,100. The last bid of the owners of main lines of the system was $8,000.

Dr. William T. Barnard, the first president of the South Side Rapid Transit Company, died on May 10. He was obliged to discontinue his relations with the company a year ago because of ill health.

F. S. Haskins has resigned the position of superintendent in St. Paul for the Twin City Rapid Transit Company, and Dow S. Smith of Minneapolis has been appointed temporarily to fill the place.

James R. Chapman, General Manager of the Grand Rapids Consolidated Street Railway Company has resigned his position to assume charge of the electrical construction of the North Chicago Street Railroad Company.

John F. Ostrom, of the Pennsylvania Steel Company, Philadelphia, was in Chicago.

Dearborn, Mich.—The village of Dearborn, has granted the Toledo, Monroe & Detroit Electric Railway Company a thirty-year franchise through the village streets.

Thomas H. McLean, manager of the Citizens' Street Railway Company, of Indianapolis, was in Chicago this week.

Foree Bain of the Great Western Manufacturing Company of Duluth, Minn., was in Chicago this week.

Allen R. Foote, of Washington, was in Chicago this week.

TRADE NOTES.

The Berlin Iron Bridge Company of East Berlin, Conn., is putting up a gas house extension for the Brookline Gas Company at Allston, Mass. The new terminal facilities for the New York, New Haven & Hartford R. R., at Providence, R. I., will necessitate two large bridges which will be furnished by the Berlin Iron Bridge Company. These bridges will carry 16 tracks over Gaspee street, Promenade street and Woonasquatucket river. The bridges will be of plate girders resting on abutments at the street line and columns at the curb line. There will be no floor beams or stringers used, but in place of these will be a metal floor supporting the ballast in which the ties and rails will be bedded. The work will require about 4,500 tons of open hearth steel material. The Berlin company is to be allowed six months in which to complete the work.

The Crescent Electric Company, Chicago, has been organized with Walter H. Adams, president and treasurer; C. Cohenour, secretary; Henry F. Elshoff, superintendent. The company will confine its work to repairing armatures, fields, transformers and commutators, and will be prepared to handle work of this class of any make or description with promptness and satisfaction. It will make a specialty of street railway work. The company's place of business is 18 to 30 West Randolph street.

The Wallace Electric Company, Chicago, is located in its new quarters at 307 Dearborn street. The company carries a complete line of street railway supplies. The W. W. lightning arrester is receiving a large share of attention at the present time. It is made for railway and lighting circuits and the company claims that it is thoroughly effective and cannot get out of order.

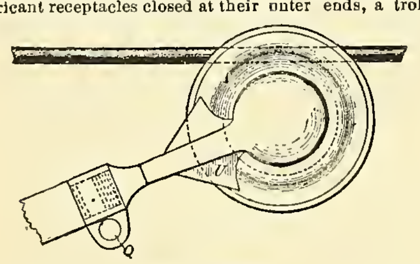
The Chicago Electric Truck Company reports the outlook for a good summer trade excellent. They have recently placed one truck in Dayton, Ohio, and another on the Chicago City Railway; and the orders which they are now filling seem to show that the principles of their "A" truck are being appreciated by progressive street railway men.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued May 1, 1894.

518,952. Trolley for Electric Railways. George W. Hooper, Rochester, N. Y., assignor by direct and mesne assignments, to James S. Baker, same place. Filed June 1, 1893.

A trolley comprising a divided yoke frame, bushings provided with lateral openings, located in the frame within lubricant receptacles closed at their outer ends, a trolley



NO. 518,952.

wheel having an axle revolving in the bushings, and springs in the bushings bearing against the ends of the axle and the bottoms of the lubricant receptacles. (See illustration.)

518,972. Switch Actuator for Street Cars. Fletcher Sparling, Boston, Mass. Filed June 17, 1893.

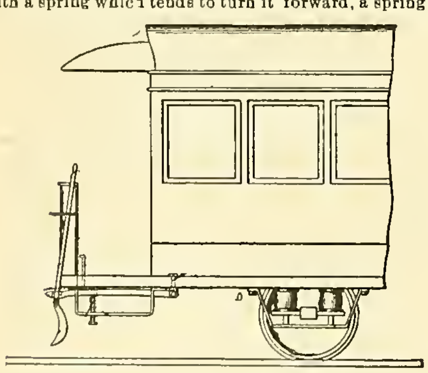
In a switch actuator for street cars, a yielding support connected to the car, and normally elevated, combined with an actuator connected to said support and adapted to be swung laterally and provided with an operating handle, and independent means to positively depress the support and the actuator. (See illustration).

519,031. Electro-Magnetic Variable Speed Gearing. William W. Beaumont, London, England. Filed March 8, 1893.

Variable speed transmitting gearing comprising a revoluble shaft, a multipolar magnet fast thereon, transmitting wheels of different diameters loose on said shaft, an armature rigidly connected with each of the wheels, each armature facing a pair of poles of the magnet, a friction device of suitable material interposed between the armatures and their magnet poles, and suitable electrical connections for energizing the magnet coils independently of each other.

519,046. Safety Guard for Street Cars. Stephen Norton, Rochester, N. Y., assignor of one-half to William H. Rice, same place. Filed August 7, 1893.

The combination, with the car, of a supporting frame at the end of the car, a roller resting in the frame provided with a spring which tends to turn it forward, a spring bar



NO. 518,972.

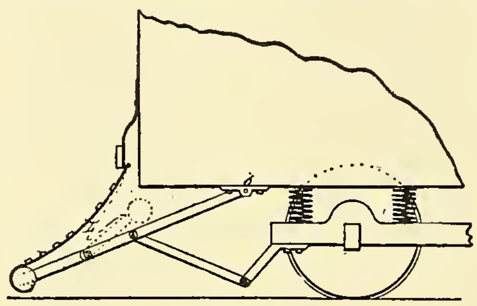
attached to the end of the car, and a flexible covering attached to and partially wound on the roller at one end and attached to the spring bar at the other. (See illustration).

519,066. Platform Gate for Cars. John Krehbiel, Cleveland, O. Filed May 3, 1893.

In a car the combination with a platform, of a swinging gate therefor, a spring for normally holding the gate closed, a movable step, a locking rod with which the step has a limited sliding engagement, a stop actuated by the rod, and arranged to support the step upon a partial actuation thereof, and to release the same upon the full movement of the locking rod, and a bell crank actuated by the continued movement of the step for forcibly opening the gate.

519,082. Railway Switch. Christopher Froelich, Brooklyn, N. Y. Filed January 5, 1894.

The combination, of an actuating rail that is fulcrumed at one end and slightly lifted above the track rail at the opposite end, a weighted counterbalancing lever below



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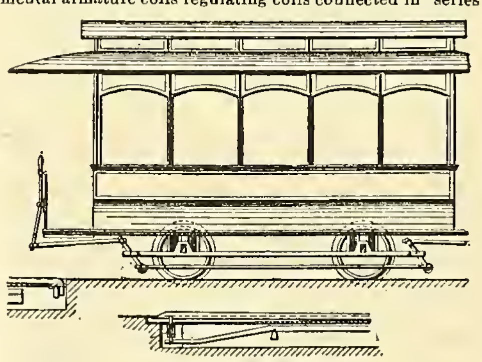
the actuating rail, a switch tongue operating mechanism having a vertically sliding member that is engaged at its upper end by said actuating rail, at its lower end by the counterbalancing lever, and a pivoted switch tongue that is connected to said mechanism. (See illustration).

519,097. Field Magnet for Electric Machines. Albert Schmid, Allegheny, assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed December 7, 1889.

In an electric generator or motor for alternating currents, field-poles composed of laminæ of sheet iron, a frame for said poles of cast-iron cast about the laminated pole pieces, certain of the laminæ projecting into the cast iron frame a greater distance than the others.

519,098. Self-exciting Constant Potential Electric Generator. Albert Schmid, Allegheny, and Benjamin G. Lamme, Pittsburgh, assignors by mesne assignments to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed February 20, 1890.

In a self-exciting alternating current electric machine the combination of an armature core having supporting spokes, main armature coils wound upon the core, supplemental armature coils regulating coils connected in series



NO. 519,082.

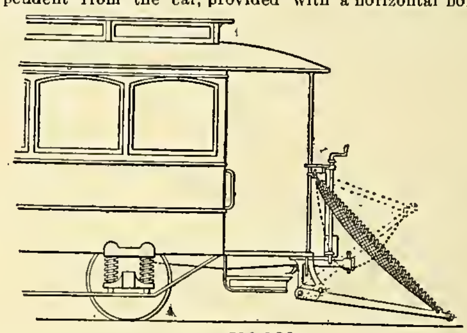
with the main armature coils and wound upon the said spokes regulating coils connected in series with the supplemental coils and wound upon the said spokes and a conductor through which the connections are made from the supplemental coils, with the field exciting coils.

519,115. Electric Railway Conductor Support. John C. Henry, Westfield, N. J. Original application filed September 27, 1889.

The supports or hangers for the working conductors of an electric railway, of spring material made weaker or less tense on the extreme end than at other parts, so as to automatically adjust themselves to the varying bends of the working conductors.

519,128. Car-Fender. Samuel C. Kindig, Baltimore, Md., assignor of one-half to Lee Biden, same place. Filed October 9, 1893.

A car fender having a frame consisting of side bars and forward end bar, the side bars being pivoted to brackets pendent from the car, provided with a horizontal bolt



NO. 519,128.

passing through sa'd brackets and engaging the top of said frame to hold it normally down, and springs for raising it when released by the withdrawal of the bolt. (See illustration).

519,188. Commutator Brush. Rudolph Kersberg, Hohenlimberg, Germany. Filed January 8, 1894.

A commutator brush comprising a metallic cloth or fabric formed of wire spirals screwing one in the other, and single wire spirals inclosed in the said fabric.

519,280. Electric Generator. William Baxter, Jr., Baltimore, Md. Filed May 12, 1891.

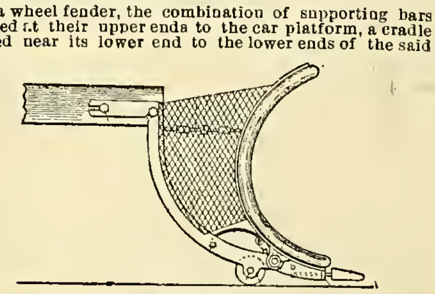
The combination of the frame, the field magnets mounted on the frame, the shaft fixed rotatably in the frame, the armature and commutator mounted on the shaft, the sleeve between the armature and commutator and the nut on the shaft, impinging against the commutator, whereby said armature and commutator are secured.

519,281. Electric Motor or Generator. William Baxter, Jr., Baltimore, Md. Filed May 12, 1891.

In an electrical machine of the character stated, the combination of the base, the standard and spider, extending from the base, the bearing supported upon said standard and spider, the shaft journaled in the bearing and carrying the pulley, armature and commutator, and the field magnets supported on the spider.

519,289. Wheel Guard or Fender for Cars. James F. Morton, Baltimore, Md., assignor by direct and mesne assignments of one-half to William H. H. Anderson and Nicholas S. Hill, Jr., same place. Filed November 23, 1893.

In a wheel fender, the combination of supporting bars secured at their upper ends to the car platform, a cradle hinged near its lower end to the lower ends of the said



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supporting bars and springs to yieldingly hold the upper part of the cradle from or away from the said supporting bars. (See illustration).

519,291. Electric Railway. William B. Purvis, Philadelphia, Pa., assignor of one-half to Halsey J. Tibbals, same place. Filed April 14, 1893.

A car with hangers, axles mounted on rods guided in said hangers, springs in connection with said rods, wheels on said axles, a bar supported on said rods and carrying brushes contacting with said axles, and an electromagnet suspended from said bar.

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CONTENTS.

The Institute Election. The annual election of officers for the American Institute of Electrical Engineers took place early in the week at the annual meeting in Philadelphia, and resulted in the choice of the council ticket, headed by the former president, Professor Edwin J. Houston. Although considerable opposition developed in certain quarters, resulting in the casting of a good many scattering votes, the election of the council ticket certainly shows that the members have every confidence in their ability to direct the affairs of the Institute in the best and most intelligent manner. Whatever the opposition may have been, we feel sure that every member will join in supporting the new officers in their efforts to increase the already widespread influence of the Institute, and to assist in increasing its usefulness as the representative electrical engineering society of the United States. The result of the successful establishment of local meetings in Chicago will doubtless lead to the holding of similar meetings in other cities where there is a sufficiently large membership to warrant it, and there is probably no better way in which the Institute can increase its usefulness than by thus extending the privileges of its meetings to members outside of New York City.

Cities and Street Railway Companies. There is one time each year when mayors of cities concede that municipalities owe much of their material prosperity to street railway companies. This admission is always to be found in the address of welcome which is given usually by a municipal officer before the convention of the American Street Railway Association; but except on this single occasion city officials seem little inclined to believe that the companies are entitled to any sort of consideration. There are many instances that might be cited to support this statement at the present time. Milwaukee is considering an ordinance compelling the local company to reduce the fare to three cents, although the interest on the bonds has not been paid for six months and the owners of these securities have been obliged to agree to waive their interest for a period of eighteen months. Detroit is considering ordinances that insist upon the sale of tickets at the rate of eight for 25 cents, although the company is finding it necessary to retrench in order to meet expenses. Ordinances compelling the companies to extend their free list by carrying mail carriers without charge have been proposed in Chicago, although the quarterly reports of the roads show that the receipts have fallen off materially. But it is unnecessary to multiply instances; examples come to light almost daily. It is manifestly unfair, to put it mildly, to impair incomes at the present time when business is poor at the best. It is too much like striking a man when he is down. If municipalities must saddle new burdens upon street railway companies, they should delay action until the business is more prosperous than, unfortunately, it is at the present time.

Westinghouse Company's Report. The annual report of the Westinghouse Electric and Manufacturing Company was issued this week to its stockholders. The report is an exceedingly satisfactory one in many respects. The period covered is the year ending March 31, 1894. The report shows that the company's prosperity for the year, notwithstanding the fact that this period included nine months of financial depression, was somewhat in excess of the preceding year. The balance sheet shows an increase in earnings of $118,687. Mr. Westinghouse reports to the stockholders that the World's Fair contract for lighting amounted to $399,000, to which about $89,000 was added for extras. The entire cost to the company, after charging the account with cost of labor and material, plus 20 per cent., was $16,000 above the total receipts, and this is very justly considered a very small outlay for the elaborate exhibit made by the Westinghouse Company at the World's Fair. The report points out the success of the Westinghouse company in securing the contract for three 5,000 horse power generators for the Niagara Falls power plant. Reference is also made to the success of the company in supplying non-infringing incandescent lamps to its customers. The new works of the company will soon be completed. These are located upon a site of 23 acres, and contracts were let for their erection at a very satisfactory figure owing to the general depression of business, resulting in cheap labor and low cost of material required. A two-story machine shop, 750 feet long and 230 feet wide, a two-story warehouse, 750 feet long and 75 feet wide, and a boiler and power house make up the new plant, the whole having a floor space of over ten acres. Considering the admirable location of Pittsburg in regard to the material required for the construction of electrical machinery and for the shipment of the finished product, this plant will certainly place the company in a position to meet whatever competion is necessary. Perhaps the most incomplete part of the report is the absence of definite figures as to the items entered under assets, including bonds and stocks, and charters, franchises, patents, etc., these three items together making between eight and nine millions of the total assets of $14,700,000. The management of the Westinghouse company is certainly to be congratulated upon the excellent way in which it has survived the general business depression of the last year. Its position is certainly on this account much stronger than many other companies engaged in the business of supplying electrical apparatus.

Attack on Pennsylvania Trolley Lines. The sweeping decision of the Supreme Court of Pennsylvania which declared that no law of the state authorized the construction of elevated passenger railways seems to be regarded in Philadelphia as a severe blow to the material interests of the city. Several projects of a promising character have been very effectually killed and the New Yorkers who intended to devote millions to the purpose of improving the transit facilities have determined, after an expenditure of $300,000 for material, litigation and experience, to abandon the field without further struggle. Some of the local papers are disposed to look at the matter philosophically, and advocate such legislation as will make the construction of the roads legal beyond all controversy. Other journals in Philadelphia in their bitterness proceed to the length of attacking the Supreme Court; one of them for example asserts that the doubts upon which the court was called to pass were so evenly balanced that it would have been justified in deciding either way; it was free to "promote the public interest, but it chose the worse part and by a narrow and technical construction it has given a foul blow to the interests of Philadelphia. Among the many requisites for a new Philadelphia would seem to be a broader-minded State Supreme Court." The Philadelphians are certainly fortunate at the present juncture in possessing an excellent system of surface transportation which is extending daily in every direction, but the statement has been made that the people are not justified in experiencing any feeling of confident satisfaction on this score. The contention has been made that the decision is so sweeping in its provisions that it may apply to trolley roads as well as elevated railways, and threaten the very existence of the former. This position seems absurd in view of the fact that such a vast amount of money has been invested in trolley roads by men who are not likely to engage extensively in enterprises of any sort unless they are assured that they are fortified against legal attacks. The ground on which it is claimed that the trolley roads may be assailed is the broad assertion in the court's decision that there is no law for an elevated passenger railroad "overhanging the street." It is argued that the overhead trolley system is an "overhanging" system, inasmuch as its power is supplied overhead, and to come within the terms of the court's definition of a "surface road" it must be wholly upon the surface without overhanging parts. This contention, it seems to us, is decidedly far-fetched, with all due deference to the eminent Philadelphia lawyers who are said to find that the decision includes the trolley in its prohibitory scope. We believe it to be true that the Supreme Court has held that the operation of the surface lines by the trolley system was only an immaterial variation from the old means of operating them by horse power. The court is not likely to go out of its way to modify that conclusion in order to attack a vested interest. From a common sense point of view there is all the difference in the world between an elevated railway and a railway operated by an overhead wire, and only by a curious course of technical reasoning could they be placed in the same category. Philadelphia lawyers are proverbially fond of discovering and arguing fine technical points of this description, but we fancy that no surface road investor in Pennsylvania will grow anxious because of the discussion of this new contention.

GETTYSBURG RAILWAY CASE.

A hearing took place in Philadelphia on Tuesday in the proceedings instituted by the United States to preserve the Gettysburg battlefield. A motion was made to condemn a strip of land two miles long forming the right of the Gettysburg Electric Railway Company and for an injunction restraining the company from continuing its construction. It has been claimed that the railway if built will mar features of historic interest on the field of the battle. This allegation the company denies, and its answer to the charges contained in the petition and bill in equity presents its side of the case. It sets forth that the company was incorporated in 1889 and asserts that the supervisors of Cumberland township, Adams county, have consented to the construction of the extension and by five deeds it has acquired a strip of land, over 6000 feet in length, as part of its right of way and that this tract is the subject of these proceedings.

Upon it the railway has been constructed and is in full operation in connection with the main line. The condemnation of this strip will cut the extension in two and prevent its further operation, and the company, not having the power of eminent domain, cannot obtain from the Gettysburg Battlefield Monument Association, the owner of the adjoining ground, the right to complete its line in any other manner.

Denial was made that the lines of battle and the leading tactical positions referred to in the act of Congress were changed, disfigured and destroyed by the construction and operation of its railway line, as the same has been constructed and is now being operated. Denial was also made that the lines and positions are truly and accurately indicated and shown upon the blue print which was annexed to the petition. It was stated upon information and belief that the route of the extension or branch of the defendant's railway as located and constructed has been arbitrarily marked and designated as being coincident with the lines and positions, in order that it may seem to appear that, in fact, the two occupy the same ground. The strip of land, the defendant alleged, is sought to be appropriated to break up the construction of the defendant's line of railway upon the battlefield. The court took the papers and reserved decision.

ATTACK ON THE KANSAS CITY CONSOLIDATED.

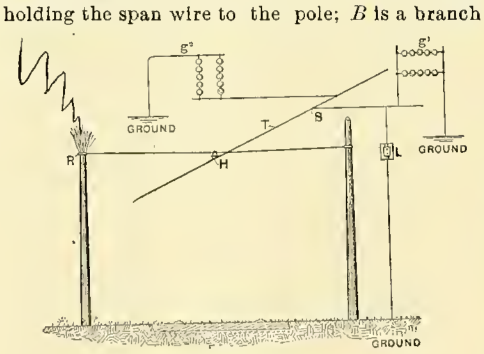
As stated in the last issue of the STREET RAILWAY GAZETTE minority stockholders of the Grand Avenue and Kansas City Cable Railway Companies have instigated proceedings, the object of which is to test the legality of the consolidation of the companies. At the instance of the stockholders the attorney general of Missouri instituted last week quo warranto proceedings against the officers and directors of the Kansas City Railway Company, which is the consolidated company. The petition which has been filed in the case not only alleges many irregularities in the manner of forming the combination, but cites statutes to prove that the combination itself is unlawful. The petition makes the sensational charge that $1,410,000 in preferred stocks and bonds were paid to the promoters of the consolidation for their services in putting the deal through, and cites itemized figures to prove the charge. The claim is made that the persons who bought the original Kansas City cable road from Mr. Smith at a "sum above par," expected to be reimbursed for the difference between the purchase price and the market value of the stock by receiving stock and bonds in the consolidated company, secured not only by the Kansas City Cable company's property but also by the Grand Avenue Cable Railway.

The petition, furthermore, charges improper procedure asserting that the proposed consolidation never came before any stockholders' meeting of either the Kansas City or Grand Avenue Cable companies; that neither of the companies filed the necessary resolutions with the secretary of the state as provided for by law, and that no public notice was given the stockholders of any meeting for the purpose of consolidation; that the consolidation was made without the knowledge of the holders of 5,000 shares of the Grand Avenue stock and at least of 4,000 shares of Kansss City stock.

The petition asserts that under the state constitution there is no power by which street railways can be consolidated. It also claims that in none of the cities in which the alleged consolidated road operates, has assent been given either the Grand Avenue Cable company or the Kansas City Cable company to transfer their charters under guise of a consolidation; that section 20, article 12 of the constitution specifically states that no charter may be transferred without the assent of the city by which the charter was granted. It also claims that the consolidation was made contrary to many other laws of the state, and that it is legal in no possible way.

RAMIFICATIONS IN A LIGHTNING DISCHARGE.

In the course of his paper on lightning arresters before a recent meeting of the American Institute of Electrical Engineers, Alexander Jay Wurts presented a photograph of a lightning discharge showing ramifications wandering off from the main path, as he said, in a seemingly aimless manner. Mr. Wurts remarked that he was inclined to believe that at times the ramifications from the main discharge found their way into electrical circuits. The figure illustrates a curious freak which is attributed to this cause. In the cut, *T* represents an overhead trolley wire, on either side of which are wooden poles; *H* is a bell-shaped insulator made of compressed mica and shellac. These insulators easily withstand an electric strain of 12,000 volts; *R* is an iron ring holding the span wire to the pole; *B* is a branch



CURIOUS FREAK OF LIGHTNING.

circuit feeding current to a group of lamps g^1, and *L* is a lightning arrester in its discharge circuit; g^2 is a group of lamps. The distance between *H* and *B* is about 50 feet. After a violent thunder storm it was noticed that one of these poles had been shattered from the top down to the iron ring, the remaining portion being uninjured. This had been done by lightning, and in the opinion of the writer, by one of the ramifications to which allusion has already been made. In any case, this discharge, whatever it may have been, passed over the span wire to the bell insulator *H*, piercing it and breaking it into three pieces, then traveled along the trolley wire to *B*, where it apparently divided, one part passing to the group of lights g^2, breaking them all, ten in number, and the other part to earth through the arrester *L*, without in any way interfering with the group of lights g^1. It is quite remarkable to note that none of the parts damaged by this discharge showed any indications of heat.

Kansas City, Mo.—W. J. Smith, formerly president of the Kansas City Cable Railway Company, has decided to rebuild the old East Fifth street railway, equip it with electricity and build extensions.

EARNING CAPACITY OF THE PHILADELPHIA TRACTION COMPANY.

The semi-official announcement that the capital stock of the Philadelphia Traction Company will be increased 100,000 shares ($5,000,000) next month has created discussion as to the company's ability to maintain the present dividend rate of $2 per share. When the new stock shall have been issued there will be outstanding, in round figures, 300,000 shares, representing $15,000,000. To pay the present dividend will require $1,200,000 per annum. For the last fiscal year the receipts of the company were $4,986,838, while operating expenses amounted to $3,310,498. It has been claimed, says the Philadelphia *Stockholder*, that through the operation of the trolley there can be saved from 30 to 40 per cent. in operating expenses. Taking the lesser figure there would, therefore, be saved, on the basis of last year's expenses, about $993,000, which would reduce the cost of operating the system to $2,317,000. It is further estimated that rentals this year will amount to, say, $1,300,000, making the total expenditures for the year $3,617,000. So far this year earnings have increased an average of $600 a day, and if this should be continued the remainder of the year (a low estimate) the receipts for the year should be $219,000 over those of last year, or $5,205,838. Operating expenses and rentals, according to the above estimate, would amount to $3,617,000, so that net earnings would be $1,588,838, as only $1,200,000 will be required for dividends, there will remain, therefore, an apparent surplus of $388,838. This, of course, is only a rough estimate. The company may not be able to effect a 30 per cent. saving in operating expenses, but against this, it should be remembered, that nearly a dozen additional lines are to be trolleyed this year, which will undoubtedly augment the present earning capacity, so that, for the purpose of estimate, we allow one item to offset the other. The result indicates, therefore, that the company can readily maintain its present dividend on the increased capital.

IMITATION OF AMERICAN MACHINES.

J. C. Monaghan, United States consul at Chemnitz, has sent to the state department the following report regarding the imitation of American machinery in Germany:

Some time since a manufacturing company of the United States wrote me relative to a Chemnitz man who had bought six of their pumps, alleging a purpose to sell them here and asking an exclusive agency, requesting at the same time that the company put his shield on the machines. He had seen the pumps at Chicago, liked them, and looked up the company on his way back. It is needless to say that the Chemnitzer is not an agent, but a manufacturer; that his intention was to take the machines apart, construct others like them, and get all the good out of such sales as he could before somebody else should forestall him in his purpose. Upon receipt of the letter I looked up the matter, found my suspicions confirmed, and after some trouble got and sent the company the information, plus one of the Chemnitzer's own catalogues. The company wrote again asking whether the Chemnitzer was making the pumps or not, and I learned upon inquiry that he boasts about how he got his pumps, and that he intends to get more American machines in the same way and copy them.

Of the six bought of the company in question he sold four. These serve as excellent advertising pumps. The other two serve as models. He is making fourteen, or was a week ago.

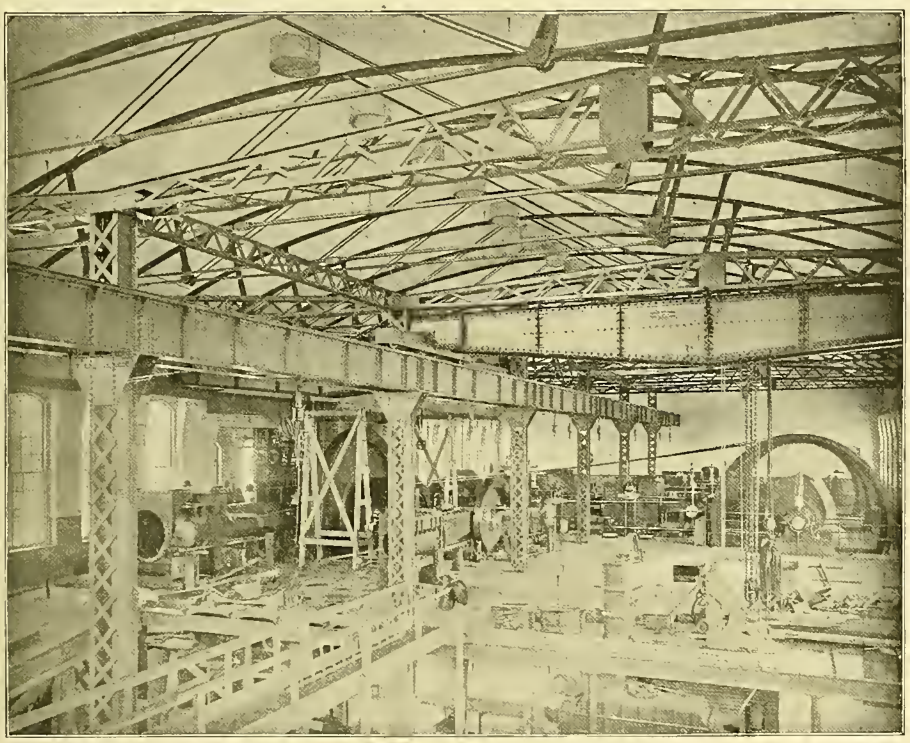
I deem it my duty to tell all this to the department, because so many Americans neglect to take out foreign letters patent for their machines.

The Chemnitzer of whom I have spoken says he can make his pumps, *i. e.*, the American company's triplex pump, 20 to 25 per cent cheaper than he can get them from the company, and that Germans prefer to buy German-made rather than foreign goods. He said further that he hoped to hold the home market by keeping the company's pump out of the hands of his competitors in the empire.

San Jose, Cal.—The Mayfield & Stanford University Railway Company has been incorporated.

UNION RAILROAD COMPANY, OF PROVIDENCE, R. I.

The street railways of Providence and Pawtucket, R. I., are now under the control of a single company, the Union Railroad Company of the former city. Of the total mileage of over 100 miles of track fifteen are entirely in Pawtucket, where horse cars at the present time are exclusively used. The track is all narrow gauge—four feet—and three rails are laid on the street traversed by both the Pawtucket and Providence cars.



INTERIOR OF THE PROVIDENCE STATION.

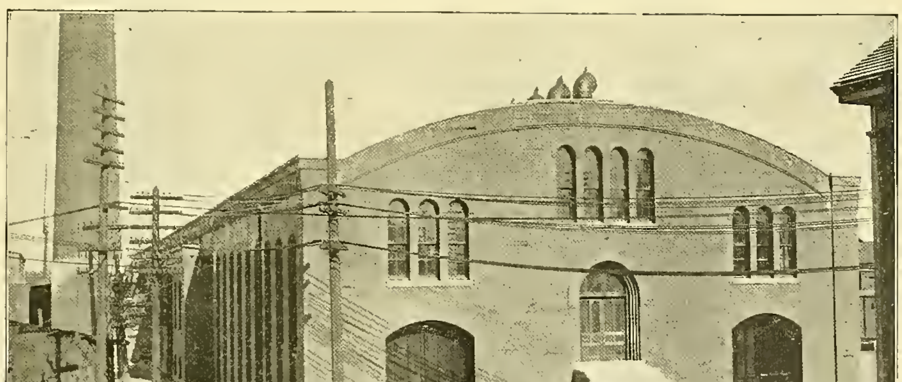
The Pawtucket lines are to be electrically equipped and work has just been begun. The power will be supplied from the power station in Providence, which is located five miles from Pawtucket. It will be necessary to run feeders nine miles in length to reach the farthest points in the Pawtucket system.

The street railways of Providence are all operated by electricity with a single exception. On one of the routes the grades are so heavy that it is impossible to mount them by motor cars, and on the steep section of the line a cable is used. The cars on this route are equipped with single motors which furnish sufficient power until the heavy grade is encountered. At this point they are attached as trailers to grip car. The ascent starts with a rise of 14 per cent. and the maximum is $16\frac{1}{2}$ per cent. This combined arrangement is found to work admirably.

The company has 161 motor cars which are equipped with G. E. 800 motors and K controllers. About half the motors have drum armatures and the remainder ring armatures. The electrical apparatus has proved more than satisfactory and during all the storms of the winter cars were operated without difficulty. The car bodies were all constructed by J. M. Jones' Sons with the exception of a few that were built in the company's shops. The cars are mounted on a variety of trucks, among which are the Peckham, Brill, Graham, Taylor and the new Manier. The last named truck, which was designed by one of the employes of the company, has been practically adopted as standard.

In the new track construction Wharton ninety-pound girder rail has been used and all the girder rail which has been laid since electricity was introduced is of the same manufacture, but some of it is of a lighter section than that which has lately been placed. There is in the system considerable T rail which was laid when horse cars were in use. This gave admirable service when the old cars were operated, but it is found to be too light at the present time. The flanges on the wheels at many points strike the paving blocks, as they are three-quarter inch while the flanges on the horse car wheels were half-inch. The T rail will be gradually replaced by Wharton girder of a heavy section.

The company has been fortunately bothered but little by complaints of electrolytic action. From the outset it has been the policy of the management to be liberal in the matter of copper. As many overhead returns are used as feeder wires, so that the rails are given comparatively little to do. The returns are tapped into the rails at varying distances ranging from 200 feet to 500 feet or more, in accordance with the amount of traffic.



EXTERIOR OF THE PROVIDENCE STATION.

The rails are bonded with a No. 0 tinned copper wire. The company is hopeful that its liberal use of copper wire may enable it to escape from electrolytic troubles.

The power for operating the system is generated in the station on Eddy street, which is conceded to be one of the finest electric railway plants in the country. The design, which embodies many excellent features, was that of F. P. Sheldon of Providence. The structure, which is of brick, is 275 feet long by 76 feet 8 inches in width, and the shaft is 200 feet in height. The building stands upon made ground and rests upon over 2,800 piles. For the shaft foundation 200 piles were driven.

The plant is not yet finished, and considerable timber may be seen in the interior of the building, but when it is completed it will be as nearly fire-proof as it is possible to construct a building and no woodwork will be in use except that in the window frames. The roof is of unusual construction. It is built with a single span of bow string arch girders enclosed with hollow tile and covered with asphalt and gravel. The boiler room is separated from the engine room by a partition wall 106 feet from the lower end.

Steam will be generated in five batteries of Babcock & Wilcox boilers, and one battery of Stirling boilers, each battery being composed of two boilers of an aggregate capacity of 500 horse power.

At the present time the power is furnished by three tandem compound engines of 800 horse power, the cylinders being 26 and 38 by 48 inches. These are belted directly to three M. P. 500 General Electric generators. The engines are the improved Green built by the Providence Steam Engine Company.

At the present time two engines directly coupled to generators are being installed, and one of the pair is about ready for operation. These engines are similar in appearance and in general design to the large direct coupled engine in the Intramural power station at the World's Fair. The engines, which are of the Green type, made by the Providence Steam Engine Company, are 26 and 48 inches by 48 inches, and their nominal capacity is 1,200 horse power each. The two generators to which the engines are coupled are ten pole 800 kilowatt machines built by the General Electric Company. Following are some of the weights and dimensions of parts of the genertors:

Weight of armature 22 tons.
Diameter of armature 8 feet.
Weight of fly wheel 40 tons.
Diameter of fly wheel 18 feet.
Weight of shaft 18 tons.
Diameter of shaft 21 inches.
Weight of frame complete 26 tons.
Diameter of commutator 5 feet 10 inches.

The flywheel is built up solidly with steel plates. The hub and web are formed of sections of steel one inch in thickness, two plates being welded together. The rim is of 16 inch face and 16 inches deep; it is made up of pieces of steel $1\frac{1}{4}$ inches cold riveted with countersunk rivets.

Each engine in the station is a distinct unit having its own condenser and pumps. The condensers are all of the Wheeler surface type and the feed pumps which are duplex compound were made by the Deane company. The water of condensation is passed through Berryman heaters where it is heated by the exhaust from the condenser and boiler feed pumps to about 110 degrees and is then conducted to Green fuel economizers where the temperature is raised to from 200 to 250 degrees.

WIRING CONNECTIONS FOR WESTINGHOUSE DOUBLE MOTOR EQUIPMENT.

In the STREET RAILWAY GAZETTE for February 24 last a diagram was published showing the connections necessary in the equipment of a street car with two G. E. 800 motors. We are now able to publish a corresponding diagram for a Westinghouse equipment showing the wiring and connections necessary for a car equipped with two Westinghouse No. 3 motors with type G controllers. Fig. 1 shows the entire wiring diagram for a car so equipped. Fig. 2 is a diagram showing the connections of the controller for both a single and a double motor equipment. Fig. 3 exhibits the arrangement of contacts provided upon the controller cylinder. The diagram on the left of Fig. 3 is for a single equipment and that on the right for a double motor equipment. The first contact is made at the left in each case and the movement is then toward the right for the successive points from 1 to 10. Fig. 4 represents in a diagrammatic form the ten sets of connections produced by the arrangement of connections shown in Fig. 1. The first contact places the motors in series with all the resistance and with each other. In the second part of the resistance is cut out and in the third all, leaving only the two motors in series with each other. At the tenth step all resistance is out and the two motors are connected in multiple. It will be noticed that no attempt is made, as in the G. E. 800 regulation, to cut out a part of the field magnet coils at certain steps in the change from the start to maximum speed.

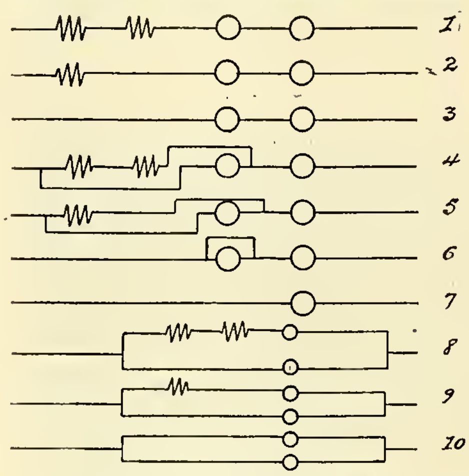


FIG. 4. MOTOR CONNECTIONS.

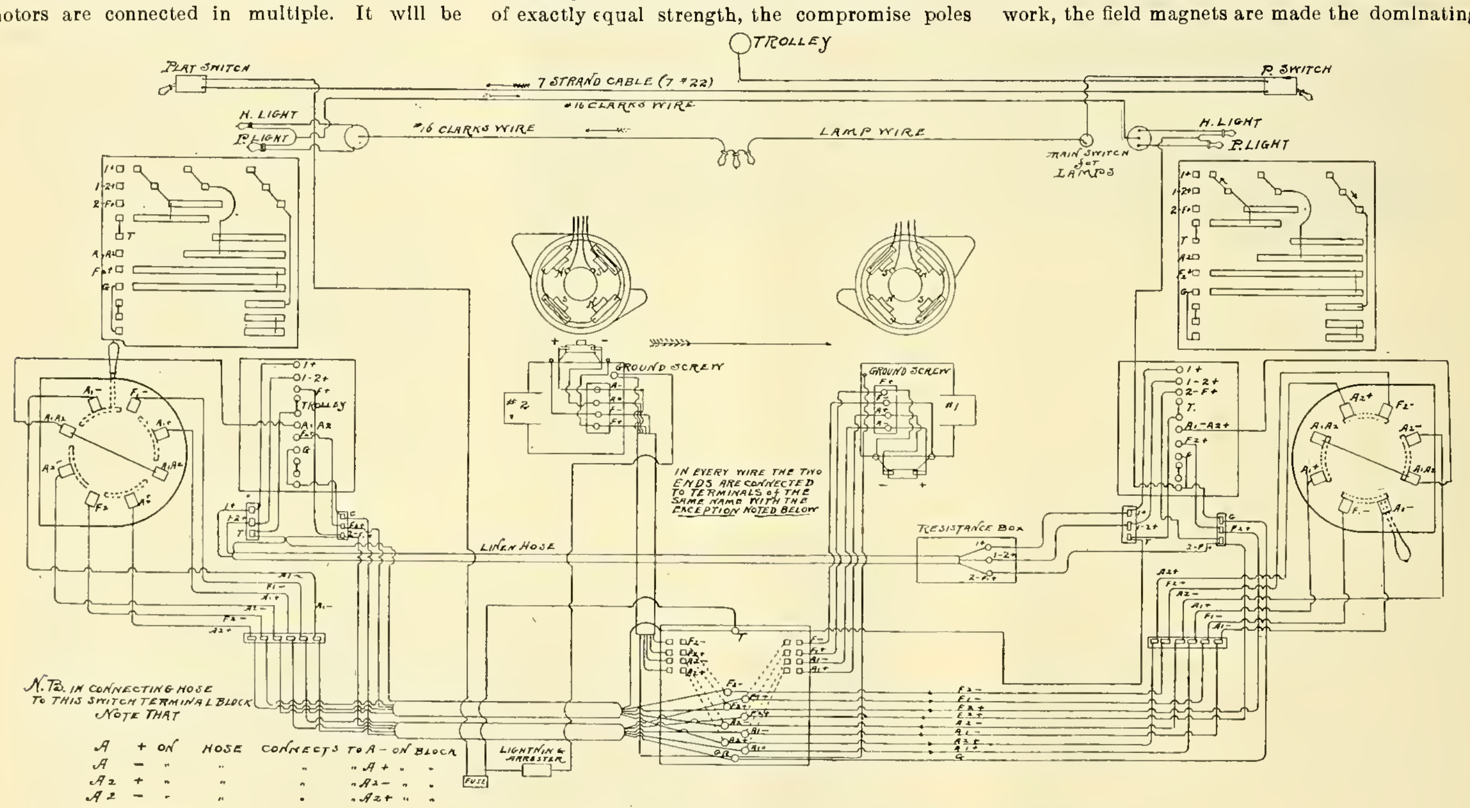


FIG. 1. DIAGRAM OF CONNECTIONS OF WESTINGHOUSE DOUBLE MOTOR EQUIPMENT.

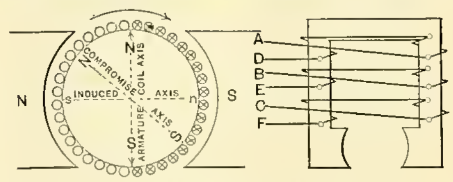
ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Nineteenth Article.)

THE LINE OF COMMUTATION.

Heretofore, in describing the action of the dynamo we have represented the two neutral positions of the wire as being on a line at right angles to the axis of the pole pieces. (See Figs. 26 and 28.) This would only be the case however when there was no current in the armature. Let us examine what would happen in a motor armature when a current is passing in its coils. If it be a closed coil armature such as is now almost universally used on street cars, the current passing through the armature coils will tend to make a north and south pole on the armature which will be at the ends of a diameter at right angles to that which joins the north and south poles induced in the armature by the magnetism of the fields. Since under the circumstances there cannot be more than two poles in the armature, there will be a compromise between the north and south poles produced by the armature coils and the corresponding north and south poles induced by the field magnets. Should these two sets of poles be of exactly equal strength, the compromise poles will be half way between the two and the line of commutation (the line which joins the positions where the individual coil is generating no electromotive force) will be at right angles to the line joining the compromise poles, and the brushes must be moved to this new position else they will pass from one commutator segment to the next



FIGS. 58 AND 59.

while there is a difference of potential between them, which will cause sparking.

If the induced poles are relatively stronger than the poles produced by the armature current, which would be the case if the armature current was weak compared with the field strength, the compromise poles would approach more nearly to the induced poles, and if the field magnets were very overpowering in their strength the compromise poles would nearly coincide with the induced poles and the line of commutation would nearly coincide with that which we have provisionally given it, viz.: at right angles to a line joining the field magnet poles. But as a motor is called upon to do more or less work, the current admitted to its coils must be increased or decreased. This results, of course, in strengthening or weakening the resulting poles. The position of the compromise poles will therefore be constantly changing, which means, of course that the line of commutation is constantly shifting. It has already been explained that to prevent sparking the brushes must bear on the armature of the line of commutation, so the brushes must be shifted as that changes. By making the armature poles weak relative to the field, considerable change of current in the armature may occur without much shifting of the neutral line and under these circumstances it may operate through quite a range of work with fixed brushes, without sparking. It is because of an abnormal rush of current through the armature on starting up a car resulting in an abnormal shifting of the neutral line that the sparking in street car motors occurs. Since the street car motor is called upon to operate through an exceedingly wide range of work, the field magnets are made the dominating ones so as to keep the neutral line very nearly stationary throughout this range. In series motors, however, if neither armature nor field is near saturation, the neutral line will not change its position.

COUNTER ELECTROMOTIVE FORCE

Considerable space was devoted to explaining and emphasizing the fact that if a closed loop of wire be revolved around its axis between the poles of a magnet, or in other words, is revolved in a magnetic field so that its rate of cutting the lines of force is constantly changing, it will generate an electromotive force.

It is perfectly apparent that when we operate a motor by passing current through it from one brush to the other we are fulfilling all of these conditions and the coils of the motor armature must also develop an electromotive force. It makes no difference whether an armature is driven by elecrticity or by steam power, if its coils revolve in a magnetic field there will be generated in them an electromotive force. In the case of the motor, however, this electromotive force is in the opposite direction to that of the current which operates the motor, and is therefore called the "*counter*" electromotive force. It follows exactly the same laws as govern the generation of electromotive forces in dynamos, and will be the higher the greater the speed of the armature. A motor running at high speed as it will if allowed to when it is running without load, will generate a counter electromotive force almost equal to that of the current by which it operated, and will therefore take but very little current. The current that a motor will take under any conditions is that which is due to the difference between the direct electromotive force of the current and the counter electromotive force of the motor itself. The counter electromotive force of a motor at any speed is exactly equal to that which the same motor would generate if driven as a dynamo at the same speed. If therefore a motor is starting from rest, it has, at first no counter electromotive force; the only obstacle to the flow of current through the armature would be the resistance within the machine itself, which being exceedingly small, would, according to Ohm's law, permit an enormous current to flow through its coils which would inevitably result in a burn out if it were not checked. This is the reason why a rheostat is almost universally used in starting. It opposes at first a great artificial resistance and this is decreased as speed is gained and counter electromotive force is generated, when all artificial resistances may be removed with impunity.

This back electromotive force of a motor has its exact counterpart in the resistance which the armature of a dynamo offers to the driving engine. We all know, or can find out for ourselves, that when a dynamo is generating no current, as, for instance, when the armature is not in motion, we can readily turn the armature with the hand, and yet when it is working to its utmost capacity, it may take hundreds of horse power to keep it in rotation. This resistance to the mechanical effort of the steam engine is really the measure of the work the dynamo is performing, so the electrical resistance opposed by the counter electromotive force of the motor is a measure of the work the motor is doing.

Prof. Silvanus Thompson, in his great work on "Dynamo Electric Machinery," cites an example which very well shows how the current that a motor will take decreases with the speed of its armature. He used a small Immisch motor with separately excited fields and connected it up with with a primary battery and ampere meter. At different speeds, the following figures were obtained:

Speed Revs. per Minute.	Current Amperes.	Speed Revs. per Minute.	Current Amperes.
0	20	160	7.8
50	16.2	180	6.1
100	12.2	195	5.1

Thus at its maximum speed it took only about one-fourth of the current that it took when the armature was held at rest. In this case 5.1 amperes were required to overcome the friction of the armature. Had the friction been less, the armature would have revolved still faster and finally come to constant speed with less current than 5.1 amperes.

In the earlier days of the electric motor, this counter electromotive force was a bugbear and thought to be an objectionable feature and attempts were made to construct motors from which it would be eliminated. But we now know that the existence of this counter electromotive force is of the utmost importance, and that upon it depends the degree to which any given motor enables us to utilize electric energy that is supplied to it in the form of an electric current. "In fact," says Prof. Thompson, "this counter electromotive force is an absolute and necessary factor in the power of the motor, just as much as the velocity to which (other things being equal) it is proportional."

As will be seen from the figures given by Prof. Thompson and the subsequent remarks, the amount of current that a motor will take is only that which is absolutely necessary to do the work which it is called upon to do. That is to say, if it has no other work to do than to overcome its own friction, its armature will automatically attain such a speed as to generate a counter electromotive force or "back" pressure such that only sufficient *effective* electromotive force remains to force through the motor sufficient current to move the armature against this resistance. If now an additional load is thrown on the motor, the speed of its armature will be at once retarded, less counter electromotive force will be generated, and consequently more current will pass and the motor at once adjusts itself to this new load.

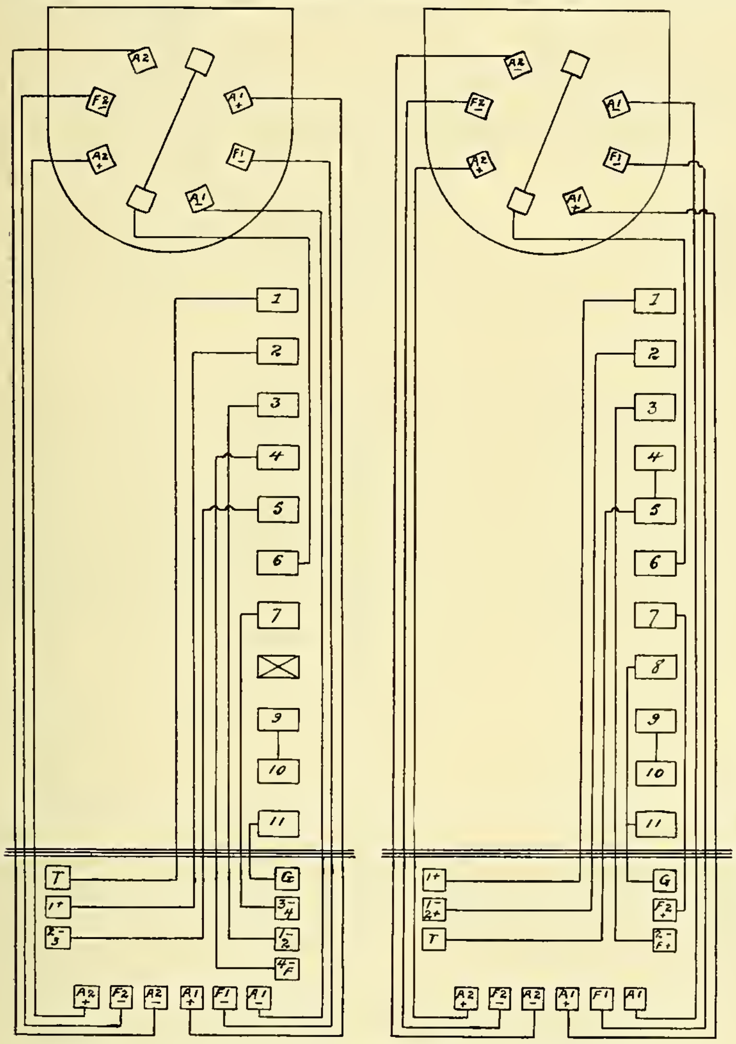


FIG. 2. CONTROLLER CIRCUITS FOR SINGLE AND DOUBLE EQUIPMENT.

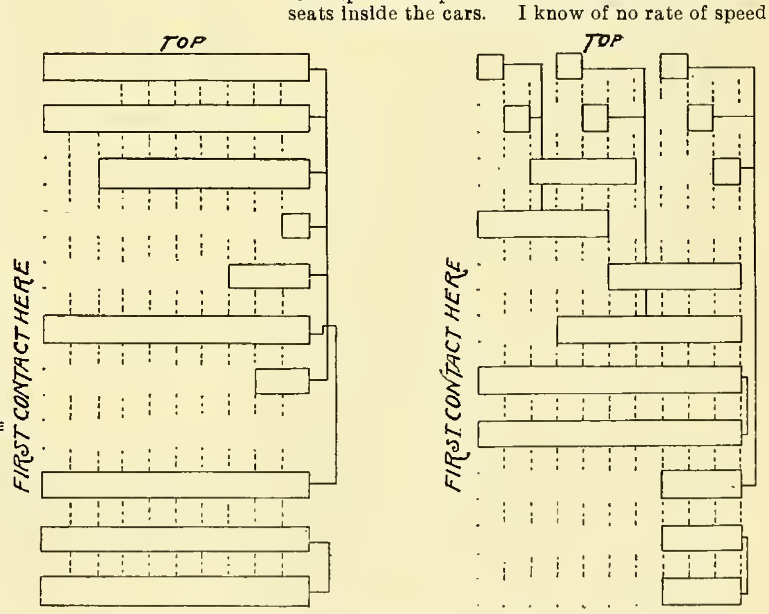


FIG. 3. CONTROLLER CIRCUITS FOR SINGLE AND DOUBLE EQUIPMENT.

SAFETY IN STREET RAILWAY TRAFFIC.

There is a great deal of common sense in the following extract of a veto message of Mayor Haynes of Newark:

No passenger has been injured while in his legitimate place, nor on any of our trolley cars. These cars can be run with safety at the rate of thirty miles an hour in some places, and the other places not more than five or six. The people demand rapid transit. The horse car was found to be too slow and rapid transit was loudly demanded, and it is found out now that the public at large must be protected.

I think the service could be improved by stopping all cars at street crossings only, passengers to be taken on or let off before the car crosses the intersecting street. Pedestrians should be instructed to cross the streets at the crosswalks, and children should be taught by their parents and teachers that it is dangerous to use the streets as a playground.

There seems to be a great necessity for instructing the community at large and the traveling patrons of the roads in order to secure rapid transit. No passenger should be permitted to ride upon the platform when there are vacant seats inside the cars. I know of no rate of speed that the cars could run that will secure absolute safety to the pedestrian, who uses the middle of the street instead of the sidewalk.

Kansas City, Mo.—The Quindaro Electric Street Railway Company has been organized at Quindaro by the following gentlemen: C. C. Dall, Isaac P. Moore, W. J. Huffaker, J. C. Klamm, L. F. Bird, A. F. Smith and C. B. Forword. The capital stock is $200,000. A large amount of the stock will be taken by the property owners who live along the line of the proposed railroad. The company is formed for the purpose of building an electric line of railway from Quindaro Park south along the road past the Sorter farm, east to the Quindaro postoffice, south and southeast through Chelsea place to Eighteenth street, thence south along that street to the city limits at the Kaw river.

THE ARNOLD SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

In building an electric power station the two principal objects to be kept in view are low first cost, consistent with the best economy, and absolute reliability. Power stations have heretofore consisted of two classes, viz:—Those having a number of engines directly belted or directly connected to small generators and those having two or more large units of power belted to line shafting, from which a number of small electric generators are driven by means of friction clutch pulleys and belts. In order to insure reliability with the first plant, it is essential to have one or more engines and generators in reserve all the time to be able to start in case of accident to any one of the operating units. In the latter system reliability is insured by being able to reach any dynamo from any engine in the plant through the shafting and belted connections.

The system here described is one which combines the flexibility of the low speed, or large engine belted plant, with the low first cost of the direct connected or direct belted plant. The advantages claimed for this system by its inventor, B. J. Arnold, of Chicago, are less cost per kilowatt of plant installed; less operating expenses; less real estate occupied; absolute flexibility; less depreciation and greater ease in handling, than is usual in existing power plants. The designer of this system claims that if a cable railway can be driven with absolute reliability, flexibility and economy, from two units of power, that there is no reason why an electric railway should not be driven with the same degree of reliability, flexibility and economy, from the same number of units of power.

We will first describe the system as applied to an electric railway plant having a capacity of 2,000 H. P., such as would have been ample to drive the Intramural road at the World's Fair. Referring to Figs. 1 and 3, engines No. 1 and No. 2 are cross compound condensing having a rated capacity of 1,000 H. P. each. Generators No. 1 and No. 2 have a rated capacity of 750 K. W. each. The armatures of the generators are mounted upon hollow cast steel shafts or quills, *Cc*, running in independent bearings, *Pp*, so arranged that they are free to revolve independent of either engine, and of each other. Through these quills, and supported at its center by bearing *D*, extends a steel or wrought iron shaft carrying upon its ends circular cast steel or cast iron disks, *Ff*, securely keyed to the shaft.

The drawing shows the engines connected to the generators with magnetic clutches which operate as follows: Attached to the end of the engine shafts, *Aa*, are circular cast iron or cast steel disks, *Hh*, carrying in recesses copper coils, *Oo*, which are connected to brushes, *Qq*, by means of rings, *Rr*, in such a manner as to permit a current of electricity to be passed through the coils while the disks are in motion. Around the vertical face of disks, *Hh*, near the peripheries are carried cast steel or cast iron rings, *Ii*, which are held in position on disks, *Hh*, by means of three gudgeons or bolts, equally spaced around the periphery of disks, *Hh*. Rings *Ii* are normally held against disks *Hh*, by small spiral springs surrounding the gudgeons or pins. Attached to quills *Cc* are cast iron or cast disks *Jj*, carrying two coils of copper wire *Mm*, *Nn*, which are connected to brushes *Kk*, so as to allow a current to be passed through the coils when the disks are in motion.

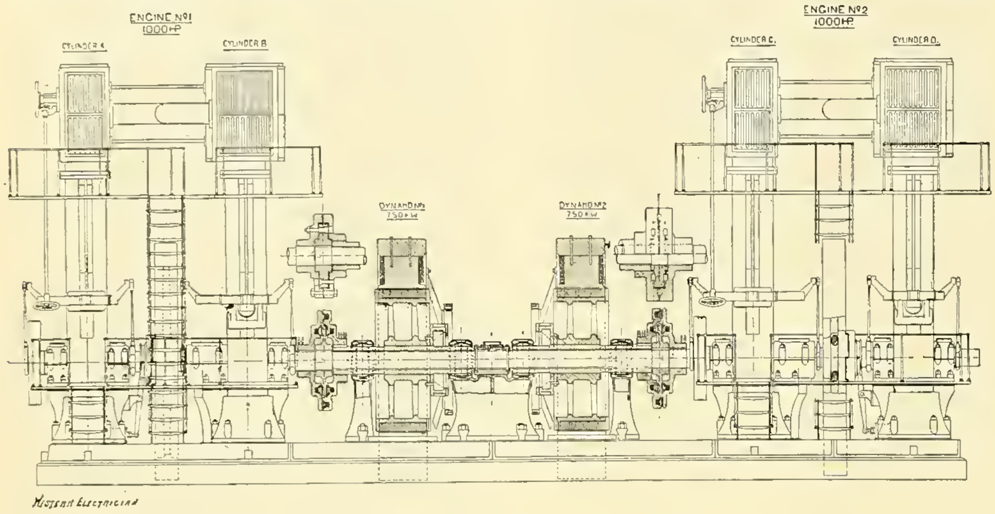


FIG. 1. ARNOLD SYSTEM OF POWER STATION CONSTRUCTION.

It will now be noticed that if a current of electricity is passed through the coil *M*, a magnetic field will be created around it which will have a tendency to attract the disk *I*, overcoming the action of the springs which normally hold it against the disk *H*, and clasping it securely to the disk *I*, so that power can be transmitted from one disk to the other by friction so long as the current travels through the coils M. If engine No. 1 now be set in motion it will drive generator No. 1 directly connected, there being no wearing parts except what are ordinarily encountered in a direct connected engine and dynamo plant. In a like manner engine No. 2 can be connected to generator No. 2, thus forming two direct connected power units.

The shaft *E* lies idle in the bearing *D*, and is not used except in case it becomes necessary to drive either generator from the opposite engine, or both generators from the same engine. In an ordinary direct coupled plant if we had but two units of power, in case the engine of one unit and the generator of the other unit should become disabled, the plant would be at a standstill, and unable to furnish any current. With such an emergency as this, the Arnold system would operate as follows: If engine No. 1 and generator No. 2 were the disabled portions of the plant, generator No. 1 would be driven from engine No. 2 as follows: Current would be passed through the coil *o* thereby attracting the disk *l* which would set the shaft *E* in motion. Current would also be passed through the coil *N* attracting the disk *L* which would set the armature of generator No. 1 in motion. Current is then cut off from the coil *M*, allowing the armature of generator No. 2 to come to rest. It will be readily understood that either generator can be reached from either engine in a like manner, thus making it practically interchangeable.

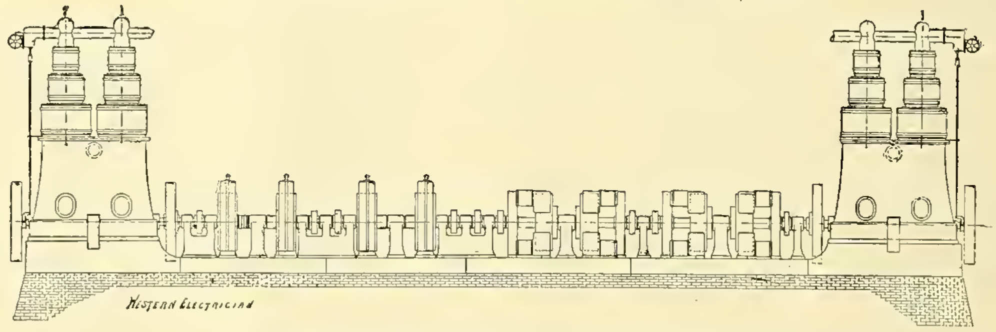


FIG. 2. ARNOLD SYSTEM OF POWER STATION CONSTRUCTION.

Should one entire engine unit become disabled both generators can be driven from either engine by simply passing the current through the proper coils as follows: If engine No. 2 were disabled generator No. 1 would be driven direct from engine No. 1 by means of the coils *M* and disk *I*, as above described. Current would be passed through the coil *N*, thus attracting the disk *L* and setting the shaft *E* in motion. Current would then be passed through the coil *n* attracting the disk *g* thus setting the disk *j* of generator No. 2 in motion.

It will thus be noticed that either generator or both generators are available from either engine, and at the same time there is not the additional investment of a third engine and generator to be carried to provide against the accident above mentioned. The fact of having to work the engine uneconomically while repairs are being made is a very small item compared with the heavy expense of carrying an additional investment of a third engine and generator to provide for this emergency, as is now usually done with direct coupled plants.

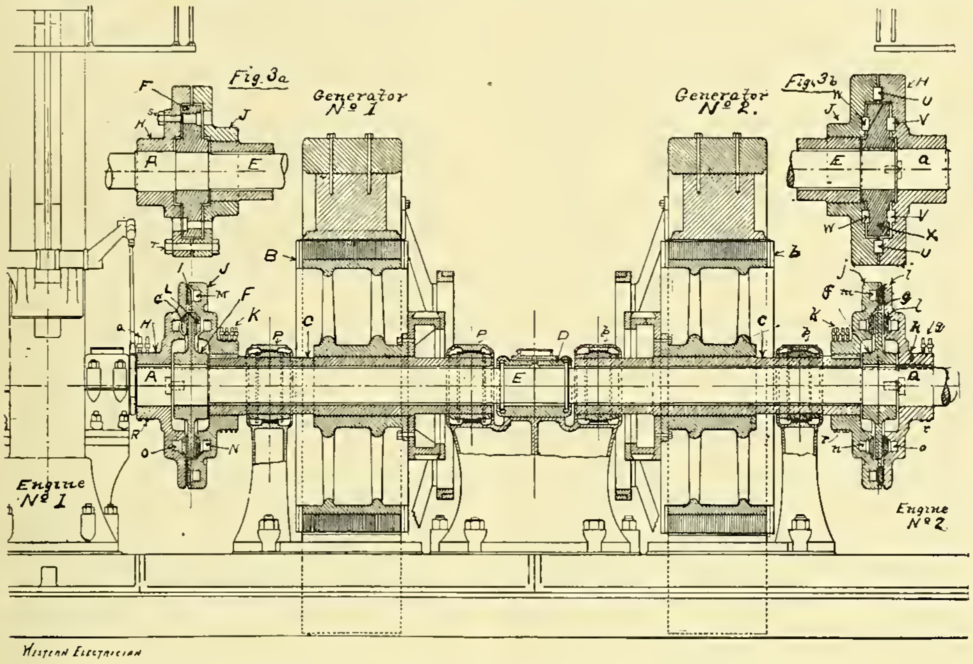
By having two engines with the high pressure cylinder of one, and the low pressure of the other direct connected to the work, the plant is arranged to operate economically with any load varying from 500 to 2,000 H. P. and it is practically impossible to shut the plant down on account of any accident that would be liable to happen.

It will be noticed from Fig. 1 that the main shaft of both engines is cut in the middle and the two parts joined together by means of positive jaw clutches, operated by steam cylinders. Thus when the load is light, say from 12 o'clock till morning, on an elevated road, engine and generator No. 1 are shut down. Cylinder *D* of engine No. 2 is cut off by means of the jaw clutch, and no portion of the plant operates except the high pressure cylinder of engine No. 2 directly coupled to generator No. 2. This cylinder can be run condensing and the plant operated with economy, until the road requires more power, when the low pressure cylinder is brought up to speed and connected in with the high pressure cylinder without stopping the plant.

In case it becomes necessary to make repairs on the high pressure cylinder of engine No. 2, at the same time that the road is demanding full power of engine No. 1, high pressure steam may be admitted to the low pressure cylinder of engine No. 1, which will be noticed from Fig. 1 is placed next to the generator. By working high pressure steam in the low pressure cylinder of this engine it will give its full power, thus driving its generator and allowing the high pressure side to be shut down for adjustment.

In order to prevent wear on the rings of the magnetic clutches above described, the following method of electrically starting the generators is covered under this system: Suppose engine No. 1 and its generator are operating, and engine No. 2

and its generator are standing idle, and it becomes necessary to throw generator No. 2 upon engine No. 1, in order to repair something on generator No. 1. Instead of starting engine No. 2 to bring generator No. 2 up to speed, or allowing the friction of the magnetic clutch to bring the latter up to speed, the following method is adopted: Current being produced from generator No. 1 is passed through the armature and fields of generator No. 2 in such a manner as to make a motor of it, until the armature attains the same speed as that of generator No. 1, when current is



FIGS. 3, 3A AND 3B. ARNOLD SYSTEM OF POWER STATION CONSTRUCTION.

passed through the coil n clamping the disk f to disk J without wear on the clutch mechanism.

Figs. 4 and 5 are diagrammatic representations of the circuits for operating the machines as motor and generators. Referring to Fig. 4 let us assume that it is a diagrammatic representation of generator No. 1 running as a generator from engine No. 1. The circuit then is from the positive bus-wire on the switch-board T^1, through the double pole switch U, conductor V^4, brushes OO, armature L, to brushes PP, to field magnet coils SS, conductor V^5, switch V^2 and conductor V, to switch U, back to the other main conductor T. This machine is therefore supplying the main conductor with current. By disposing the parts as indicated in Fig. 5, the circuits will be varied so that the circuit of conductor V includes at first the high variable resistance V^3, and excludes the series winding of the field-magnet, and the shunt circuit excludes the resistance W^2 by means of switch W^1, so a variable current may be made to pass through the armature by varying the resistance V^3. Thus the machine operates as a shunt motor and its sleeve shaft is driven at any desired rate of speed by simply adjusting the resistance V^3. The rotation of the sleeve shaft will vary from the rotation of the main shaft, and when the armature of machine No. 2 has attained approximately the same speed as the shaft E, the magnetic clutch is thrown in circuit, the proper switches are thrown, and generator No. 2 ceases to be a motor, and becomes a generator capable of producing current.

In case it ever becomes necessary to increase the capacity of the power station designed under this system, it is done by adding two more generators to the right of engine No. 2, as shown in Fig. 6, having similar connections to generators Nos 1 and 2, thus making four generators available from engine No. 2. The third engine is added as the power is required.

Figs. 3a and 3b show different forms of mechanical clutches which can be substituted for the magnetic clutches above described if necessary. In a railway plant the fact of having to stop the station for a few minutes at the time of changing from one engine to another, is not so serious as in a lighting plant, and the above clutches have been designed for substitution for the magnetic clutches in case the conditions were such as not to warrant installing the magnetic clutches.

In Fig. 3a (see Fig. 3) H is a disk securely keyed to the engine shaft A of engine No. 1. J is a circular disk securely keyed to the quill C of generator No. 1. F is a circular disk keyed to the common shaft E. If it is desired to drive generator No. 1, three bolts, T, spaced at equidistant points on the circumference are used to bolt the disks H and J rigidly together, as in cable railway plants. Engine No. 1 is thus driving generator No. 1 directly connected, without any wearing parts except the bearings of the two machines. In case it becomes necessary to drive generator No. 2 from engine No. 2 bolts S are inserted as shown, thus rigidly connecting the disk H to the disk F, and revolving shaft E. Bolts S can be reversed so that the disk F will be rigidly bolted to the disk J, permitting the shaft E to drive generators No. 1 from engine No. 2, thus performing all the functions of the magnetic clutch as described above.

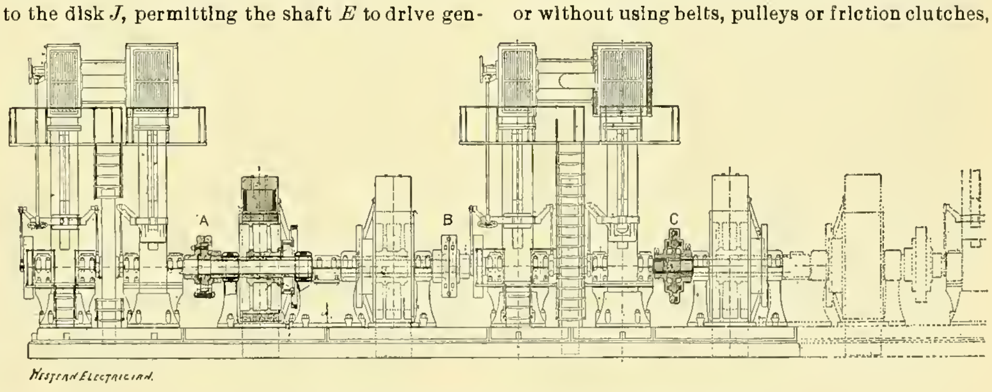
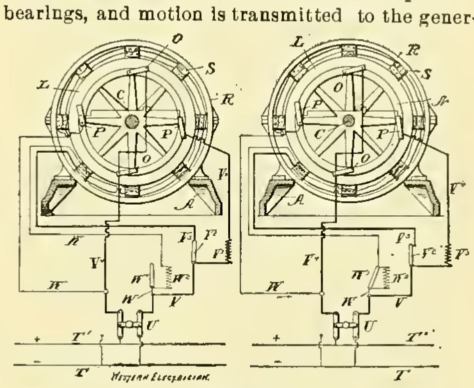


FIG. 6. ARNOLD SYSTEM OF POWER STATION CONSTRUCTION.

Fig. 3b. (See Fig. 3) is another form of clutch now commonly used in cable railway plants. Disks H and J are keyed to the engine and generator shafts respectively, and the disk X is keyed to the shaft E. If it is desired to drive generator No. 2 from engine No 2, two steel or wrought iron keys are inserted in recesses UU, thus rigidly connecting the disk H to the disk J. By inserting the wedges in the recesses VV, the shaft E is made to revolve from engine No. 2 and by inserting the wedges in recesses WW generator No. 2 is caused to revolve from the shaft E, thus making the plant interchangeable in all directions.

The entire plant is mounted upon cast iron bed-plate construction, cast in sections and thoroughly anchored, as in first-class cable railway power station construction of the present day. The system is especially applicable to arc lighting stations where, as it is well known, a large number of small electrical units must be used, owing to it being usually necessary to run a machine for each arc light circuit.

Fig. 3 shows a 1,000 H. P. combined incandescent and arc light station. At each end of the line shaft is placed a high speed engine directly connected to the shaft. The shaft being detachable from each engine, parting at its center so that either portion of the shaft can be shut down in case of a hot journal, while the other portion of the plant remains in running order. The generators are mounted on quills carried in independent bearings, and motion is transmitted to the gener-



FIGS. 4 AND 5. ARNOLD POWER STATION CONSTRUCTION.

ator by means of positive jaw clutches. It will thus be noticed that when the generator is not running there is absolutely no wear on the shaft, no side strain by the pulling of belts, and no friction clutch pulleys to get out of adjustment. The strain on the shafting is purely torsional, thus permitting it to be small in diameter and making it much less liable to get out of alignment.

When it is desired to start any generator, it is brought up to speed as a motor, and when it attains the same speed as the line shaft, a positive clutch, operated either by hand or by electricity, is thrown into connection, after which the current is reversed through the machine and it immediately becomes a generator. It will thus be noticed that any generator in the plant can be started and stopped at will, without stopping either engine, or without using belts, pulleys or friction clutches, thus having all the flexibility and reliability of the ordinary low speed lighting station, where shafting and belting are used, and occupying, it is claimed, not over one-quarter the amount of real estate that such a plant ordinarily covers. This permits a very much less expensive building to be constructed, less investment in real estate; greater ease in operation on account of having fewer wearing parts to lubricate and to maintain, and less labor in operating the plant.

Another important feature of this system which the designer has covered with various patents, is that any standard make of dynamos and engines can be utilized, thus necessitating no radical departure from the present lines of manufacture. For this reason many of the present plants can be rebuilt to conform to this system, utilizing a large part of their old equipment.

ELECTROLYSIS CAUSED BY STREET RAILWAY RETURN CURRENTS.

The exhaustive paper by I. H. Farnham on this subject was quite fully discussed at both the New York and Chicago meetings. At the Chicago meeting B. J. Arnold, in opening the discussion said: "The subject of electrolytic action of the railway current on underground pipes and conductors is now being agitated in almost all cities where railways have been running long enough for the destructive effect of the current to make itself known, and it will not be long before we shall hear from it in our own city, if the many ordinances now being considered by the Council are passed without some stipulations regarding the construction and carrying capacity of the rail return circuit of the roads which the companies propose to build under these franchises. In my judgment there is no reason why an electric road cannot be built so as to almost effectually prevent the destructive electrolytic action that has been pointed out to us to-night.

"The original method of constructing the return circuit of the electric railways was to join the ends of the rails with No. 4 bond wire, depending upon this and the fish plates for whatever metallic circuit was necessary, and the earth to make up for the lack of metal. The idea of the supplementary wire was not contemplated on the first roads, but as the small bond wires soon became eaten off or broken, they were found inadequate, and a No. 0 copper bond wire was added to supplement the rails.

"Examination in some cases has shown that the supplementary wire has disappeared entirely after a few years' use, which resulted in the abandonment of it entirely and the adoption of the larger bond wires between the ends of the rails. It is now customary to use a No. 0 wire to bond the rails with and depend upon the rails alone for the return circuit. I am of the opinion that if the rails are supplemented by a system of feeders, so that the resistance of it is not greater than that of the out-going circuit, and the rails joined with a bond equal in conductivity to the rail itself, which is most effectually accomplished by welding the rails together electrically, the entire difficulty caused by electrolysis will disappear.

"Mr. A. C. Balch, of Portland, Oregon, in a communication to one of the railway papers recently, described the method of using the three wire system on the electric railway in that city. The trolley is divided into sections of about one thousand feet in length, the positive wire of one dynamo being connected to one section and the negative of the other dynamo to the adjoining section, while the neutral wire is connected to the rails. It will be noticed that with this arrangement there is a difference of 1,000 volts between the adjoining sections of the trolley wire, but as they are thoroughly insulated and the motor cars pass from one section to the other quickly, there seems to be no difficulty caused by the sudden reversal of the current through the motors when passing from one section to another. So long as the cars are properly distributed on the line, I see no difficulty in the operation of an electric railway with the three wire system, but if the cars were to become 'bunched,' as sometimes happens in large cities, the feeder wire supplying that particular section would be overworked, although I do not regard this difficulty as serious. With this arrangement the electrolytic action on pipes is almost, if not entirely, avoided, as there is practically no current flowing from the trolley to the earth when the road is working under normal conditions. I believe there is also a three wire electric road in operation in Bangor, Maine, and so far as I am able to learn it is working with entire satisfaction."

A. T. Welles, of the Western Electric Company, in continuing the discussion said: "In December last a cable which we had laid in Louisville less than a year ago for the Ohio Valley Telephone Company began to give out. We sent a cable splicer there and he located the trouble in two sections of several hundred feet each, near one of the power houses of the electric street railway. About Christmas, Captain Gifford telegraphed my company requesting that Mr. Patterson or myself should come at once to investigate the cause of the trouble, and I was sent. I found that the two sections had been partially pulled out of the conduit and in examining the pieces cut off, found that holes were partially or wholly eaten through the lead covering at regular intervals. These holes occurred every 18 inches and corresponded exactly with the joints of the vitrified clay conduit.

"With Mr. Maxwell, the electrician of the telephone company, I made a number of potential tests in the manholes near the place of the trouble and found as high as two and one-half volts from the cable to the rail of the trolley road. In these manholes there were also gas and water pipes which had about the same voltage as the cable. I also made 40 or 50 tests across the joints of the rails with a voltmeter reading down to one-tenth and I think we could have noticed one-hundreth of a volt, but there was not the slightest movement of the needle.

"These tests were reported to Captain Gifford, who then called in the electrician of the street railway. This gentleman explained that besides having the rails perfectly bonded at their joints, they had two return wires of No. 0 or larger copper run underneath the rails and bonded to them at frequent intervals. In Louisville the underground telephone cables run from all points of the compass into the company's office. These cables, some 30 in number, are practically bunched at or near the exchange, so that any currents coming in on their sheaths can, without trouble, reach those of such cables as will most readily return them to the power houses. All of these cables run parallel with trolley lines or with gas or water mains which parallel the trolley, so that each carries to the common point more or less current. Taken singly, these currents are slight and would probably cause no trouble for a long time at least, but one-half or two-thirds of their total was sufficient to eat through the pipe of the cable in trouble in seven or eight months. At present there are but two cables which run from the exchange to points near the power houses. One of these runs to a point within a block or so of a power house about two miles from the exchange in one direction and the other to within three blocks of a power house in the opposite direction. The first one giving the best return and also running for a long distance parallel with a trolley line and water mains, where it picked up additional current, is the one which gave out. Preventions which we used will, I suppose, save the other. From Louisville I went to Cincinnati where we had laid a large quantity of cable for the City and Suburban Telegraph Association. Here, with Mr. Robinson, their superintendent of construction, I made a large number of voltmeter tests between the cables and the trolley-road rails in different parts of the city, and found at no point more than one-half volt pressure in either direction.

"Since Mr. Farnham collected the data for his paper, we have run across another very peculiar case of electrolysis in Cleveland. A cable which my company laid there in January last for the Postal Telegraph Company was reported as having given out entirely about two weeks ago. The cable ran from their office down about 1,500 feet and then through a tunnel about 80 feet deep under the river to a pole on the opposite side near a manhole at the mouth of the tunnel. Through this tunnel a large water main also runs. We sent a splicer there at once and he located the trouble in this manhole where he found the cable pipe entirely eaten through. Mr. L. L. Summers, of the Postal Company, made voltmeter and ammeter tests at this place and found 18 or 19 volts on the cable, and also on the water main in the tunnel and 45 amperes current. The cable pipe was eaten through in ten weeks. What is going to become of that water main and what is going to become of that tunnel?"

Prof. W. M. Stine asked Mr. Welles what conditions he found where they were using the double trolley in Cincinnati, and in reply Mr. Welles said: "My tests were made on New Year's Day, which was particularly dry and clear. This probably accounted for the very low potentials found on the cables. On account of the intricate system of water and gas mains running close to the conduits, and often through the manholes, it is impossible to say whether the leakages came from the single trolley or the double trolley system. We found current on cables which, in no part of their circuit, paralleled either system. I was told, however, that in rainy weather much trouble is experienced by the telephone company on account of the splashing of mud against the cars motors of the double trolley system, which often brings down 200 or more drops at a time in the switchboard. But this, I should think, is simply a matter of construction of the motors."

C. G. Armstrong said: "Wherever we have a flow of current through the earth, owing to its irregular conductivity, we are bound to have differences in potential, and where we have differences in potential, electrolysis and chemical decomposition will occur. Even if this difference is extremely slight we will have some destructive action. At the same time I doubt whether we can have any serious destruction unless we have one and one-half volts, or sufficient to decompose the moisture, liberating the oxygen which in its nascent state, to my mind, is the most destructive agent produced by electrolysis. I cannot feel that electrolysis is guilty of all things charged to it. I do not believe that every defective water pipe and gas main was destroyed by electricity. I have seen miles of water and gas pipe that was in much worse condition than that shown on the screen to-night, where the nearest electric wire was twenty miles away. I believe the gas companies are responsible for two-thirds of the trouble found in pipes to-day. Where we dig up the streets we find the earth permeated with ammonia and other destructive products of the gas retort, which within themselves are sufficient to attack and decompose any metal they come in contact with; in fact, one of the pipes shown on the screen was a gas pipe, and there was a serious decomposition of the metal on each side of the union. The author of the paper attributes this to the resistance of the union; why might it not have been the leakage of the gas? I have found gas pipes that could not possibly be acted upon by electricity that were decomposed in exactly the same manner, from the gradual leakage of the gas."

A. V. Abbott, in closing the discussion at the Chicago meeting, said that he believed the double trolley system did afford a perfect solution of the question, but only at the expense of a greater investment of capital in the original line construction, as the amount of copper required for a double trolley system over that needed with the single wire would be increased about fourfold, and as much complexity would be involved in the erection of the wiring. Continuing he said: "The objections to the double trolley system, other than those of increased capitalization, are entirely mechanical ones and in ordinary lines can be overcome. The double trolley, about three years ago still survived, and it is probably chiefly due to the Thomson-Houston Company that it does not still exist. In all railways which are reasonably straight and do not encounter a great number of intersecting lines, the introduction of the double trolley is not a serious obstacle, and by affording to the street railway an independent return, places the railway circuit entirely under control of the railway managers, presenting to the company in this respect considerable advantage. It is probable, nay, almost certain, that should street railway companies be obliged to protect all present existing underground structures by means of special return feeds, as indicated by Mr. Farnham, the expense of these feeds, and their introduction would be considerably less than the original cost required to equip the line with a double trolley system.

"Personally, I have always been in favor of all electrical companies operating entirely upon metallic circuits which should be peculiarly and appropriately their own. I think the advantages to be derived from this principle of operation will, sooner or later, be appreciated, and that street railway companies, electric lighting companies, telephone corporations, in fact, all electrical industries will, in the not far distant future, be each equipped with its own individual and independent complete circuit.

"The presence of overhead wires in the crowded city streets, is constantly urged as an objection to the trolley system, whether it be single or double. Inventors have been constantly called upon to devise methods whereby the streets could be relieved from this objection. A conduit electric road is at the present time perfectly feasible, and its successful construction and operation is merely a question of the amount of capital that the promoters are willing to invest. Ordinarily speaking, an electric road can be built and equipped in running order at an expense of from thirty to forty thousand dollars per mile, including all items, excepting that of real estate, franchises and buildings. The cable road is typical of the conduit system, and is always expected to cost from one hundred twenty-five to one hundred fifty thousand dollars a mile. The widespread and rapid introduction of electric roads has chiefly resulted from the fact that they require so much smaller capitalization in the outset, and that they, therefore, may be introduced in districts that are not thickly settled, in which the traffic could never be made to pay the interest and depreciation on the more expensive cable plant. Cable roads could never, for a moment, be considered, in many of the districts where electrical roads are now successfully and remuneratively operating, having superseded animal traction. If a street railway company is willing to invest in an electric road the same amount of capital as is called for by the ordinary cable road, a successful conduit system can be at once introduced, the success of the conduit electrical road simply depending upon its being built well enough to do the work required of it.

"In a consideration of the return system for an electric road, the railway company should not forget, that by providing an adequate return circuit which will protect other underground structures, they are not only securing immunity for themselves from damage suits, but at the same time are putting more money into their pockets in a saving of coal pile, than the interest and the depreciation upon the investment involved in the return circuit will amount to.

"In building some 300 miles of electric road I have universally found that the grounded return circuit absorbed more energy from the station than any other part of the line, the car motor only excepted. In one instance in mind, the return circuit of the road was so poor, owing to defective rail bonding and the dry condition of the soil that, in many instances, the rail bonds had actually burned their way through the ties of the road and allowed the rails to separate. In another instance, motor repairs were reduced several hundred dollars a month by the addition of an appropriate amount of feed wire. In a third case, the amount of power required for operation was reduced to 80 H. P., by the provision of an appropriate return. I feel quite confident that, if the engineers of the majority of electric railways in this country would carefully study their circuits, making accurate measurements thereon, they would be immediately convinced that the expenditure required for an appropriate return circuit which could in a majority of instances be arranged to protect existing underground structures, would result in an actual saving to them in fuel, and would be an investment upon which they could immediately enter."

NEW YORK DISCUSSION.

Prof. George W. Plympton of the Subway Commission of Brooklyn, remarked that the first experience with electrolysis in Brooklyn dated from about a year ago, and he feared that at the present time the extent of the damage was still not realized, for there had been no search for the results of corrosion. He continued: "Of course, as Mr. Farnham says, the current will still be divided between the rail and the moist earth in proportion to their relative conductivities. You cannot convey all of that current back by the best conductor that you can put in the ground. So the method of relieving the pipes of that positive charge, where the corrosion has been set up, is the best way to ensure the protection. But in regard to its permanency, as I said before, I am inclined to feel some fear."

Townsend Wolcott said it was an interesting point to note how small a voltage will corrode a cable in the earth. "We are generally familiar," he continued, "in electrolyzing solutions with voltages of one volt or over—almost any solution—over one volt. But I take it that the conditions in the damp earth are such that the corrosion is just about ready to go on anyway, and a very little help will make it go."

A. E. Kennelly said that he did not believe that it was necessarily "good policy to connect the positive pole of the dynamo to the trolley lines, and for this reason, that supposing you are grounding one terminal of your dynamo which is supplying a total current distributed to your trolley wires, say of a thousand amperes, that thousand amperes goes into the ground on your district, and it has to come out of the ground at the point of your ground connection to the dynamo. Now, if you bury in the ground a large mass of iron pipe, or lead tube, or metallic conductor of any kind, that metallic conductor will, perhaps, absorb a large fraction of the thousand amperes. Let us say it absorbs 750 amperes. The metallic system will have 750 amperes entering it and 750 amperes issuing from it. Now, when you have the negative pole to line, the current will go from your ground plate, will enter all this mass of metal in the vicinity, and there it will do no damage, because where it enters the iron or lead, hydrogen is given off, as we have seen represented on the screen. But it will issue from the iron or lead over a large area in the remote districts. That large area will be in danger of corrosion, and there will be corrosive electrolysis going on all over that area to the extent of 750 amperes collectively. But when you reverse the current, as is suggested as advisable in the sixth conclusion of this paper, you reverse that condition of affairs. All the distant district is free from danger and all the oxidizing and corroding effect is close to you; but the 750 amperes are still there and are now actively corroding a much smaller surface. Instead of being spread over, as shown on the map in the previous case, several square miles, the same total corrosive electrolysis is spread over, perhaps, half a square mile. The danger area is reduced, but the danger is greater, because the activity is consequently augmented in that district. You have, say, twenty times the amount of corrosion going on over a given surface of pipe, and the result is you will eat through those pipes twenty times as rapidly, and if the danger is in bursting a pipe you will probably burst it twenty times as soon under those circumstances. But if, as Mr. Farnham says, we prevent that, as was done so skilfully in this case, by throwing out a ground feeder, which prevents the current from emerging out of the pipes into the surrounding soil near the power house, why then, coupling together the sixth and the seventh conclusions, all is well; you have stopped the corrosive action. But unless you do couple together the sixth and seventh suggestions, you are likely to cause more danger by having the positive pole to line, than if you have the negative pole to line. The fact Mr. Farnham mentions, that he did have trouble with his lead-covered cables while the negative pole was to line, but did not have trouble when the positive pole was to line, is an argument in his favor. But he would probably have had electrolysis on the cable in one district or another whichever happened to be the danger district, if the lead had been suitably placed for electrolysis, and a lead cable of this kind is singularly liable to be spoiled by electrolysis. The resistance of an ordinary lead telephone cable sheath, as we know, is much greater than that of a large iron water pipe. But being continuous, and having very few or no unsoldered joints, it has far less resistance than a large iron pipe with a large number of poor electrical joints. The result is that where there is an opportunity for the lead sheathing to be corroded at any point, there will be active corrosion, and at that point those destructive effects so fully brought out in this paper will be produced.

"Furthermore, I would like to point out that the difference of potential as measured by a voltmeter between a cable sheathing and the ground in its vicinity, is not necessarily a criterion of the degree of corrosive activity taking place at that point. If the direction of the P. D. is such that the cable is positive, there will be a corrosive current there, or a tendency to produce a corrosive current. But if the P. D. is three volts or four volts, the corrosive current is not necessarily twice as strong as if the P. D. were one and a half or two volts respectively. For suppose you had a perfectly insulated cable and sheath, but at some distant point, say, half a mile off, the sheathing of lead was exposed to the ground, and that there destructive action was being produced; there might be at that point, half a mile away, a difference of potential between sheath and the ground of three volts, but at the point where you stand the P. D might happen to be five volts. Now, the five volts could not be so active in producing corrosion as the distant three volts, in fact it could not be active at all, owing to the perfect insulation of the entire cable in the vicinity. The point I want to make is, that though the observed P. D. is an evidence of action, it is not an evidence of quantitative or corresponding intensity of action.

"Again, while all admit that iron is corroded, and iron pipes are corroded electrolytically, and the evidence has been amply brought forward tonight, I do not think that Mr. Farnham means that as much corrosion takes place with iron as with lead, for the reason that we all know a given weight of lead is much more readily consumed by electrolysis than a given weight of iron.

"The destructive effect of electrolysis, while it is serious, is often exaggerated by not taking into account the actual amount of decomposition that can take place, electrolytically, under the most favorable circumstances. If you have a mile of eight-inch water main, which is half an inch thick, that is, its exterior diameter is nine inches and its interior diameter is eight inches; and a thousand amperes are kept steadily flowing day and night, with uniform density, out of that surface into the surrounding soil, it will take about six years for that current to reduce, by electrolysis, the thickness of the iron to one-half. Of course, it would be unfair to make a positive statement of that kind, because we assumed uniform corrosion, whereas corrosion does not take place uniformly.

"The resistance of the ground is really far higher than we ordinarily attribute to it. We are so accustomed to use the ground universally in telegraphy, we are so accustomed to the idea of a ground return circuit with very little resistance in it, that we come to grasp the idea, unconsciously, that the ground has very low resistivity, whereas it has very high resistivity. We may take the position, in fact, that the ground itself has an enormous resistivity, and what we really measure in the resistance of the ground, is the resistance of the water that happens to be suspended in the ground. The resistivity of ground under ordinary circumstances is something like 50 or 60 ohms. The result is, that if you had two iron water pipes, each nine inches in diameter, deeply buried in the soil, and 30 feet apart, at a constant difference of potential of ten volts, you would not expect less than 2.5 ohms resistance between the pipes per linear foot of either, nor more than four amperes of current between them per linear foot. In the case of ten volts between one such buried pipe and two surface track rails, supported on wooden sleepers, the resistance between track and pipes would probably be much more, and the current strength per linear foot of pipe, perhaps less than one ampere."

Mr. Farnham said he could not agree with Mr. Kennelly that it would be more serious to have the corrosion take place in a limited territory, even though it were more rapid, than in a large territory. "Would it be more convenient," he asked, "to dig up all the paved streets of a large city once in ten years, or to dig up a radius of a thousand or of two feet once in a year? It is an open question which hydraulic and gas engineers must pass upon. But it would seem to me better to confine the trouble in a small serritory, even though you had to take other measures, put in larger pipes if you please, in that territory, rather than have the destruction slowly but surely going on all over your city. The suggestion of putting the positive side of the dynamos to the trolley and thereby bringing the danger territory near the station, was primarily for the purpose of rendering it more easy to treat the trouble with the return wire system which I have described.

"I would like also to remark in connection with the first speaker who opened the discussion, that I recognize the importance which he named, and the difficulty of having a good connection with all the pipes. As to how the connection should be made on water pipes has been considerably discussed. I am hardly able at present to advise. Whatever we do in this line we must watch constantly. We must take our voltage measurements frequently, as noted in conclusion 11. We can tell certainly by this whether there still is danger or not. As to the number of years that may elapse before pipes will be eaten through, is a question we hardly need to discuss. If the action is slow it ought to be prevented. We may easily determine whether there is danger or not, and whatever we do to remove the danger by these means, we must watch the electrical conditions constantly or we shall find ourselves again in trouble. In illustrating this fact let me say that since the system just described has been applied in Boston, the West End company has run out in one direction several large return wires in addition to those previously in use in that locality, and thus practically moved the power station, that is, it changed the zero line from its former location to a point very distinct, making it necessary to rearrange and extend the cable return wire system."

Prof. Houston said that one of the interesting points brought out was the fact that an exceedingly small potential difference was sufficient to effect electrolysis and that a fraction of a volt was sufficient to induce the action. He thought there was an error, for the disintegration of lead electrolytically in a storage cell required two volts. He continued: "Of course, if actual measurement, as Mr. Farnham has said, of the one one-hundredth of a volt can produce electrolytic corrosion of lead, why there is nothing to be said against actual measurement. I should, however, look very carefully at the source used, and the method by which the experimenter assured himself that he did not actually limit the potential difference to the small fraction stated."

Mr. Farnham replied that Mr. Lee, the chemist of the American Bell Telephone, had informed him that he produced the action easily by .01 volt. Dr. Leonard Waldo remarked that "as to the small voltages existing, and having the effect of corrosion, I think anyone who has actually made measures on those pipes in position, with and without the presence of electrical action is quite prepared to testify that the smaller voltage and the corrosion of the pipes are present at the same time; whether the corrosion is wholly due to the action of the current on the principal metal alone or not is quite another question."

A PLEA FOR INANIMATE POWER AND STEEL ROADS.*

BY MARTIN DODGE,
President Ohio Road Commission.

The two largest factors in the problem of improving our common roads are, first, the enormous cost of such improvement in the aggregate, if the system is co-extensive with our territory, and, second, the excessive cost of transportation over such roads, if animal power is to be applied. The mileage of common roads in the State of Ohio may be approximated at 80,000 miles. The cost of suitable improvement will be, in some sections, $9,000 per mile; in others it may cost as little as $3,000 per mile. If we have an equal amount of each kind, that would make an aver- cost of $6,000 per mile. Supposing this could be reduced to $5,000 per mile on the average, it would still cost the enormous sum of $400,000,000 to improve all the roads in the state. This enormous cost of construction is not so large a factor in the problem as the excessive cost of transportation over these roads when built. My own investigations, extending over a considerable period

*Abstract of an article in *Good Roads*.

of time and having reference both to short hauls and long hauls, satisfy me that our own rate in Ohio is twenty-five cents per ton per mile, and that there has been but little improvement or reduction in this cost in a generation or more, and that there is not likely to be much in the future.

Most people who discuss the subject of good roads assume that if any way could be devised to raise the enormous sum of money required for their construction, *then* the problem would be solved; whereas the fact is that if these roads were already built and could be maintained without cost, the excessive rate of transportation over them which prevails and must prevail, is destined forever to forbid their use for any considerable distances for the purpose of transportation.

We have reduced the cost of transportation with steam cars to so low a point as half a cent a ton per mile, which is fifty miles to one with horses. Upon steamships we have reduced it still more, so as to carry two hundred miles to one with horses; and, upon electric street cars we have reduced the cost of carrying passengers for short distances much below the cost that prevails upon the steam cars.

It seems probable that the application of electricity to the cars upon our streets and roads is destined to do for the short haul what the steam cars have already done for the long haul. So far as electricity has been applied already, it has shown that the cost of transportation by that means is far less than upon steam cars, which is indicated by the rate of charge for transportation—the common rate upon steam cars being three cents per mile for passengers, while in many cases upon the electric cars, it is but one cent and even less per mile. What has been done by way of cheapening transportation of passengers may be done to a great extent in cheapening the transportation of certain kinds of freight, especially the food products that are raised upon the farms and conveyed to the markets for immediate consumption.

The fact that we have made such great and unexpected improvements in the means of transportation by other means than with horses, while the cost of transportation by horse power has remained almost a constant unit, has led many to suppose that the great difference is owing to lack of skill or to inattention to wagon roads, and, with that view, the general attention of the people is now directed to the road question as never before. It seems most likely, however, that the improvements which we shall make in the future will rest upon the same economical advantages as the improvements that we have made in the past, and that we shall only succeed in securing a cheap transportation upon our common roads by substituting inanimate power for animal power. We have already reached the maximum power of horses and other animals for draft, speed and endurance. The only improvement that we could hope to make to lessen the cost of transportation with these animals would be in improving the roadbed. A comparison of cost will show that the average expenditure required to macadamize a road or make it hard with any kind of metal is fully equal to the cost required to lay down steel rails over which not only wagons and carriages propelled by horses but cars propelled by electric power might also go at a greatly reduced cost in transportation. Gilmore's tables show that the same vehicle can be moved over steel rails with one-eighth of the power that would be required to move it over a macadamized road, and with one-eighteenth of the power that would be required to move it over a gravel road, and with one-twenty-fifth of the power that would be required to move it over a common earth road in good condition.

Having given the cost of construction—which is the same for each kind of road; and the cost of moving a vehicle being so much less over the steel rails than over a road of any kind, and knowing also that the cost of inanimate power is less than the cost of animal power, it seems clear that the substitution of steel rails for macadamized roads and inanimate power for the animal power are destined to cheapen our transportation in the most effectual manner. The greatest difficulty is the question of terminal facilities. The profitable use of steel rails and the application of inanimate power can only be limited by the convenience or inconvenience of these terminal facilities, because it will always cost much less to move over a smooth steel rail than over a pavement, whatever power may be applied; this advantage may be neutralized by the disadvantage of loading and unloading—that is the only thing which, in the long run, will limit the application of this new power.

The Hon. John M. Stahl, makes an estimate of the wagon freight of this country for the year 1892 as five hundred million tons. He also estimates that this will be transported over country highways an average distance of eight miles, which would be equivalent to four billion tons one mile at twenty five cents per ton per mile,—which would be required to move it by horse power with ordinary vehicles, it would amount to the enormous sum of one billion dollars. This may be stated as the cost of operating the wagon roads. Now, if by substituting the steel rails and the inanimate power, there could be a saving of four-fifths of this amount, which would be much less than the proportion indicated by Gilmore's tables, the cost of moving this tonnage would be only two hundred million dollars instead of one billion dollars, leaving a gain of eight hundred million dollars;—this, for a period of ten years, would make a net sum of eight billion dollars

Neither the steam cars nor the street cars up to the present time have received the aid of public money, but there can be no doubt that both of these means have contributed more to reduce the rates of carriage without such aid than the wagon roads have done with it. It being the established policy of the people to aid in cheapening transportation by deepening rivers, harbors and channels, by building roads and bridges, streets and viaducts, all by appropriations of public money and by contributing the use of the streets and roads for electric cars, we see no reason why they might not as logically and profitably contribute to the construction of street railroads to be and remain a part of the common roads, as well as to the paving of these roads to be operated with horses and wagons.

As already stated, we have made great and unexpected improvements in the means of transportation where we have substituted other power for horse power, while we have made but little improvement in the cost of transportation where we have adhered to animals as the motive power. To this fact should be added the other important one, that millions and millions of dollars of public money have been expended to aid in cheapening transportation with horses, while nothing ha been expended to aid the means that have been most successful in cheapening our rates of transportation. If we should extend the same liberal policy to the electric car that we have extended to horses and wagons, by preparing a free track for it to go upon as we have for other vehicles propelled by animal power, the rate of transportation would be still further cheapened in the future as it has been in the past, and a lower rate can so be reached than by any other means. The economical advantages are so greatly in favor of steel rails and inanimate power that no objection can be sustained against their introduction unless it rests upon the supposed inconveniences of using this new means in the most commodious manner. In all our great cities and most of our smaller ones, double tracks are already laid and are being rapidly extended to the suburbs for considerable distances, from ten to fifteen miles; their use at the present time is entirely confined to the matter of carrying passengers, but after midnight passenger traffic is over, and from that time until five o'clock in the morning, these tracks are idle and the streets vacant. During that time they could be used to great advantage and with great economy for transporting fr ight and food products placed upon trail cars, to various markets and other places of distribution in the centers of population, so that the question of introducing steel rails and inanimate power is only a question of extension. The nucleus of the system already exists, and its use could undoubtedly be extended with great advantage. It is thought by some that a difficulty would arise in the matter of operating over such tracks. It is not suggested that the State or the public should operate vehicles, but only prepare the track over which the vehicles might go. Attention is called to the fact that many of the states have built, at a very great expense, a system of canals which they never operated, but allowed the owners of boats to operate at their own will upon payment of tolls for their use. It is also true, that all the roads and streets and bridges and viaducts of our country are built with public money and through public agencies; but none of them are operated by the State or the public, but vehicles are put on by various owners as canal boats are put upon the canals.

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

To Increase its Capital.—A bill is now in the Senate chambers in the Massachusetts state legislature, which if passed, will grant authority to the Lynn and Boston Railway Company to increase its capital to an amount not exceeding $3,000,000, over that now authorized, and the further right to issue mortgage bonds to the amount of about $5,000,000. The road is controlled by the North Shore Traction Company. A great many people, including many of the legislators themselves are opposed to the passing of the bill.

Underground Conduits.—Notwithstanding the efforts which have been and still are being made to obstruct the passing of the bill forcing all electric wires to go underground, the bill must become a law this session of the state legislature. The work will be done under the supervision of an inspector appointed by the mayor of Boston. One of the provisions of the bill is that not more than one quarter nor less than one-sixth of the area in the city proper, included in the bill, is to be treated each year, which means that in about six years from the time when the work shall begin, practically all of the overhead wires will have been buried in underground conduits.

To Regulate Stock watering.—One of the outgrowths of the petition of the Bell Telephone Company for authority to increase its capital by $30,000,000, now before the Massachusetts states legislature has been the introduction of a bill or bills to prevent the watering of stock by either railways, water, gas or electric companies. A most determined fight is now in progress on Beacon Hill. An effort is being made to secure the appointment of a board of commissioners who shall control such matters, it being considered only just that the interests of investors shall then be watched and cared for. In the course of a debate on the matter, one speaker said that there are over $350,000,000 invested in railways by more than 100,000 persons in Massachusetts alone.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

General Interest Increasing.—The ten days ending on Tuesday last have witnessed a most gratifying increase in the interest generally manifested in street railway securities. As explaining the rapidity with which these securities have leaped into public favor, it is well to quote here what Messrs. Pfeiffer & Pronick, large local investment brokers, who make a specialty of this kind of business, have to say: "The desirability of street railway stocks and bonds as investments is due to the fact that such securities are never affected by the causes usually influencing the course of quotations of other stocks. Street railway stocks are not liable to depression by change of rates, the 5 cent fare being rather well maintained everywhere; crops do not affect them, bad weather is generally a blessing and rate cutting is unknown. This freedom from disturbing influences makes them much more sought after than the stocks of steam railroads. Again, the street railway companies are required by law to make explicit quarterly statements of earnings and expenses to the State Railroad Commissioners, and this serves as a guide to investors and as an indication as to the progress made by the companies in question, whereas most of the corporations whose securities are offered in Wall street furnish no detailed information for months and months or ever for the benefit of would-be purchasers. Moreover, real good railroad bonds, the gilt-edged kind, are becoming scarcer every day and prices for them are reaching exhorbitant figures. This has set the tide of investment in the direction of street railway bonds. Note the steady demand for the new Broadway bonds. They are now selling around 109, some 10 points above the price at which they were first subscribed for, and yet people continue to buy them because they are cheap, when you compare them with Third avenue 5s which are quoted at 117½, or Brooklyn City Railroad 5s selling around 111½."

Third Avenue Railroad Shares, as predicted in this correspondence last week, now receive 4 per cent. semi-annual dividends, that being the amount declared at this week's meeting of the board of directors. Checks for that amount were received by the stockholders this week. The 4 per cent. dividend is an increase of 2 per cent. over the last semi-annual dividend and is a doubling of the dividend rate maintained since the increase of stock consequent upon the introduction of the cable system. It calls for the distribution of $280,000, which is more than the whole 12 per cent. dividends formerly paid annually on the original capital stock. The directors do not make any figures public, but they assert that quite a tidy sum was left over after paying the dividend. If this is so it bears out their assertion that the company is making more money than ever. Gross earnings are said to be gaining $1,250 a day, while the saving in wages alone is said to be $300 a day. Even ex-dividend, the stock continues to sell above 180. The transfer arrangements just inaugurated and recently treated of in these columns, have more than come up to the expectations of the management, and and the prospect of a heavy summer traffic is understood to be exceedingly good.

CROSSTOWN LINES.—A feature of the recent trading in street railway stocks has been the good inquiry made for the shares of the crosstown railways, especially for such as have become leased lines of the Metropolitan Traction Company. All these latter companies have made favorable leases, and, owing to the fact of continued increases in earnings, are much sought after by investors. The shares of the Dry Dock road are in demand but none are offered for sale. In the same way the shares of the Central Crosstown have risen 10 points (from 140 to 150) on the offer of a broker to buy all the shares he can lay his hands on. There are hints of early and important developments in crosstown railroad matters.

SECOND AVENUE SHARES continue in demand in consequence of the spread of the report, exclusively made by the STREET RAILWAY GAZETTE last week, that a change of control was contemplated. The syndicate aiming at a purchase of the controlling interest has now nearly enough stock in hand to make its scheme a success. Permission has not yet been given to identify the syndicate, but it may be stated without any breach of confidence that the Second avenue road will soon become a part of the Metropolitan Traction Company system in New York City. The section of the city traversed by the Second avenue line is the most densely populated part of New York. True, the Third avenue cable and the Third avenue elevated roads furnish some outlet for the enormous traffic north and south in this section, and the new Lexington avenue cable line of the Metropolitan Traction Company will when completed relieve the Third avenue roads of some of the congested travel during the busy years. But with a cable road on Second avenue and a cable road on Lexington avenue, the Metropolitan Traction will be in a position to force the Third avenue cable people, who have always displayed a most independent nature, to come to some kind of mutual understanding.

SIXTH AVENUE RAILROAD SHARES are steady. The company reports a net income for the quarter ended March 31 of $381,364. The balance sheet reported at the same time shows: Assets—cost of road, $1,893,133; stocks of other companies, $4,800; due by companies, $36,250; cash on hand, $21,142; real estate, bond and mortgages, $225,000; total, $2,180,325. Liabilities—capital stock, $2,000-000; due companies and individuals $10,094; profit and loss (surplus), $170,231; total, $2,180,325. Some other recently reported earnings are those of the Atlantic Avenue Railroad Company, which reports for April net earnings of $27,626. The Brooklyn Traction Company reports for April net earnings of $24,664 and a total income of $28,039. Gross earnings show an increase of 17 per cent. over April, 1893.

BROOKLYN CITY RAILROAD SHARES have declined from 175 to 165 and a further slump to 150 is predicted on the report that a further issue of either stocks or bonds for improvement purposes is contemplated in the near future. The Stock Exchange has just listed $4,140,000 of the $6,000,-000 bonds issued under the first mortgage on the consolidated properties of the company. The bonds bear 5 per cent. interest.

LONG ISLAND TRACTION has declined from 23 to 16½ on selling ascribed to a house which has been actively engaged in many of the recent street car deals. Brokers in the stock say that this house is taking advantage of the efforts of others to make the stock active and is unloading its own holdings. Some effort was made to support the stock by manipulation but without much success.

THE EARNINGS OF THE WEST END STREET RAILWAY for the six months to March 31 that have just been made public have led to renewed buying in Boston. It is shown that the net of $960,183 is more than half the year's charges and dividends at 6 per cent, which will be this year about $1,800,000, whereas last year, with 9 per cent. dividends, they will be $2,019,428. Interest payments this year will be increased by $45,000, (six months on $2,000,000 4½s), but taxes will be reduced $50,000 by the lower taxable price of the stocks May 1 and dividends on the $9,000,000 common stock will be 6 per cent. instead of 9 per cent. The management might do well, however, to listen to the renewed expression by many stockholders of a desire to have regular monthly statements published.

PHILADELHHIA TRADING has been unattended by any excitement of late. There is a slackening off of buying orders and the bears, undismayed by their experiences of a month back, are contemplating new raids. Nothing is doing at present, however.

Financial Notes.

Sale of the Centerville (Conn.) Railway.—The Centerville Horse Railroad Company has been formally transferred to the New Haven & Centerville Street Railway Company. Cornelius Pierpont, as trustee, deeded the property in behalf of the second mortgage bondholders. Negotiations for the sale of the property were first made in January, 1893, and the price fixed was $225,000.

Nashville United Electric.—The purchasers of the United Electric Railway Company have organized as the Nashville Street Railroad Company. Gen. W. H. Jackson, Capt. T. M. Stegar, Nat. Baxter, Jr., and R. L. Jackson were elected directors. The directors elected W. H. Jackson president, Capt. T. M. Stegar vice-president and R. L. Jackson secretary and treasurer.

Interest on Milwaukee Bonds Waived.—The holders of the Milwaukee Street Railway Company's bonds have agreed to waive the interest to which they are entitled for a period of eighteen months, or until June 1, 1895. The interest is already six months in arrears. The bonds outstanding amount to $10,000,000.

Stillwater, Minn.—The bondholders who purchased the street railway will organize a company with $75,000 capital stock, to be known as the Stillwater Electric Railway Co., and will extend its lines and make additions to its rolling stock.

NEWS OF THE WEEK.

Calais, Me.—The Worcester Construction Company of Worcester, Mass., has been awarded the contract for the construction and equipment of eight miles of electric railway for the Calais Street Railway Company. The company will utilize the water power of the St. Croix river for operating its generators. The road will be ready for operation by July 1. The company has elected the following directors: H. B. Goodenough of Boston; I. C. Libby, Waterville; Amos F. Gerald, Fairfield; C. A. Richardson of the Worcester Construction Company, Worcester, Mass.; G. A. Curran, G. D. Hill, W. A. Pike, the latter three residents of Calais. H. B. Goodenough was elected president; I. C. Libby, treasurer. Amos F. Gerald, vice-president and general manager; G. A. Curran, clerk.

Elwood, Ind.—The project of building an electric railway to connect Elwood, Alexandria, Frankton and Anderson has been revived and a company has been formed with a capital of $1,000,000 to carry out the work. M. S. Eringer of Indianapolis and some Chicago capitalists are interested in the project, while citizens in the four cities above mentioned have taken stock. According to the announced plans, there will be twenty-five miles of track and four power houses, one at each city. At a central point between Frankton and Elwood an immense park of forty acres will be laid out and fitted up with the latest improvements and conveniences.

Gettysburg, Pa.—During the winter and spring months the Gettysburg Electric Railway Company has built a mile and a half extension and has greatly improved its line. Despite the opposition to the railway, the beneficial results of its operation are manifest. A large, modern new four-story brick hotel has been erected in place of the old frame "Eagle Hotel,". recently destroyed by fire, and several of the other old hotels have built commodious brick additions. The railroad has also added an electric light plant to its equipment, and the old town has passed from the stage of tallow dips and kerosene. All the hotels and streets as well as the battlefield are now illuminated by electricity.

Woodbury, N. J.—The Camden, Gloucester & Woodbury Electric Railway commenced making regular trips from the Court House in Woodbury to Camden last week. The officials of the road and a number of city councilmen and invited guests made the initial trip. The fare for the round trip between Woodbury and Camden has been placed at 20 cents. The Almonesson extension is graded to that place and the tracks will probably be finished within a week.

Brooklyn, N. Y.—As trolley competition continues to decrease the receipts of the Brooklyn Elevated Railroad, further economizing measures have been adopted. The men and women ticket agents, who have been working twelve hours a day at so much an hour, will be employed for only ten hours and from 1 A. M. to 5 A. M the fares will be collected by the conductors. The women who have been getting $1.43 a day, will now only receive $1.20 and the men have been cut down from $2 to $1 67.

Philadelphia, Pa.—At the last meeting of the council ordinances were introduced granting the following companies the right to install the trolley system: The Citizens' North End Street Railway Company, the Citizens' Passenger Railway Company, the Citizens' Clearfield and Cambria Streets Railway Company, the Brown and Parrish Streets Railway Company and the Citizens' East End Street Railway Company.

Kansas City, Mo.—The announcement is made that the Metropolitan Street Railway Company has secured control of the Kanas City Elevated Railway Company. Although for the present the two roads will be operated as separate companies, yet their transfer arrangement will be such that so far as the general public is concerned they will be one, and it is predicted that as soon as the necessary formalities can be arranged the two will be consolidated into one corporation.

Milwaukee, Wis.—An ordinance has been introduced in the city council providing that fares on the street railway shall be 3 cents during hours in the morning and evening when working people are going to and from their places of employment. As the company has not been making money it will resist strenuously the efforts to reduce its income.

Baltimore, Md.—The contract for grading the Point Breeze electric railway has been awarded to Sanford & Brooks. The line starts at Highlandtown and extends to Point Breeze, a distance of three miles. The line will be probably completed in three months.

Belleville, Ill.—The Belleville Electric Railway Company last week closed a deal with the East St. Louis Electric Railway Company for terminal privileges in East St. Louis and will begin the construction of an electric line between the two cities at once.

Chicago, Ill.—At the last meeting of the City Council an ordinance was introduced giving a franchise to the Northern Electric Railway Company, which proposes to build a road commencing at West 47th street.

Oshkosh, Wis.—J. K. Tillotson of Toledo has been granted a franchise by the city council. It is provided that at least eight miles of road shall be in operation within six months.

Akron, O.—The Akron Street Railway Company has secured consents of property owners for the construction of a line to Barberton. The road will be built during the summer.

Keokuk, Ia.—J. C. Hubinger, the purchaser of the street railway property, has announced his intention of operating the system by gas motors instead of by electric cars.

Springfield, Mass.—The Chicopee board of aldermen has granted a franchise to the Springfield Street Railway Company to build an extension to Chicopee Falls.

Baltimore, Md.—The Lake Roland Elevated Railway Company began operations a year ago last week. During the year it carried 4,652,000 passengers.

Port Byron, N. Y.—An electric railway from Port Byron to Skaneateles by way of Auburn is projected. The estimated cost of the road is $100,-000.

Mt. Pleasant, Ia.—The Mount Pleasant Street Railway Company has been incorporated. Work will be begun as soon as a franchise is granted.

Fort Wayne, Ind.—The Centlivre Car Company of Fort Wayne proposes to double track its line and to introduce an electric system.

Rockford, Ill.—F. G. Jones has accepted the position of general manager of the Rock River Electric Railway Company.

PERSONAL.

James R. Chapman's Resignation at Grand Rapids.—In reference to the resignation of James R. Chapman from the position of general manager of the Consolidated street railway system of Grand Rapids, to assume the position of general manager of the electric railway system of the North Chicago Street Railway Company, the Grand Rapids *Press* says: "The citizens of Grand Rapids have met with a loss of a valuable and valued citizen in the resignation of Mr. Chapman as vice-president and general manager of the street railway system. In no other one thing has this city made so decided a step in that advancement which is indicative of healthy progress in modern cities, as in the splendid street railway transportation facilities built and perfected under the master hand of Mr. Chapman, to whom most, if not all, the credit is due."

Austin H. Roby, of the Duplex Car Company, Boston, was a caller at the New York office of the STREET RAILWAY GAZETTE this week.

TRADE NOTES.

Good Traction Earnings.—The weakness displayed by Philadelphia Traction the past few days cannot, according to the Philadelphia *Stockholder*, be attributed to an unfavorable showing of the earnings, as there has been marked improvement in them since the Ridge avenue trolley was started. In no single day from May 1 to May 10, inclusive, has there been a decrease over the corresponding day last year; on the contrary, the increases have ranged between $94 and $2,175, the total increase for the ten days having been $13,317, or an average daily increase of $1,331. The average increase is decidedly larger than anticipated, as recent estimates of the company's increase for the year have been based on an average daily increase of only $600. The Metropolitan's earnings are also showing a steady improvement, though not to the extent of Philadelphia, as. for the first eleven days of May, there were three days on which earnings fell behind those of the corresponding days last year. The aggregate increase for the eleven days, however, deducting the three days' decrease of $2,188, was $6,810, or an average of $619 per day. The returns of the Baltimore Traction for the same period are less encouraging, showing, as they do, a daily decrease, ranging from $109 to $802. The aggregate decrease for the first eleven days of May was $5,167, or an average daily decrease of $469. The decrease, however, is in gross, not in net, and it is understood the showing made by the latter will be more favorable because of largely reduced expenses.

The General Electric Company reports the following orders for railway apparatus taken during the past week from the New York office alone: Brooklyn, Queens County & Suburban Company, 450 motors; Bridgeport (Conn.) Traction Company, 60 motors and generators; Danbury (Conn.) Street Railway Company, 20 motors; New Haven (Conn.) Street Railway Company, 20 motors and generators; Hartford (Conn.) Street Railway Company, 8 motors; Allegheny Traction Company, Pittsburg, Pa., 30 motors and generators; Jacob Rich, San Jose, Cal., 2 equipments and generators; W. B. Ferguson, Boston, generator; Franklin, Pa., 6 motors; Electric Traction Company, and Peoples' Traction Company, Philadelphia, Pa., large marble switchboards.

The Charles Munson Belling Company reports trade very much improved the past six weeks. The company has received orders for a number of large belts, and contracts have been awarded to the Munson company from quite a number of large manufacturing establishments for their entire equipment of belting. The company has just completed arrangements with the L. M. Rumsey Manufacturing Company, of St. Louis, to handle the different brands of Munson belt in the southern territory; and arrangements have also been made with the Revere Rubber Company to have a full line of different brands of Munson belt in stock at its San Francisco and Minneapolis houses.

John S. Parmele, formerly manager of the fixture department of the Great Western Electric Company, and Mr. George F. Heald, formerly treasurer of the American Bronze Company, have connected themselves with the McLean Armature Works, Chicago. This company reports a steady improvement in its business of winding and repairing armatures and electrical apparatus, and will enlarge its works, so as to retain its reputation for promptness.

Manhallan Earnings.—The statement of the Manhattan Elevated Railroad Company for the quarter ending March 31 is follows:

	1894.	1893.	Inc.	Dec.
Gross	$2,560,755	$2,776,467	......	$215,712
Net	1,162,182	1,346,093	......	183,911
Other income	37,500	35,000	$2,500	....
Total	1,199,682	1,381,093	......	181,411
Surplus after charges	555,761	726,002	......	170,241
Balance of divisions	105,761	276,002	......	170,241

Col. McGuire of the McGuire Manufacturing Company, Chicago, has just returned from a hasty trip to the Pacific Coast. While there, he took an order from the Los Angeles Consolidated Railway Company for 50 of the company's celebrated bicycle trucks. The company is also in receipt of orders for the bicycle trucks from Boston, Hamilton, Ont., the New Jersey Traction Company, Jersey City, and other places.

General Manager Robinson of the Laclede Car Company of St. Louis in a letter to the McGuire Manufacturing Company, Chicago, says: "I was at Indianapolis three hours last Saturday and President Mason could not say enough in praise of your double truck now in use on his road."

Gilbert Car Works.—It is stated that the Gilbert Car Works on Green Island will be sold to the New York Central for $500,000, and that the plant will be used for the construction and repair work of the Delaware & Hudson.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued May 8, 1894.

519,328. Conducling Device lor Electric Railways. David F. Graham, Springfield, Ohio, and William P. Allen, Chicago, Ill., assignors of one-third to Oliver S. Kelly, Springfield, Ill. Filed October 25, 1893.

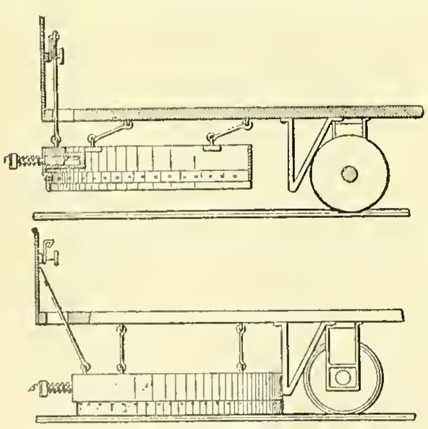
In an electrical contacting device, a central standard, a hinged shuttle connected thereto, and a pivoted frame connected to said shuttle, contacting devices on said frame and shuttle respectively, and an electrical connection between the respective contacting devices.

519,338. Electric Swilch. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car-Heating Company, Wheeling, W. Va. Filed August 2, 1893.

In an electric switch, a cylinder provided with a series of passage ways cored therefrom, and extending in a path parallel to its axis, a seri s of metallic plugs placed within said passage ways, insulating material placed between said metallic plugs, the periphery of the cylinder cut away immediately above each of said plugs, leaving each of said metallic plugs flush with the surface.

519,380. Conduit Electric Railway. James F. Cook, Mansfield, Pa. Filed February 5, 1894.

In an underground conductor street railway system a trolley arm having a horizontal upper arm or arms journaled in bearings secured to the framework of the car, a downwardly extending middle portion made narrower



NO. 519,402.

than the arms for passage through a slot, and a lower horizontal arm provided with a wheel, the entire trolley arm being made of two halves secured together, and inclosing a wire in the center.

519,402. Life Guard for Slreel Cars. James Campbell, Brooklyn, N. Y. Filed September 21, 1893.

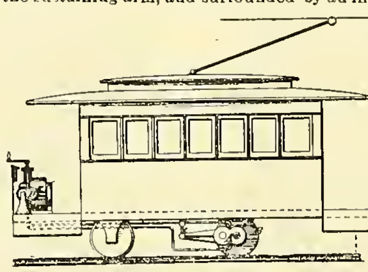
In a life guard for street cars, etc., the combination of a V-shaped fender suspended on links; a lifting rod formed with a shoulder; and a spring latch. upon the body of the car for engaging said shoulder on the rod and holding it and said fender in an elevated position. (See illustration).

519,442. Slove lor Healing Slreel Cars. Menard K. Bowen, Chicago, Ill. Filed October 14, 1893.

In street car heaters the combination of a circular back casing with the braces which where they come in contact with the casing of the stove, possess a form corresponding to that of said casing and which may be moved forward or backward around the arc of the casing to fasten it to any car seatback of whatever width. (See illustration).

519,446. Trolley Wire Hanger. Albert B. Crounse and Charles A. Rutledge, Passaic, N. J. Filed July 21, 1893.

A trolley hanger or support insulated at its upper end from the sustaining arm, and surrounded by an insulating



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sleeve, in combination with a petticoated insulator secured to the insulating sleeve by a screw thread. (See illustration).

519,469. Electro-Hydraulic Car Motor. Charles E. Emery, Brooklyn, N. Y. Filed March 27, 1891.

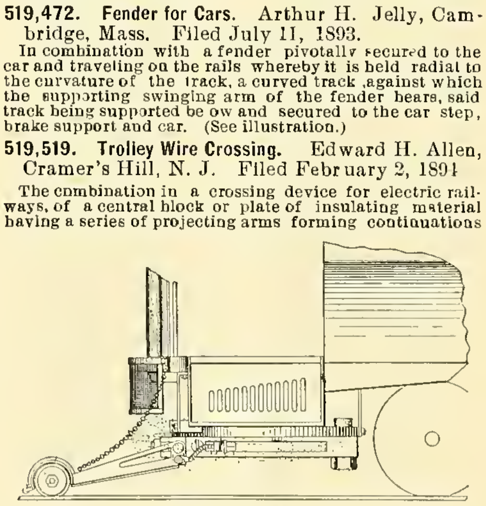
In combination with an electric motor, a series of pumps of different sizes operated thereby, a hydraulic motor operated by the fluid delivered by such pumps and suitable valves and connections all operable at will to transmit fluid from the pumps to the hydraulic motor and operate the same at different relative velocities proportioned to the size and number of pumps at the time in use. (See illustration.)

519,472. Fender for Cars. Arthur H. Jelly, Cambridge, Mass. Filed July 11, 1893.

In combination with a fender pivotally secured to the car and traveling on the rails whereby it is held radial to the curvature of the track, a curved track against which the supporting swinging arm of the fender bears, said track being supported be ow and secured to the car step, brake support and car. (See illustration.)

519,519. Trolley Wire Crossing. Edward H. Allen, Cramer's Hill, N. J. Filed February 2, 1894

The combination in a crossing device for electric railways, of a central block or plate of insulating material having a series of projecting arms forming continuations



NO. 519,446.

of the conductors and provided with clamping devices for engaging said conductors.

519,562. Car Fender. Carl Bersch, Baltimore, Md. Filed September 25, 1893.

In a fender, the combination with a guard or fender proper and a pivoted frame carrying said guard or fender and having an upwardly extending toothed bar; of a swinging support adapted to engage the toothed bar of the guard frame so as to normally hold the guard above the ground or surface of the track, and a suitable means for moving the swinging support so as to release the guard frame.

519,586. Cable Replacer. John Z. Murphy, Chicago, Ill., assignor of one-half to Frank W. Hudson, same place. Filed December 23, 1893

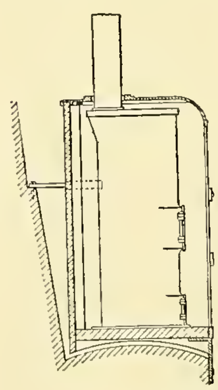
The combination with a traveling cable and rotary supporting sheave therefor, of a rotary replacer for said cable at the side of said sheave, comprising a cone-frustum-shaped extension of the sheave provided with a circumferential cable-engaging worm.

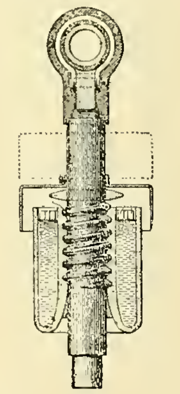
519,587. Car Brake. Frank P. Musser, Beaver Falls, Pa. Filed January 23, 1894.

In a brake mechanism, the combination with the brake bar the clog and the vertically movable shoe having a pivoted friction block at its lower end, of the levers pivoted to said shoe, the cranks to which said levers are also pivoted, secured to a short transverse shaft, the arm secured to said shaft and the operating lever and connections.

519,621. Trolley Wire Hanger. Charles F. Strasburg, Lincoln, Nebraska. Filed August 31, 1893.

A trolley wire hanger having a body portion which is provided with a rectangular groove or seat for the trolley wire and having a central lug rising from the upper side





NO. 519,469.
NO. 519,472.

of said body portion, to which it is braced by integral webs, the forked upper end of the lug, being divided by a central longitudinal slot extending into the webs.

519,648. Safely Car Fender. George C. Schmidt, Baltimore, Md., assignor of one-half to Abraham Harmon, same place. Filed July 25, 1893.

In a fender for cars, the combination of a number of resilient spring fingers, each secured at its upper end and having its lower end free: a rigid stay-bar having position in the rear of the spring fingers; and a vertically disposed revoluble roller in advance of the spring fingers and midway between the rails of the car track.

519,674. Electrical Propulsion ol Railway Cars. Jean J. Hellmann, Belfort, France. Filed December 18, 1890.

An electric railway car, comprising a body provided at one end with a sharp prow, and at the rear end with rearwardly extending wings, hinged to each side, a bogie truck at each end, electric motors mounted concentrically on the axles of said trucks, and a compound steam engine, one or more dynamos driven thereby, and a steam generator, all inclosed in said car body, said dynamo or dynamos being connected with said motors.

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VOL. X. CHICAGO, MAY 26, 1894. NO. 21.

CONTENTS.

New York Rapid Transit. Governor Flower has signed the New York rapid transit bill, and it might be thought that the metropolis was now in a fair way to improve its transportation facilities. There is a vast deal of opposition to the measure in influential quarters, and it is by no means incredible that the purpose of the act will be defeated. In his memorandum Governor Flower seems to incline to this view as he remarks that although the present bill may not prove to be what was wanted its passage is a good thing, as it may be a stepping stone to the legislative act that is necessary.

Electrolysis in Boston. We present elsewhere in this issue an interesting contribution to the reports of investigation of the results of the corrosion of pipes and cables by electrolysis. The subject is considered in the annual report of the Boston Water Board, and the engineers who make the report incline to the belief that serious corrosion is now in progress though they are frank enough to admit that it still remains to be shown whether it is a serious factor in lessening the life of the piping system as a whole. No specific recommendations are made as it thought that the data as still so incomplete that positive inferences are not warranted. However, they believe in the use of heavy copper returns.

West End Generosity. We are pleased to note the generosity displayed by President Little and his board of directors in providing for the immediate necessities of the unfortunate employes who suffered loss in the Boston fire of last week when more than twenty conductors, motormen and shop hands upon whom nearly seventy children depended for support were deprived of their homes and in many cases their entire possessions. President Little personally looked after the needs of the men, and the company generously provided housekeeping outfits, groceries, provisions etc., for their immediate use. It is certainly an indication that the officers of the road have a kindly interest in the welfare of its employes—much more than it has often received credit for possessing. The example set in this particular instance is certainly worthy of imitation by those thoughtless employers who think their only object in life is to reduce expenses and increase dividends.

Storage Battery Traction. The idea of securing a satisfactory and serviceable storage battery for traction purposes has not by any means been abandoned. One company is at present experimenting in Chicago with one car fully equipped and doing regular service, while another investigator hopes to solve the problem by using a modified form of the alkaline cell, which he is now testing at his laboratory in this city. He hopes to be able to equip a car with sufficient battery power without exceeding 1,000 pounds as the weight of the cells necessary. Although no actual experiments have been made with a fully equipped car the figures so far obtained in tests actually made would seem to indicate that the above results can be obtained. It may be, however, that in actual service, where a very different condition of affairs exists, quite different results would be developed. It goes without saying that a satisfactory cell requiring only 1,000 pounds for a complete car equipment would be of the greatest consequence.

Senseless Ordinance Disapproved. The mayor of Baltimore has disapproved a particularly objectionable ordinance recently adopted by the city council. The measure provides that street cars running in the same direction on the same tracks should at all times remain at least fifty feet apart. The enforcement of such an ordinance as this would sadly interfere with the transportation facilities of any great city. When large numbers of cars are operated on any line they are bound to approach each other very closely in the centers of cities where travel is always slow. To comply with such a measure in almost any city would involve a very decided decrease in the number of cars in service. Imagine an attempt to put into force such an ordinance in Broadway in New York City, or in Tremont Street, Boston. The object of the ordinance was to decrease the congestion in the central part of the city, but such a desideratum cannot be accomplished in any such way. If good street car service is desired the inevitable result must be a multiplication of cars in those sections of the city where the lines converge.

End of the Brooklyn Strike. In view of the fact that street railway companies have found it necessary to reduce wages in many cases during the last year the number of strikes has been extremely small. Most of these strikes have been short-lived and have not been attended by such scenes of violence as one has been accustomed to expect when street railway employes endeavor to enforce their demands by a strike. This has been gratifying to the public as well as to the companies; yet it has been proved that the men have gained their points fully as often as when they and their sympathizers gave evidence of their earnestness by destruction of property or by assaults on new employes. The strike in Brooklyn this week may be cited as an example. Had the men followed the course of Brooklyn street railway employes in former years a bitter struggle might have ensued, accompanied by violence and vexatious inconvenience to the public. As they remained generally quiet and inoffensive the trouble was soon patched up by a compromise that was mutually satisfactory. It is to be hoped that street railway men may learn a lesson from the issue of this strike. If they adopt this means to coerce their employers they will find that their surest hope of success lies in a determination to refrain from acts of violence.

Increasing Business. Very few street railway systems have escaped the results of the past twelve months of financial depression. In many cases very heavy decreases in the traffic have been reported, and this was especially the case where roads were so located that much of their daily revenue was derived from the transportation of workmen to and from the shops which were among the first to feel the effects of the financial depression. It is a satisfaction, however, to note from the monthly and quarterly reports of many of the companies that the traffic receipts are rapidly recovering their former volume. This is especially noticeable in the reports made in our financial news columns this week. The present volume of passenger traffic is rapidly becoming satisfactory and the outlook is reported as excellent for the summer months when the volume of travel is always at a maximum. These reports cannot fail to add to the confidence which investors have only recently placed in the intrinsic value of street railway securities and consequently lead to the extention of existing lines and the building of new ones. The greatest development is to be looked for along the line of suburban roads and the extension of the existing service to the transportation of freight, express and mail matter over the same track but in specially built cars.

Lightning Arresters. A great deal of practical information was contained in the lecture delivered by Mr. A. J. Wurts at the meeting of the Chicago members of the American Institute of Electrical Engineers on Wednesday evening of this week. This lecture was practically the same as that delivered before the Society of Arts in Boston a few weeks ago, when it was reported quite fully with illustrative diagrams in our columns, and dealt very largely with the phenomena experienced in the operation of lightning arresters, or more properly lightning "deflectors" as one of the members preferred to call them, upon street railway lines. This lecture is published in full in the May number of the Institute *Transaction* and will well repay the most careful study that any street railway manager may be able to give it. No subject connected with central station operation is so little understood and yet it is not at all a difficult one when carefully examined. Mr. Wurts points out in a very practical way the necessary requirements for successful protection and explains very clearly why the arresters as often installed fail to protect central station apparatus. He certainly deserves the thanks of everyone who has been able to attend the various experimental lectures he has recently delivered on this subject and for his honest endeavor to educate central station men and others interested in the vagaries of the lightning flash and in the methods employed for protection against its damaging effects.

STRIKE IN BROOKLYN.

All the lines of the Atlantic Avenue Railroad Company were crippled on last Sunday because the men were not allowed to go to work as a result of their refusal to purchase uniforms in accordance with an order of the company. Six hundred men failed to appear in the new dress, and few cars were run during the day. On Monday the strike or lockout was extended to the Brooklyn Bath and West End road and 700 motormen were unemployed. The company property was well protected by the police, and policemen rode on the few cars that were operated. Some of the trolley wires in the outlying districts were cut. The most serious trouble occurred on the Seventh avenue line, near the Twentieth street depot. At 4 o'clock three cars were run out from the stables in charge of new motormen and conductors. They had only gone a short distance when a crowd of men and boys in sympathy with the strikers rushed forward from the adjoining street corners and stopped the cars by blockading the tracks with rocks, barrels, window shutters and other obstructions. A shower of stones landed on the cars, smashed the windows, and frightened the motormen so badly that they deserted the cars and took to flight. The few policemen on duty were unable to prevent the riotous demonstration, but before the arrival of the reserves from the Fifth avenue station the crowd had dispersed.

During the scrimmage one of the cars was derailed. The cars were taken back to the station and no further attempt was made to start them. At 6 o'clock traffic was suspended for the night on all the other lines.

Repeated efforts were made during the day to compromise the matter, and at night President Norton yielded a point which put an end to the trouble. While the company insisted on the purchase of the uniforms by the men, it was willing to postpone until July 1 the time of the purchase. The men would not be required to make any deposits, and those whose uniforms were in good condition would be allowed to wear them. As a further concession the men were not "docked" for the time the lockout continued.

TO DETERMINE THE RESULTS OF ELECTROLYSIS.

A. J. O'Reilly, supervisor of city lighting of St. Louis, recently addressed to the committee on public buildings and city lighting of the Board of Public Improvements, the following communication relative to a method of ascertaining the results of the electrolysis of water pipes:

It being desirable to make records of the electrolysis at various places along the water pipe system of the city that comparison may be made of the relative extent to which the electrolysis is going on during a definite time in various parts of the city, and, as this cannot be done with any degree of accuracy with the instruments available for the purpose, without a great increase in the number of observers, the following method has been determined upon by the Water Commissioners and myself.

A connection will be made with the water pipe at convenient stop valve and fire plug boxes with a small copper plate of known weight, and placed in the moist earth close to the water pipe, and allowed to remain there for a definite time, its percentage of gain or loss in weight will be a measure of the current passing to or from the pipe through the plate and into the earth at that place. As a check, a similar test piece of copper, not connected to the pipe, will be buried close to the other in such a way that it will be subject to the same conditions from action of soil and moisture on the copper which may take place independent of the electric current from the water pipe. The proper corrections are to be applied on account of the action that may be set up between the iron and the copper independent of the earth return currents under consideration.

I am led to believe that, by continuing experiments of this kind and keeping proper record thereof, the affected territory can be definitely circumscribed. The determination of the direction of the street railway return currents must be by voltmeter and ampere meter methods.

NEW YORK RAPID TRANSIT BILL SIGNED.

Governor Flower of New York has approved the Chamber of Commerce Bill which provides for a new rapid transit commission in New York City. In approving the bill the governor filed a long memorandum summarizing its provisions and setting forth the reasons which had led him to attach his signature to the measure. At the outset he refers to the bill in these terms:

"This is popularly known as the 'Chamber of Commerce Rapid Transit bill.' It amends seven sections of the Rapid Transit act of 1891, leaving the remaining thirty-one sections untouched, and inserts thirty-five new sections.

"The original act of 1891 authorized the construction and ownership of the rapid transit system by a private corporation. The new sections added by this bill give to the city of New York the option of municipal construction and ownership. Such option is to be determined by the electors of the city at a general election. If the result of the election be in favor of municipal ownership, the original act of 1891 becomes permanently inoperative. If the result of the election be against municipal ownership, then the new sections added by this bill become permanently inoperative, and the efficiency of the original act of 1891 is restored, with only two changes of importance—first, the establishment of a new board of rapid transit commissioners, and, second, the limitation to five cents for a single fare."

He considers at length the allegations that the bill is unconstitutional, and does not find them pertinent. The memorandum concludes as follows:

"Other minor objections have been raised to the bill, which it is not necessary to further discuss. It already sufficiently appears that the problem of rapid transit for New York City is not easy of practical solution. I consider this bill a sincere attempt to solve the problem. But other equally sincere attempts have preceded it and have failed. It may be that this measure will postpone the final solution of the problem until it also in its turn can be repealed and a new attempt made by further legislation, but, if such be the unfortunate result, the experience of one more attempt and failure will furnish guidance for a new act which shall avoid the possible blunders of this. But I do not think the bill can do serious harm, and the final responsibility for its efficiency for good or evil rests where it ought to rest, with the people of the city of New York.

"I sincerely hope that the new rapid transit commissioners created by this bill, and the common council, may promptly agree upon the route and plan of a rapid transit for New York City, and that the rapid transit commissioners may be able to comply before October 7, next with all the conditions preliminary to the submission of the question of municipal ownership to the city at the coming fall election, so that the people may promptly determine whether they wish to adopt the new system proposed by the bill."

Radically different opinion regards the merits of the bill prevail among those whose names are closely associated with the rapid transit movement in New York. Mayor Gilroy alleges that the bill is unconstitutional and that it is the most pernicious act passed by the legislature. William Steinway was greatly gratified to know that the governor had signed the bill, and said he thought the election could take place in the fall. Abram S. Hewitt said he thought the city would now be able to secure rapid transit. Russell Sage said he had been opposed to the bill and he believed it was unconstitutional.

STORAGE BATTERY TRACTION IN LONDON.

A few weeks ago, it will probably be remembered, some experimental runs were made in the city with a self-contained electrically propelled light vehicle, which appeared of a very promising character, says the *Practical Engineer* of London. From a letter which appeared in the *Times*, however, it would seem that any efforts to introduce vehicular traffic of this kind at present are liable to instant suppression. The correspondent in question wrote the Commissioner of Police for information as to the conditions under which such vehicles could be used in the metropolis, and in reply to his inquiries this functionary informed him that "an electric van is a locomotive within the meaning of the Locomotive Acts, and subject to the provisions of those acts as regards not going at a greater speed in a town than two miles an hour, with a man walking twenty yards in front and having three men to drive," etc. It is, of course, needless to say that such ridiculous restrictions utterly preclude the use of an electrically propelled vehicle for the purpose of ordinary light traffic, and practically extinguish the use of electricity or any other motive force for ordinary road vehicles.

LIGHT AND POWER PLANT NEEDED IN MESSINA.

Charles M. Caughy, United States Consul at Messina, has sent to the State Department a report in which he states that an electric light plant could be profitably installed in Messina. The present contract for illuminating the city by gas expired in March and action will be taken next month on a new contract. The prices charged and the character of the existing service are unsatisfactory to the residents of Messina. The company could also furnish power to a street railway company. The report says:

As to the motive power there is one applicant already in the field willing to adopt it as soon as it is installed, and that is the tramway company, which runs its lines from Messina to Faro Point, a distance of 9 miles, and to Barcelona, a distance of 30 miles. At present the road is operated by dummy engines.

I realize that the first questions that will arise are, what will be the cost of constructing a plant and what will coal cost? When I say that the average price for unskilled labor is 35 cents, and for skilled 45 cents per day; that the laying of stone, including cost of material, is 50 per cent. cheaper than brick; that lumber is no more expensive than in the United States; that land is remarkably cheap, and that Cardiff coal costs, delivered on the wharf, $4 per ton, I think the questions are satisfactorily answered.

Before writing this report I made a thorough canvass of the business men of the city, and they, without exception, promised their most earnest coöperation, both with their influence and their purses, to make the installation of an electric plant in Messina a success.

With the day of deliverance from the thralldom of a gigantic monopoly at hand, the advent of any Moses will be hailed with joy, and if he come from the West, with which the commercial interests of Messina are so closely allied, he will receive the heartiest of welcomes.

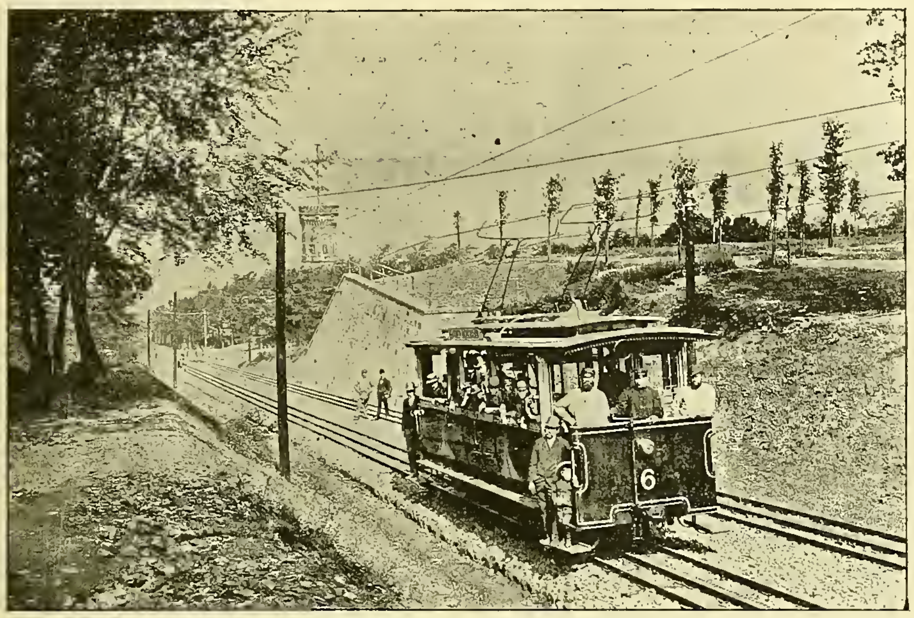
Let me say to those companies who may see fit to enter into competition that they should do so personally, so to speak, by sending a well-equipped representative to look over the ground, and to be on hand to meet any emergency or to answer any question that may arise. To enter into correspondence and overwhelm those in authority with circulars, indorsements, etc., printed in a language that, to most of them, is unintelligible, is a sheer waste of printer's ink, stationery, and stamps. The fast steamers of the Hamburg-American line leave New York every two weeks, and land their passengers in Naples in ten days, from which place it is only a night's sail to Messina. A personal representative will, I am sure, be productive of good results, while correspondence will only tend to fill the waste basket.

I do not wish for one moment to be understood as saying that the installation will be an over-easy task to accomplish, for the gas comany is in no wise different from like corporations in the United States, and no doubt will make a bitter fight, but in this case the intruder will find helping hands awaiting him from a long-oppressed people, who will only too gladly array themselves on the side of progress.

Hammond, Ind.—It is likely that a new street railway will be started within the next thirty days. One of the projectors of the enterprise is Thomas Burnham, of Chicago, who owns large tracks of land in West Hammond and Burnham. The line will be started from the Indiana-Illinois state line, will run through West Hammond and Burnham, and will make connection with the Calumet Electric Railway at One Hundred and Fifth or Ninety-fourth streets. By this route the trip to the heart of Chicago can be made in an hour.

BARMEN ELECTRIC RACK RAILWAY

The cities of Barmen and Elberfeld, which occupy prominent positions among German industrial centers, possess attractive suburbs, but until recently the parks and resorts in these localities have been difficult of access. The



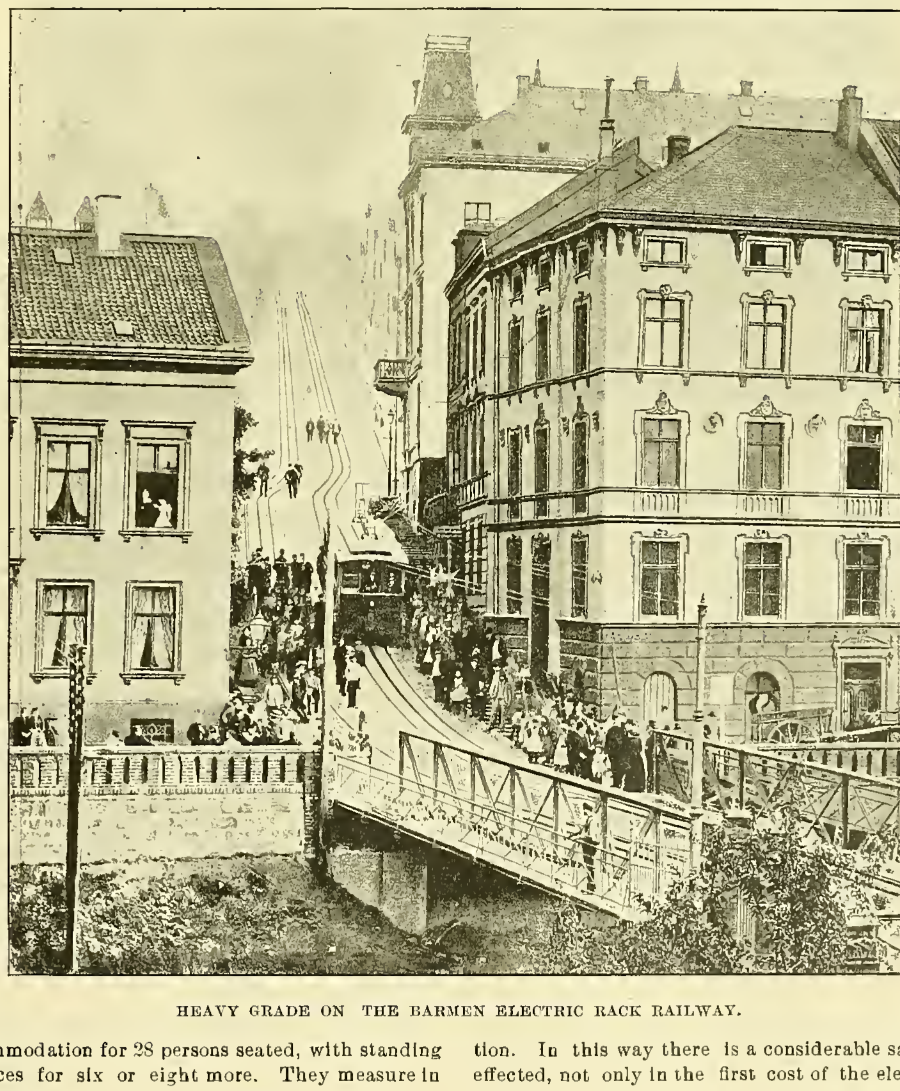
CAR ON THE BARMEN ELECTRIC RACK RAILWAY.

neighboring hills made the trip to the resorts so tedious and fatiguing that they were not as popular as they otherwise would have been. For a long time a demand existed for a quick and inexpensive means of transit from the town centers to the outlying districts. At first proposals were made for the construction of a gravity cable railway like that at Giessbach where a car at the top of the grade is weighted with water sufficiently to draw up an ascent a car connected to the same endless rope. This plan was abandoned as well as that which contemplated the introduction of locomotives. A plan for an electric rack railway was finally submitted by Siemens & Halske and it was accepted by the Barmen Mountain Railway Company.

The line begins in the center of the town in a large terminal station. By means of an iron bridge, 65 feet span and 30 feet wide, it crosses the Bergisch-Märkische State Railway, thence passing over the Kampstrasse on the level, it climbs up the extremely steep incline of Luisenstrasse, the gradient being not less than 1 in 5.4. On the ascent it connects with a narrow gauge line worked by steam locomotives, which makes connection with the Ronsdorf-Müngsten Railway, and thereby gives easy and rapid communication with all the popular resorts within the neighbor hood as far as Remscheid, Müngsten, and other towns.

The total length of rack line is about one mile, in which distance it rises about 550 feet. The mean grade is, therefore, in round numbers, 1 in 10, the steepest being, as already mentioned, 1 in 5.4 and 1 in 7.2. The sharpest curve, where the line crosses into the Luisenstrasse, has a radius of 500 feet. There are two intermediate stations. The line is double tracked throughout, and is of one meter gauge. Between each pair of rails is fixed a rack rail of the Riggenbach pattern, with teeth about $3\frac{1}{2}$ inches long, pitched three inches apart. Each section of rack rail is about 10 feet long. The adhesion rails are in general of the ordinary flat-bottomed type, though Phoenix girder rails (with grooves as used on street tramways) are employed for the sections along or across the streets. Both rack and adhesion rails are fastened to iron cross sleepers, spaced 40 inches apart. To prevent the rails—both adhesion and rack—from slipping downward, they are firmly secured for their entire length to footplates bolted to the sleepers; while at intervals of 50 or 60 yards two adjacent sleepers are firmly anchored to strong concrete foundations sunk deep into the earth. The adhesion rails average 30 feet in length.

At the terminal stations cross transfer tables, worked by electric motors, move the cars, as they arrive, from one line to the other; all shunting is thereby avoided, and a great amount of time and trouble saved, as the tables operate automatically. The rolling stock is designed solely for passenger traffic, each car having ac-



HEAVY GRADE ON THE BARMEN ELECTRIC RACK RAILWAY.

commodation for 28 persons seated, with standing places for six or eight more. They measure in length 26 feet, and are divided into four compartments, of which the inner two are entered from the side while the outer ones are approached from the end platforms. Each car has two axles, carrying toothed wheels, which gear into the line rack, and are revolved by means of two separate electric motors, with a capacity of 36 H. P. each. An independent brake is fitted to each axle, and both brakes can be applied from either of the end platforms, by means of a handle and screw gear, after the usual fashion. Besides these, however, there is an automatic brake fixed to the frame, independent of the car body itself, and so arranged as to come into action whenever the speed rises above the maximum velocity fixed as the safe limit—about six feet per second. The method employed for this purpose is based upon the principle of a powerful stretched spring, which, when released by a centrifugal governor, throws on the brakes at once. As an additional safeguard to the braking appliances thus mentioned, each car has also a mechanical safety brake, which would alone hold it on the steepest grade in the rather remote case of a fracture occurring to both rack pinions at the same time. This safety brake is of the friction type, and consists of wrought-iron shoes, which are pressed down (when in action) upon the rails under the car wheels. The ensuing friction between the shoes and rails at once acts as a powerful brake. It is possible to actuate this brake by hand from either platform of the car.

There is also available for such a purpose the power of the reversed electric motors. This method has the great advantage of giving a uniform and easy descent of heavy grades without requiring any mechanical brakes at all. The electric motors practically act as generators, and as the car travels down hill they give out current (being driven by gravity acting on the car, and thence through the rack and rack pinions) at the same pressure as that supplied by the supply station. In this way there is a considerable saving effected, not only in the first cost of the electric supply station, but also in its working expenses. Siemens & Halske state that about one-third of the total energy required for the ascending cars may be relied upon from the generation of current by the cars which are simultaneously descending.

The cars are lighted by means of electric glow lamps, fed with current from the main conductor. The latter is placed overhead, along the center line of each pair of rails; it is of solid drawn copper, and hangs at a height of about 16 feet above the ground level from insulators, on cross wires, which span the track at regular intervals of 100 feet or so. Along the city streets these span wires are stretched across from insulators on the top of ornamental steel tubular poles; but outside the town, and along the line where fenced in, wooden poles are employed for the purpose. Travelling contact between the conductor wires and the motors on the cars is maintained by means of two oblong metal frames, the top sides of which bear against the under side of the conductor. The frames themselves are supported by tubular uprights hinged to the car roof, and so arranged with strong spiral springs that the frames at the top come, as stated, into contact with the conductor wire. The return circuit is completed through the rails to the supply station, strong copper bonds of large section being employed to connect the rail ends together electrically.

The power station is situated in the Barmen town terminus, underneath the platforms and rails. Two horizontal compound condensing steam engines, running at 165 revolutions, are employed for driving the generators, each engine indicating 250 H. P. They are coupled direct to two ring dynamos with interior field magnet systems generating current at a potential of 500 volts. Steam for the engines is obtained at a pressure of 140 pounds to the square inch from three water tube boilers, each of which has a total heating surface of about 1,800 square feet.

One boiler acts as a reserve, the other two being sufficient for supplying the engines. Water for feeding the boilers and also to replenish the condensers comes from two wells, one of which is sunk in the station yard, while the other is sunk in the adjacent bed of the river Wupper. Both supplies are connected to one another by means of a pump, and the boiler feed water is passed through a filter as well as a recording meter.

The total capacity of the station is such as to allow of erecting two more generating sets and two more boilers, similar to those now in use, and these will probably soon be required, for the station not only supplies current for the mountain railway but also for private purposes in the town, for electric lighting, small motors, etc. Besides this, it will provide electric energy for a complete system of street tramways in the town.

Milwaukee, Wis.—A reporter undertook recently the task of riding over the entire street railway system of the city. The journey required twelve hours and the fares aggregated $1.05.

LAWRENCE UNDERGROUND CONDUIT SYSTEM.

The accompanying cuts illustrate a new underground conduit electric railway system which is the invention of William Lawrence, of New York City. For some months an experimental line in the yard of the Harlan & Hollingsworth Co., of Wilmington, Del., has been in operation and, according to the claims of the inventor, the practi-

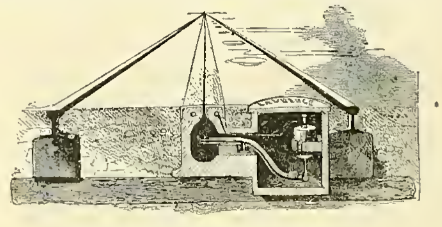


FIG. 1. LAWRENCE SYSTEM.

cability of the system has been demonstrated. The leading feature of the Lawrence road is the use of circuit breakers, which, as the car passes, bring into circuit 32-foot sections of a girder or trolley rail. As each section is passed by, it goes out of circuit. A single feed wire is carried along the track and connects with each of the 32-foot sections of the trolley rail to the switches. The rails are used for the return.

Several constructions of the road are shown in section in the cuts, which are reproduced from the *Scientific American*. In Figs. 1 and 2 may be seen a cross section of the single and double track

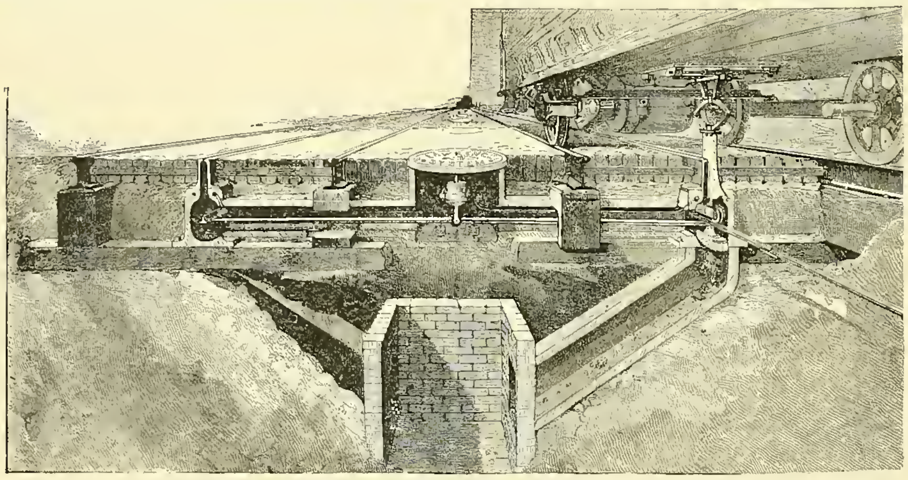


FIG 2. THE LAWRENCE UNDERGROUND ELECTRIC RAILWAY.

road, and Fig. 3 is a longitudinal section showing the trolley rail in place of the conduit. Fig. 4 shows a new form of rolled steel conduit, which will probably be adopted, as it occupies a space of but 4½ by 9 inches.

The general construction resembles the cable conduit, but is much simpler. Through and along the conduit formed under the slot passes a a small girder or trolley in 32-foot sections, fastened together by fiber pieces, so as to insulate the different lengths. Each rail is carried by levers which run out at right angles thereto. On the outer end of the levers are weights which overbalance the girder, no springs being employed. The other end of each lever is connected to a circuit breaker which connects by vertical connection with a feed wire in the junction box. When the weights raise the trolley rail, as they normally do, the circuit is open and the trolley rail receives no current.

FIG. 3. THE LAWRENCE UNDERGROUND ELECTRIC RAILWAY.

When the car is above any given section it depresses the trolley rail a little, forcing up the other end of the lever and closing the circuit so as to bring the depressed section of the trolley rail into electrical contact with the feed wire. As the car passes from the section of rail, the rail is raised by the weights on the lever and the current is broken by gravity.

The car carries a special trolley device 2 feet 6 inches long, with a wheel at each end, which is a radical feature of the system. Between the trolley and the car is an elliptical spring, so that the shoe is always forced downward. It is the pressure of this spring that directly depresses the section of trolley rail. Another object of the two

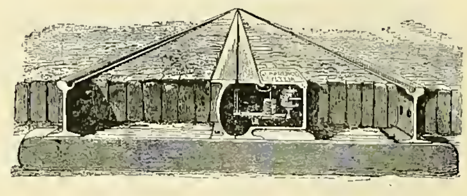


FIG. 4. LAWRENCE CONDUIT.

rollers is to enable the car to force down the rail in advance, before it leaves the rail it is just passing over; this prevents jarring as the rail junctions are passed. Whether a single or double line of track be laid there is required only the one feed wire, and only the one set of circuit breakers with one or with two sets of levers. This feature is brought out very clearly in the illustration of the double track system.

It is assumed that the conduit will naturally accumulate dirt. To dispose of such, a brush pressing against the bottom of the conduit may be attached to the trolley shoe which will sweep all dirt before it. Every 1,000 feet or so a special pit and dirt chute, shown in one of the cuts, is provided, down which the dirt accumulated in front of the brush falls, thus keeping the conduit clean.

One of the claims made for the system is its cheapness. The very small size of the conduit necessary will permit of its being built in steel entirely above the ties, and of the 9 inches of depth, only 5½ inches are used.

The inventor claims that no danger of leakage will exist. The car on the experimental road has frequently been operated when the line was submerged by water. The system will be introduced by the Lawrence Electric Co., of New York.

CUMMINGS ELECTRIC CARRIAGE.

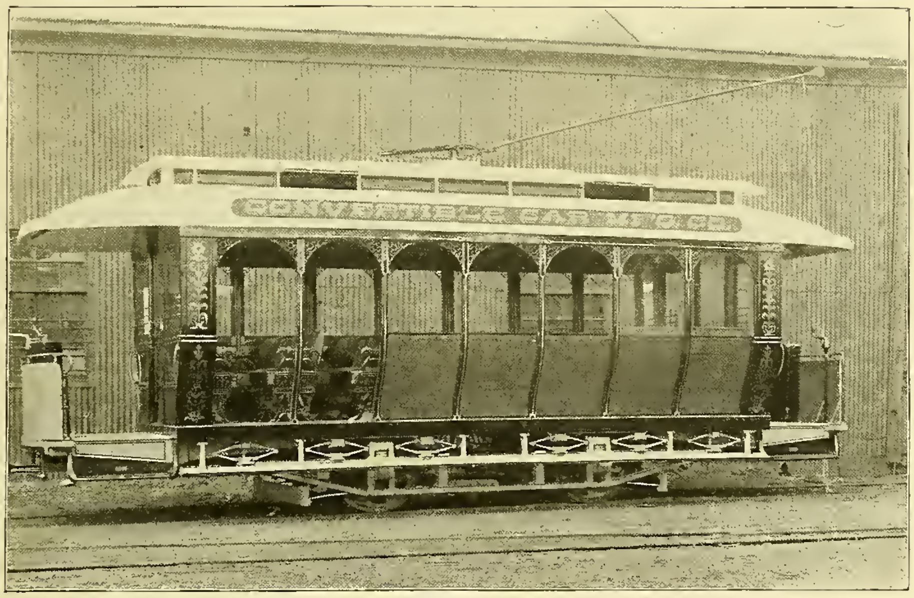
During the past few months, Geo. K. Cummings of Chicago has been engaged in designing the electrically propelled carriage shown in the accompanying figure. It is a two-seated vehicle capable of carrying four people at a maximum speed of twelve miles an hour on ordinary level city roads. Instead of attempting to produce a vehicle of impractically light weight, Mr. Cummings has kept in view the fact that a carriage for every day use must necessarily be capable of withstanding more or less rough usage without damage to any of its parts, and any vehicle not strong enough to undergo the same treatment as an ordinary carriage receives, must always prove a commercial failure. Such devices, or so-called improvements as rubber tires, bicycle wheels, ball bearings, etc., which theoretically aid traction or lighten the load, when put to ordinary street usage, generally fail to fulfill their promise as improvements over ordinary methods, and at a critical time break down through inherent weakness. The order of improvement is always towards simplicity, hence the best designs are primarily devoid of complications. How well this object has been attained a close inspection of the illustration, coupled with a brief description of the device, will determine.

A two H. P. 25 volt motor is supported on a light steel frame between the two axles. A raw-hide pinion on the motor shaft drives an intermediate shaft, which through a sprocket chain and wheels transmits motion to the rear or main driving axle. The action is direct and positive, yet the use of the link belt secures a certain flexibility which is very necessary in work of this kind. The front axle is divided into two short movable axles to which the front wheels are attached. To these movable axles the steering device is connected, which seems simple and compact, consisting of a pinion meshing into the gear of the right hand movable axle, the latter in turn being connected by a steel rod with the left hand movable axle. A light wooden box protects the motor from dust and dirt as well as from mechanical injury. One of the chief difficulties heretofore has been to obtain a simple and effective method of applying the driving power to both wheels and at the same time allow each wheel to have an independent speed irrespective of the speed of the axle or other wheel. This is necessary in order that when turning curves or in any manner deviating from a straight course, the outer wheel may travel fast enough to cover the increased distance it has to traverse. This problem has been ingeniously solved by Mr. Cummings through a novel arrangement of a series of five roller clutches applied to each hub. The inventor prefers not to publish the details of this automatic device, but it will be seen that it takes up so little space as to be scarcely noticeable, while it accomplishes its purpose in a very satisfactory manner.

The current to operate the motor is derived from 12 cells of storage battery, six each under each of the two seats. The cells at present in use are of the chloride accumulator type, made by the Electric Storage Battery Company. They have a capacity of 200 ampere hours each, and are supposed to furnish current without recharging for a run of 60 miles. They are connected in series. The speed of the motor is regulated by a rheostat connected in series with the armature. The rheostat lever or contact arm is operated and controlled by means of a treadle directly under the driver's foot. The total weight of the vehicle is given as only 1,270 pounds.

Recent tests of this carriage show that over level city roads at a normal speed of ten to twelve miles per hour an average of from 1½ to 2 electrical horse power is all that is required, except at starting, the difference in power consumed depending on the state of the road and the style of pavement traversed. The questions of running through the mud, over street car tracks, raised obstructions, such as manhole covers and the like, starting up out of ruts and gutters, have each been taken up carefully, and through practical experience and actual operation it has been demonstrated that the vehicle successfully and easily overrides such obstacles.

Taking two electrical horse power as the average consumed at a speed of ten miles an hour, the total operating expense for current used would be ten dollars per month for a daily trip of fifty miles. This is based upon the published rate of charge for current of the Chicago Edison Company and would, it seems, put the matter upon a commercial basis at once.



THE CONVERTIBLE CAR.

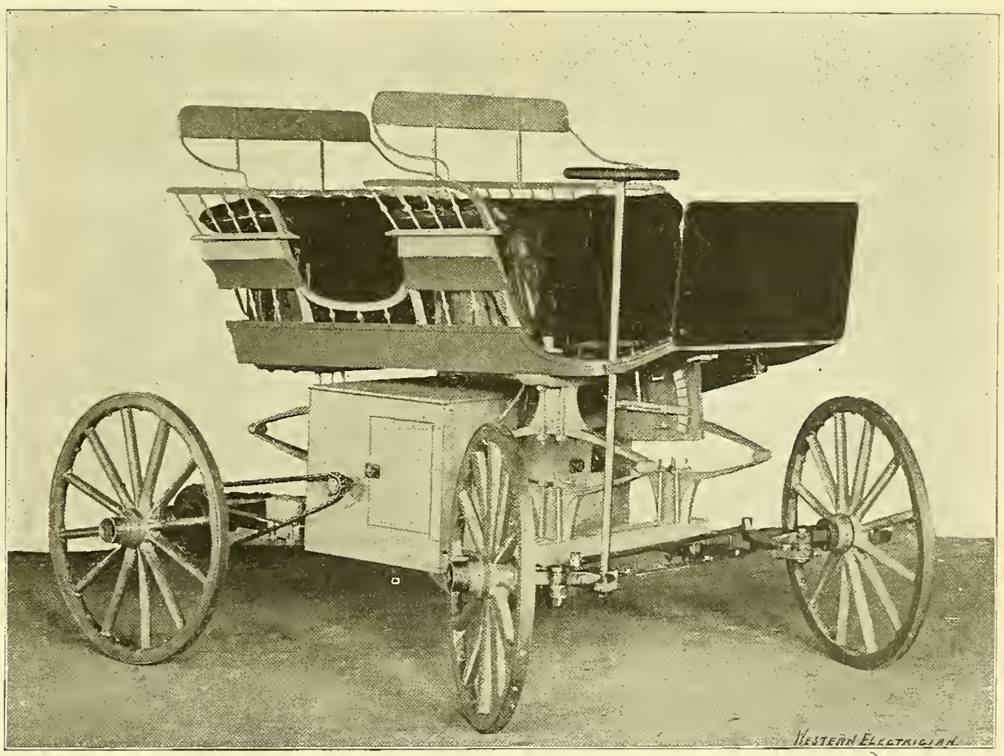
A CONVERTIBLE CAR.

The accompanying illustration shows a car adapted for both summer and winter use, now in operation on the 63rd street line of the Chicago City Railway Company, making regular trips from Jackson Park to Ashland avenue. This car is operated under the auspices of its builders, the Convertible Car Manufacturing Company, of Chicago.

The manufacturers claim that the use of this car will obviate the necessity of carrying a double equipment, as a single line of cars can be used as open cars in summer and closed cars for winter use. The change from one style to the other is very easily made and this can readily be arranged by the conductor in case it is necessary to make the change while the car is in regular service. The company has the exclusive right to use T. H. Lovejoy's patents covering this style of construction. Cars similar to the one shown in the illustration have been running upon lines in San Francisco, Tacoma and Portland, Oregon, although some improvements have been added to the car now operated in Chicago. When closed it is claimed that the car is dust tight and that none of its movable parts or windows can give any annoyance from rattling.

The car is 26 feet long, seats 32 passengers and weighs 7¼ tons complete with electric motors and suitable trucks. When closed, a movable panel extends from the floor to the bottom of the window. This panel is constructed on the same principle as the roll top desk, except that the strips are fastened together with steel rods. The panel is pulled up or down between posts at each seat and slides through a groove which compresses the parts together making it rigid and very tight.

The car is equipped with Stanwood steel steps and the H. A. Wheeler seats. The car body is mounted upon one of the trucks manufactured by the Chicago Electric Truck Company, and the special exhibit trips on Saturday last proved that the truck is capable of giving satisfactory service. The motor used is a G. E. 800.



THE CUMMINGS ELECTRIC CARRIAGE.

New York Rapid Transit.—Governor Flower's delay in considering the rapid transit bill in his hands has about made it certain that nothing like a final solution of the vexed problem can possibly be reached for at least another year or two. That is to say, that the system of transit which is to settle the question cannot even be begun for probably two years, whether the final determination be to build it by public or by corporate power. There is too much of detail to be carried out under the bill, if it becomes a law, to admit the possibility of getting ready for the popular vote at "the general election" next November, and the effect, in respect of the delay, of not being ready at that time need scarcely be pointed out.—*New York Commercial Advertiser*.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Twentieth Article.)

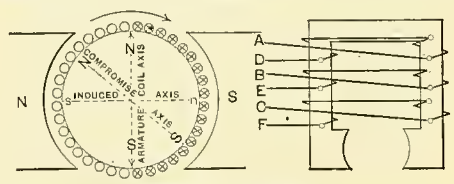
COUNTER ELECTROMOTIVE FORCE AND RESISTANCE.

But this counter electromotive force must not be confounded with dead resistance. It has in some respects the same effects as resistance, but differs from the latter in very important particulars. It has been stated that counter electromotive force cuts down the current. Resistances placed in circuit will do the same thing exactly, but the cutting down of current by means of the counter electromotive force which tends to produce a current in the opposite direction is merely a problem in subtraction—the taking of a lesser quantity from a greater and the utilization of the remainder. No energy whatever is consumed when the current is reduced in this way, but when it is reduced by the use of resistances, the electromotive force which disappears is employed in overcoming these resistances, and the energy thus expended appears as heat. In electric lighting, welding, etc., this energy is usefully expended, for by designedly localizing the resistance we localize the heat to such an extent as to produce the desired results of high temperatures. But in most other applications of electricity it is not heat that we want, but mechanical energy. Every bit of heat that is generated in our circuit or in our translating devices, therefore, represents so much energy uselessly employed and constitutes a drain upon our source of energy for which we have to pay as much as we pay for the energy which serves a useful purpose. The heat produced in an electric circuit corresponds very closely to the water lost in a leaky water main along the route. If the pipe be very leaky, half the water that is pumped into it at the pumping station may leak out and while it does the consumer at the other end of the line no good, costs at the pumping station just as much as the other half does which he can make use of. Where an electric motor heats up badly or resistances are introduced into the circuit near the motor in order to cut down the current to the required amount, they constitute large leaks which in the water analogy would correspond to the diversion of a portion of a waterfall from a water wheel so as to let that portion diverted run to waste, or where the water is conveyed to a water motor in a pipe, to the opening of a large faucet just above the water motor so that a portion only of the water that was delivered at that point would go to the motor, the remainder being allowed to run out upon the ground.

But it is often necessary, with electric motors, to resort to these wasteful methods of regulation. As everyone knows, it requires the expenditure of considerable energy to set in motion any body which is at rest, and it also requires the expenditure of this energy for a considerable time before that body—especially if it be a heavy body—can be set into very rapid motion. Everyone also knows that when the moving body has once attained a certain speed that this same speed can be maintained with the expenditure of but a very small fraction of the energy required to bring it up to that speed. The same is true, in a reverse order, of bringing a moving body to rest. This property, which is characteristic of all matter, by which it resists any change as regards motion or rest, is termed inertia, and the heavier the body is, the longer must a given force act upon it to start it from a state of rest and bring it to a given speed, or to check it from a given speed and bring it to rest. We therefore see why in electric motors it is necessary in starting them to reduce the current by what have been termed dead or hurtful resistances, for when the armature is at rest, there is of course no counter electromotive force to oppose the current. The only resistance opposed to its flow at this instant is that which is offered by the coils on the armature (and fields in the case of series winding) and this has been made by the builder as small as possible purposely to prevent the loss of energy which resistances necessarily involve. If, therefore, the current were turned on full from a 500 volt circuit, the momentary rush would be so great as to burn the motor up at once.

To realize how quickly the heating effects increase with the current we need only to remember the law that the heat thus produced is proportional to the *square* of the current. It would be bad enough under these circumstances, if double and treble the current produced only double and treble the heat, for a motor in starting may take ten times the amount of current that it would require when doing the full work for which it was designed, but when we remember that the heat will be increased to *four* times and *nine* times for double and treble the current and one hundred times for ten times the current, the seriousness of such a situation will be realized at once.

Some means must therefore be resorted to to prevent this enormous rush at starting and the one usually employed is dead resistance. A large resistance, sufficient to cut the current down to the safe amount is first introduced. As the armature starts to revolve it immediately begins to generate a slight counter electromotive force. By reason of this the full amount of the original resistance is no longer required to maintain the same current, and a smaller resistance may be substituted. As the speed of the armature increases, so does the counter electromotive force,



FIGS. 58 AND 59.

and in like manner does the necessity for dead resistance decrease. In fact with the speed of the armature the counter electromotive force gradually usurps the functions of the resistance until the speed has reached that at which the motor was designed to run, when it will have supplanted it entirely.

To facilitate the introduction into the motor circuit of resistances of various values as required, such resistances are usually grouped together and their terminals connected that any one or more of them may be thrown into circuit by the movement of a lever. Such an arrangement is called a *rheostat* and such in fact is the arrangement on the platforms of electric cars to which the controlling lever is attached by which the motorman controls his car.

The desire to avoid as much as possible the losses necessarily involved in the "rheostat regulation" of current as well as the requirements for speed regulation, so essential in street cars, has resulted in numerous other arrangements which will be referred to after we have considered what the requirements of speed regulation involve.

THE REQUIREMENTS OF SPEED REGULATION.

In discussing this question, it will be understood, of course, that we are not speaking of how to build motors suitable for various speeds, but how to regulate the speed of motors already built or in use. We must, therefore, take the motor as we find it, viz.: with certain elements, such as the number of turns of wire on the armature, which, if changed, would modify the speed fixed. We cannot do better on this subject than to quote from Crosby and Bell's most excellent treatise on "The Electric Railway," which those wishing to go more deeply into the subject of electric railways than it is intended to do in this series of articles, should certainly read.

"The other quantities, changes in which are connected with changes in speed, are (1) strength of field, (2) the rate of work, i. e., the quantity of work done in a given time. As has been already shown, the rate of work is measured by the product of (3) the current and (4) the counter electromotive force. The current, however, is readily expressed in terms of the counter electromotive force, the resistance of the machine and the applied electromotive force, since it is always such a current as will flow over the given resistance under a pressure equal to the difference between the two opposing pressures—that applied or impressed by the dynamo through the line, and that generated by the motor armature itself. (5) As seen from the above, change in the applied E. M. F. is also connected with change in the speed. The quantities (1), (2), (3), (4), (5) are interdependent, but are separately mentioned, since convenience requires reference first to one, then to another.

"Of these five quantities, perhaps that which in practice is most constant, is strength of field. As has been shown, the efficiency of a motor depends upon the relation of the counter E. M. F. to the applied E. M. F. High efficiency or relatively high counter E. M. F. is desirable at any and all speeds. But high counter E. M. F. goes with a large product of the three factors: (*a*) number of armature loops, (*b*) speed of rotation and (*c*) strength of field. As noted (*a*) the number of loops is fixed; (*b*) the speed is limited by practical requirements, hence (*c*) great strength of field is constantly desirable. It is therefore good practice so to wind a street railway motor by putting a relatively large number of turns around its magnet, that a maximum strength of field is attained, even when the current flowing is small as compared with the maximum current.

"This is equivalent to saying that the magnetization given by a relatively small current is yet sufficient to saturate or nearly saturate the iron of the magnetic circuit. If, however the field be kept below saturation and be varied in strength, this variation may be used to accomplish a certain degree of speed regulation. Let us suppose a car moving on a level (or on a uniform grade) and at such a speed as to produce a counter E. M. F. of 400, the applied E. M. F. being 500. For convenience assume the internal resistance of the armature circuit to be 10 ohms. Then the current flowing will be $\frac{500-400}{10}$ = $\frac{\text{Impressed Electromotive Force—Counter E. M. F.}}{\text{Resistance.}}$ $=\frac{100}{10}=10$ amperes. The mechanical work done would be 400×10=E.×C.=Impressed E. M. F.×Current=4000 watts.

"Now suppose it is desired to run more slowly. Increase the field strength by 10 per cent. The Counter E. M. F. at the same speed would be 440 volts. The current$=\frac{500-440}{10}=6$ amperes, and the work, $440\times6=2640$ watts. But since the car requires 4,000 watts to maintain the previous speed it is now evident that it must now decrease its speed until there shall be an equality between the work required to maintain the lower speed and the work done by the motor at the lower speed due to the greater field strength. Let us learn what this speed is.

"It was seen above that work at the rate of 4,000 watts ($=\frac{4000}{746}=5.36$ H. P.=176,880 foot pounds per minute) must be performed in order to maintain the speed existing before the change of field strength. Suppose the car to weigh 8 tons and suppose that on the particular track in question, a horizontal effort of 25 pounds per ton is required to overcome all resistances, including those of gears or other mechanism between the armature and the axles; then a total horizontal effort of $8\times25=200$ pounds must have been exerted. This quantity multiplied by the number of feet traveled per minute must be equal to the number 176,880, representing the total foot pounds of energy utilized per minute. Hence the travel per minute $= \frac{176,880}{200} = 884.4$ feet $= 10.05$ miles per hour. At the new speed we must have a similar relation, viz., $\frac{\text{work done in foot pounds}}{200} =$ feet traveled per minute; or since 1 watt minute $= 44.24$ foot lbs. $= \frac{\text{work in watts}}{200 \div 44.24} =$ feet traveled per minute; hence the work in watts $= 4.52 \times$ feet raveled per minute."

It will be observed from the above that a reduction in speed results from increasing the strength of the field. The converse is also true, viz: that a weakening of the field results in increased speed. This latter can be readily proved by placing an iron bar across the pole pieces of a stationary motor, thus diverting some of the lines of force from the armature. A very noticeable increase of speed of armature will at once occur due to the weakening in this way of the field in which the armature is working.

Thus far we have assumed that the car is running upon a level track or up a uniform grade, or in other words, that the work the motors are called upon to perform remains constant.

Of course if the load be increased, more energy is required to move it at the same speed—a greater torque will be required in the armature, and this may be accomplished by increasing the current in the latter as already stated. The conditions for maintaining uniform speed under increased load therefore are obtained by a relatively large increase of armature magnetism over field strength. Thus in a shunt motor operating under constant E. M. F. the strength of the field remains constant under all conditions of work while the armature current may vary within wide limits and does vary directly as the load. But in a series wound motor, such as is usually employed on street cars, since all the current passing through the armature also passes around the field, the magnetism of both will continue to increase in about the same ratio until either one or the other becomes saturated, after which its magnetism cannot increase further and remains stationary while the other increases with additional current. It has already been stated that in street railway motors it was customary to make the fields relatively stronger than the armature. This is done by making so many turns in the field magnet coils that with the currents usually employed, the field magnets are nearer a state of saturation than the armature. If this be the case in a series motor and sufficient load be thrown on to slacken the speed of the motor and thereby lower the counter E. M. F., sufficient additional current will pass to saturate the field. Should the speed become still slower, more current would pass, but the field being already saturated would not be further increased in strength while the armature strength would be still further increased, thus fulfilling the conditions of relative increase of armature over field required for greater speed, and the motor would run faster until the increase of counter E. M. F. resulting from its increased speed restores a balance and the speed remains constant.

Thus far we have considered all the windings on the field magnet to constitute one integral coil. Much greater elasticity or flexibility of control may be obtained by winding the field magnet with a number of separate coils which may be connected up in various ways so as to be used separately, in series or in multiple arc, thus enabling the motorman to change the relative strengths of field and armature through a much wider range. This will be made clear by reference to Fig. 59 and the following explanation.

Suppose three coils of wire to be wound around the magnet cores of a motor as shown in Fig. 59. Let the resistance of each be one ohm. Connect D to B and E to C (so that the three coils are in series). Suppose a difference of potential of 100 volts be maintained between the terminals A and F; then the total resistance of this field circuit would be three ohms. The current flowing would be $\frac{100}{3} = 33.3$ amperes. The number of turns in each coil is two—one on each leg. There will therefore be 6 coils in all, and the magnetizing effect expressed in ampere turns would be $33.3 \times 6 = 199.8$.

If however we connect the three coils up in parallel by connecting A, B and C together and D, E and F together the resistance of the field circuit would be one-third of an ohm instead of three ohms as before and the current flowing would be $100 \div \frac{1}{3} = 300$ amperes instead of 33.3 and the number of turns around which this whole current would flow would be but two and the resulting magnetizing effect expressed in ampere turns would be $300 \times 2 = 600$, or three times the former value.

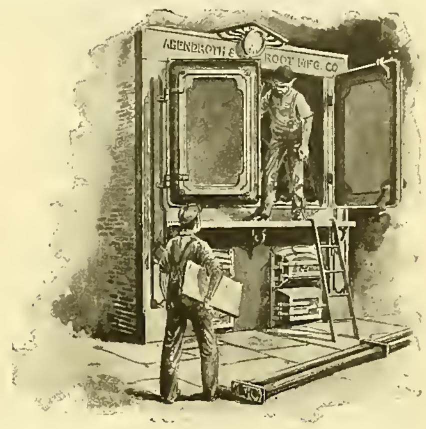
If sufficient current passed through the coils when arranged in series to saturate the field no further magnetism would be added to the field by the second arrangement, but the strength of the armature, if that were far from saturation would be proportionately increased as well as relatively giving the latter a greater torque as well as a tendency by reason of a relatively weaker field to greater speed, but even if the field also be far from saturation with the first arrangement and its strength increases proportionately with the additional ampere turns of from 199.8 to 600 which would result from the second arrangement, the drop if potential required to force a given current through the field windings would be much less in the second arrangement than in the first because of the lessened resistance (in this case $3 - \frac{1}{3} = 2\frac{2}{3}$ ohms) and the electromotive force in the armature, if the latter be placed in series with the field coils would be greater in the second arrangement than in the first, again fulfilling the conditions necessary to greater speed. It is evident that other combinations of these coils may be employed to produce different results. Thus in starting all three coils may be put in series, then one may be cut out and the other two connected in series and next the two in multiple with each other and in series with the third, then two in multiple with the third cut out, and finally the second arrangement above described —all three in multiple. The various changes above enumerated, changes of connections, from first to last are progressively toward the attainment of higher speeds. This method of regulation is known as that by "commutated field circuits."

On most street cars there are two motors. It is evident that with two motors the commutation method of control can be still further extended by throwing the coils of the two motors not only into the above combinations with the other coils on the same motors but by throwing the coils of one motor into various combinations with the coils on the other. Thus in starting, all the coils on both motors would be thrown into series, and these in series with the armature coils of both motors, themselves in series with each other, and so by various changes gradually decreasing the resistance of the field circuits until all the field coils in each motor are in multiple with each other, and the two motors are in multiple with each other, which would be the condition for maximum speed.

Terre Haute, Ind.—An electric railway has been projected to connect Brazil and Terre Haute. Robert Smith, of Terre Haute, represents the new enterprise, and has been in the city this week pushing it. The right of way, which has already been partially secured, is executed to Max Joseph and Robert Smith, of Terre Haute, and is conditioned on a fifteen cent fare one way or twenty-five cents round trip, less than a cent a mile.

FACILITIES FOR REPLACING TUBES IN THE IMPROVED ROOT WATER TUBE BOILER.

When a skilled designer produces a complicated machine he always contrives to introduce into his mechanism a part weaker than any of the other parts. This weak point is intentionally the easiest and cheapest part to replace, so that in case the machine is put under undue strain through the disarrangment of its parts, or through the catching of the work which is passing through it, this weak part will be the first to break, and then the whole machine, of course, is relieved of its strain, thus saving other more

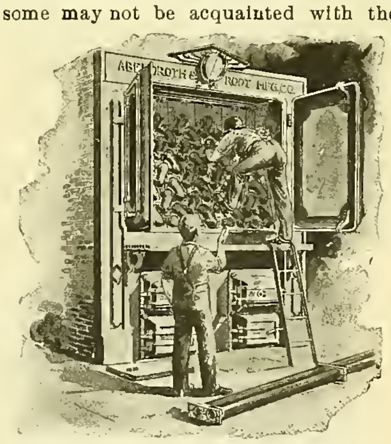


Opening the front doors, preparing to remove a package of tubes.

complicated and expensive parts. On this same principle, the weakest part of the water tube boiler is found in its tubes, which are the easiest and cheapest of all parts to be repaired. In case of any trouble occurring in the boiler, it is found, almost invariably, to occur in these tubes; hence the best possible provision should be made for their quick and easy removal, and for immediate repairs.

The improved Root boiler has received much attention from its makers in the perfecting of this detail, and in order to place this interesting process before our readers, we reproduce on this page a series of ten photographs taken during the different "steps" of this work, which in connection with the few lines of descriptive matter beneath each cut will show very clearly how it is accomplished and how rapidly it is done.

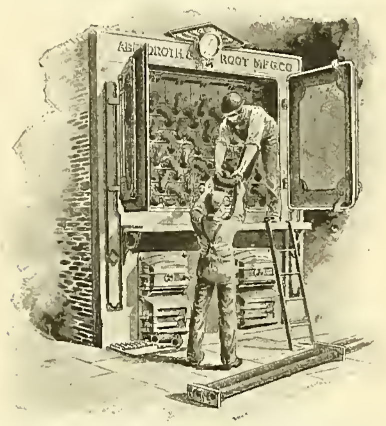
Although the Root boiler is probably the oldest of its type and quite familiar to most of our readers, some may not be acquainted with the de-



Removing the nuts from the connecting bends.

tails of its construction, and so a few words of description may not be amiss, as they may lead to a better understanding of the engravings.

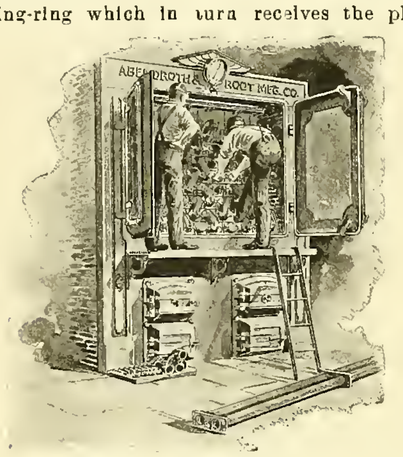
Two four-inch boiler tubes are expanded into a header at each end, forming what is termed a package. These packages are placed one upon the other in a regular arrangement, so that a tube in any horizontal row stands directly over a space between two tubes in the next horizontal row below it. This places the tubes in a staggered position (in vertical arrangement), which causes the heated cases from the fire to impinge against them, and to be broken up so as to unite with the air which accompanies them. This arrangement also breaks all vertical lines of joints in a manner similar to that of bricks in a wall, and everyone knows that a brick in the lower part of a wall can easily be removed without disturbing the structure above it—and also it can easily be



Handing down the second connecting bend. (Between this operation and that shown in the next cut, the same operations are performed at the rear of the boiler.)

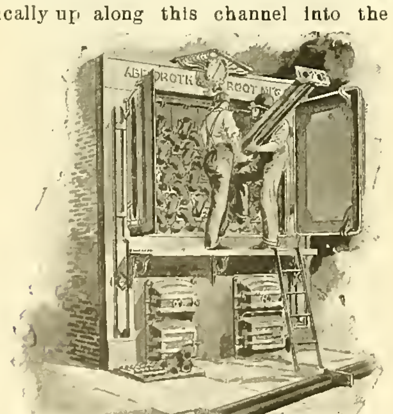
replaced. It is in this same way the package of tubes is removed and replaced in this boiler.

Directly opposite the tubes in the box-like header an opening will be seen (by referring to the cuts), and when these openings are not covered the interiors of the tubes are easily inspected, scraped, and cleaned. The metal around each of these openings is carefully milled to an exact form and size, so as to receive an elastic metal packing-ring which in turn receives the plug



Pulling out the package of tubes.

shaped end of the cover. This, when examined, will be found to be one end of a U-shaped tube, which is called a connecting bend. The office of this bend is to connect one of the box-like headers in the lower horizontal row with the header immediately above it, so that the water and steam will have a channel of escape from one header to the other,—from the lowest headers, vertically up along this channel into the top

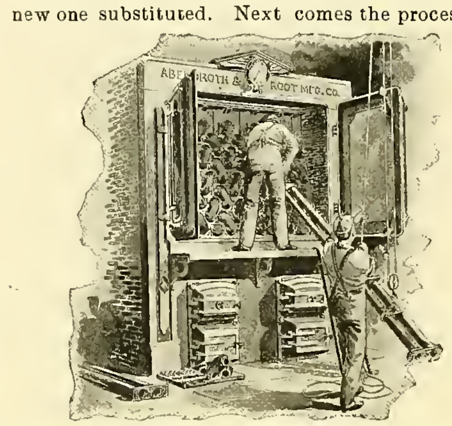


Removing the old package of tubes.

header, and thence at the front end into the overhead drum. Thus it will be understood that the boiler is made up of a number of these vertical connections (called sections), placed side by side, thus forming the complete boiler.

Each of the connecting bends is held up to its seat by four bolts, two bolts to each opening. The ball-shaped heads of these bolts are received into similar shaped sockets in the headers. In order to remove a package of tubes, two connecting bends must be removed from the front and two from the rear of the same package; one of these connecting bends, at one end, of course, connecting the header with a header immediately below it, while the second bend forms the connection to the header above.

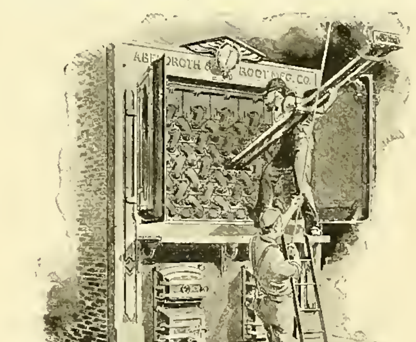
In the first place, before removing, say, the two front connecting bends, eight nuts must be removed, then the bends are lifted out of place; next the eight bolts are removed, and then the four packing rings are taken out of their seats. The same operation is repeated at the rear, and then the package of tubes is pulled out and the new one substituted. Next comes the process of



Putting in the new package of tubes.

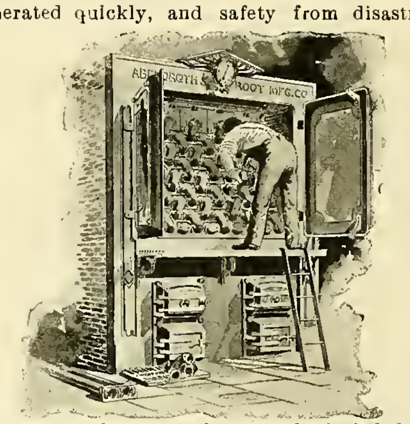
putting the packing rings back, also the bolts, the bends, and the nuts—the reverse of the process of removing them.

It will be noticed that two tubes are required to form a package, and one would naturally exclaim that it is unfortunate that two tubes must be removed when but one may be affected. Strange though it may seem, the reverse is actually the case, as, when the affected tube is removed, the second tube holds the headers their exact distance apart, and therefore any boiler maker in any boiler shop can easily and quickly expand the second tube into its place without careful measurement, and it is bound to be exactly right. In fact, any engineer of ordinary intelligence, who has an expander, can put in a new tube with but little trouble. By having an extra package of tubes in the boiler room the reader will see that in case a repair is needed he will not have to shut his plant down for a protracted time—as such a repair will not require more than two hours at the outside; and when the repair is made the boiler will be as good as new, with no patched or "cobbled up" portions about it. By thus keeping up with the deterioration which occurs in every form of boiler, and making inexpensive repairs from time to time, the life of the boiler is practically without limit. It must not be thought, because such facilities for repairs are provided, that "breakdowns" are frequent, as this certainly is not so, the makers referring to many who have used this boiler for



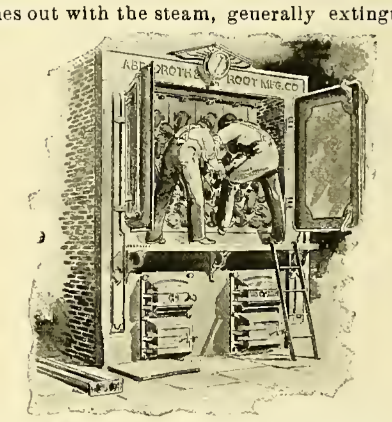
Pushing the new package of tubes back into position.

years with practically no repairs at all. By dividing the water up into small portions, as is done in water tube boilers, a maximum amount of heat absorbing surface is obtained, steam is generated quickly, and safety from disastrous



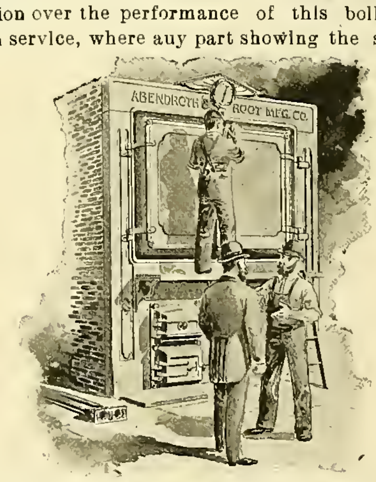
The second man has gone to the rear to slip in the lock plate (which holds the rear end of the packages firmly in place), while the man in front is tapping the front face of the package back flush.

explosion is obtained. Thus, by making the tubes "the weakest point in the machine," much is added to the safety of the boiler. In case a tube ruptures, as the area of the tube is but little larger than the safety valve, the result can be in effect but little different from that of the opening of the safety valve—except only that water rushes out with the steam, generally extinguishing the fire, thus preventing the burning out of an exposed empty boiler.



After securing the two connecting bends in place at the rear, the same operation is repeated at the front.

Many steam users who are obliged to use very bad water, such as salt water or other waters impregnated strongly with alkalies, lime, etc., or where steam is generated from the liquids of manufactured products—which liquids are destructive to boilers—have expressed great satisfaction over the performance of this boiler in such service, where any part showing the slightest deterioration can be so quickly, easily, and cheaply removed and replaced.

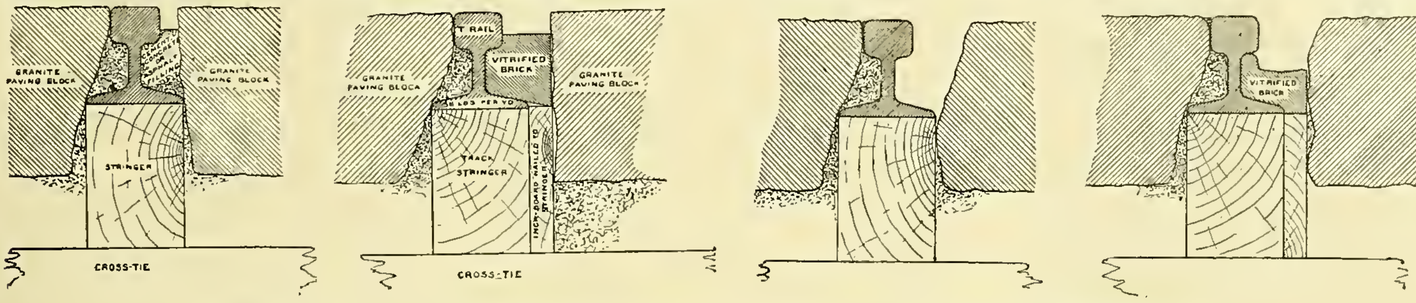


Closing the front doors, ready to get up steam. Time actually taken in performing the whole operation was forty-eight minutes.

It might be well to mention one point which may have presented itself to our readers, in the form of the question: How are the tubes, when inclined at the angle shown, prevented from "sliding down hill?" This is accomplished by the use of flat steel plates called "look plates," which are slid under lugs or tongues cast on all of the headers, and when in position, the faces of the rear headers are held perfectly flush, and each lock plate is found between the face and the tongue of both an upper and lower heading adjoining. Thus, with all the headers held rigidly in position at the rear of the boiler, all lengthening and shortening of the tubes takes place at the front end of the boiler, where the joints are easily seen by merely opening the front doors.

RAIL CONSTRUCTION IN SPRINGFIELD, MASS.

We have shown in former issues various methods of T rail construction for paved streets. Two other methods, used in Springfield, Mass., are shown in Figs. 1 and 2. In one of these the space on the flange side of the rail is filled with cement, concrete or asphalt filling, while in the other the space is filled with vitrified brick resting at its outer side upon the edge an inch board nailed firmly to the side of the longitutional stringes. Fig 2 shows the two styles of construction after about one year's use the concrete filling has entirely disappeared, while the vitrified brick has worn down to about one-half its original thickness. Fig 3 shows a T rail construction as laid in a street entirely paved with vitrified brick, as used on Main Street, in Springfield, Mass. The vitrified brick blocks are each 7½x3½x2 inches and each weighs 4½ pounds. The method of laying them is clearly shown in the figure. Our illustrations are reproduced from *Good Roads*.



FIGS. 1 AND 2. T RAIL CONSTRUCTION USED ON THE STREET RAILWAY TRACKS IN SPRINGFIELD, MASS.

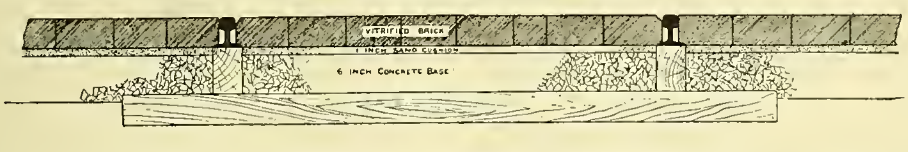


FIG. 3. VITRIFIED BRICK PAVEMENT IN SPRINGFIELD, MASS.

TEST OF THE HEILMANN LOCOMOTIVE.

Henry P. Bellet, United States Consul at Rheims, France, is enthusiastic over the Heilmann electric locomotive. This machine, which is equipped with boiler, engine, dynamo and motors was recently tested, and the United States Consul thus speaks of the results:

At eight different times in two days the electric locomotive has pulled with all ease an ordinary train of 180 tons over the 25 kilometers separating Havre from Beuzeville-Breauté, and on what is probably the worst track of the Western Railway system—that is to say, under particularly unfavorable circumstances and under a pouring rain. This locomotive of 800-horse power which, according to the predictions of "mossbacks," would never be able to start, has, with a speed of 58 kilometers per hour, climbed the heavy and 3-league long grade of 8½ millimeters situated between Harfleur and St Romain. The start was made so easily that on the first trip not one of the seventeen persons packed in the closet room at the fore part of the locomotive, which is used by the engineer, had noticed that the train had left the station.

In compliance with the prearranged programme, the electric locomotive has successfully, without effort and accident, traveled at the increasing speed of 65, 70, 80, 95, and even 100 kilometers (40, 43¾, 50, 60 and 62½ miles) per hour.

I know that some who dream of phenomenal speed will find the above figures rather small; unfortunately, in the question of transportation by rail there are two things equally important—the road which does not move, and the train which does. And if, theoretically, trains can be moved at a nearly unlimited speed, the tracks constructed a long time ago in view of a speed of 50 kilometers (31¼ miles) per hour, which the most sanguine then thought could not be exceeded, are limited as to their power of endurance.

When we shall have created what the railroad men call "the train 100"—that is, the train of 100 tons—running for five or six consecutive hours at a speed of 100 kilometers (62½ miles) in sixty minutes, then we shall not be far from having realized the ideal, allowing for the preservation of the actual outfit.

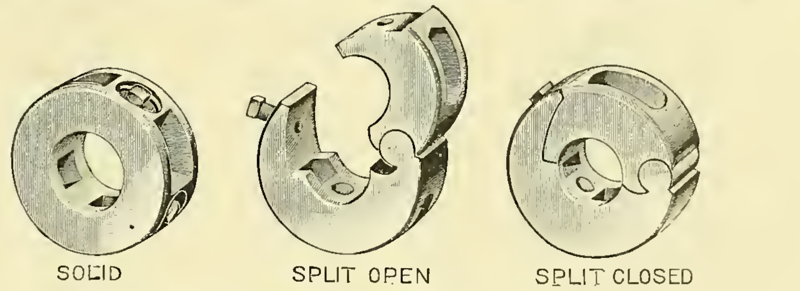
No doubt, after what we have witnessed, the Heilmann locomotive, which necessitates no change in the existing rolling stock, will soon realize that ideal and at a minimum expense.

Let me add that the notes with which I have prepared this article have been taken standing up on the locomotive running at a speed of 1,300 meters (1,420 yards) per minute, and I shall have said all that can be said for a while about this marvelous engine, imagined altogether by the brain of a good Frenchman, built in France, and let us hope that, unlike the steamboat and so many other French inventions, the Heilmann locomotive will not need foreign indorsement to be finally adopted.

In the railroad game, the English with Stephenson won the first hand; Heilmann has just secured the second. Our honor and our interest demand that we should not lose it.

GIANT SAFETY COLLAR.

The accompanying illustrations show the Giant safety collars, manufactured by the Gouverneur Machine Company of Gouverneur, N. Y. These collars are made solid and split, as shown in the figures. They are chambered to avoid unnecessary weight upon the shaft, but this is done in such a manner as to preserve full bearing surfaces at each end. The split collars have a hinge joint and may be put upon the shaft in a space equal to their length. When in place, the set screw that holds the collar also secures it in position on the shaft. No belts are used and the set screw-heads do not project above the surface. Manufacturers claim that they contain material sufficient to give the necessary strength where this is required, useless weight being avoided.



GIANT SAFETY COLLAR.

BOSTON WATER BOARD ON ELECTROLYSIS.

The most interesting feature of the recently published report of the Boston Water Board is a statement by City Engineer Jackson of an investigation of the corrosion of pipes by electrolysis. "During 1893," he states, "a number of leaks in lead service pipes were found which were caused by electrolytic action, due to underground currents of electricity induced by the street railway system. The pipes were decomposed on the exterior surface, and presented a pitted appearance. Most of the cases were discovered in the immediate vicinity of the power station of the West End Railroad Company, where the quantity of current is naturally largest. As the use of electricity for motor power is constantly increasing, and as the destruction of our water mains and services would be of incalculable injury to our city, an investigation has been begun into the causes and extent of the difficulty, with the view of taking the necessary measures to preserve the pipes, both lead and iron, from further injury.

"This investigation was placed in the hands of Stone & Webster, electrical engineers, and the result of their preliminary study indicate that decomposition of the pipes is going on, but that, generally, it may not be apparent for some years.

"The cases which have so far been discovered have been where the quantity of electricity in the ground was large; but we have no proof that the same action is not taking place more slowly all over the city. The investigations show that there is a constant current of electricity flowing through the earth toward the power station, and that the intensity of the current varies continually with the amount of power used. As these currents must unavoidably pass into and out of the water pipes by way of the earth, and as electrolytic action follows in a greater or less degree, it is more than probable that the gradual decomposition of our pipes is taking place.

"Whether this corrosion of decomposition is sufficient to seriously affect the pipe system has not yet been determined, and I recommend that the investigations be continued during the present year. I would also recommend that test pits be dug for the examination of the pipes in different parts of the city, particularly in the immediate vicinity of the West End power station, and if evidence of corrosion of the pipes is discovered I would recommend that the pipes be drained by means of heavy copper conductors connected with the power station."

The report of Stone & Webster gives the summary:

It seems * * * * that the direct evidence is good, although not yet ample; that injury has been wrought upon iron and lead pipes buried in the earth; this injury being the direct result of corrosion arising from the passage of the return currents of an electric street railway into or out of the pipes.

It seems further to be almost incontestably shown that the underground conditions in Boston are such that electric currents, presumably of considerable magnitude, pass into and out of the pipes by way of the earth, and with the unavoidable accompaniment of electrolysis and corrosion.

It remains to be shown whether this corrosion is or is not, under existing conditions, a serious factor in lessening the life of the piping system as a whole or of any part of it in particular.

Upon this most important subject we feel that the points previously made in this report would certainly not warrant a hopeful view. They would rather incline one toward the opinion that serious corrosion may be now proceeding; but we must strongly call attention to the fact that it has been impossible, thus far, to acquire sufficient reliable information to warrant a decision.

The matter is under further investigation.

As to the remedy, it is clear, of course, "that were the return railway circuit to be confined to channels provided for it, the trouble would cease. This it is impossible to do with a railway system in which the cars give up their return current to the uninsulated rails as now. However good the conductivity of the copper return lines provided, the current will divide between them and the earth, the fraction going back by earth being to that going back by the copper lines as the earth conductivity is to that of the lines. Now, the earth conductivity is at least fairly good, so that the amount of copper required in returns becomes enormous to reduce the earth currents to small amounts. Railway systems which do not ground the return have not proved successful for various reasons.

To remove the difficulty with telephone cables, the New England Telephone & Telegraph Company has laid a special copper return along the affected part of the cable, and thence by a heavy overhead line back to to the power house. This, together with the practice by the West End Street Railway Company of making the trolley positive, has proved largely successful.

It is feasible because the number of these cases to be dealt with is comparatively small, so that the expense is not intolerable.

A similar suggestion respecting certain portions of the water main system was offered by us in February, 1893.

The larger and better distributed such a system of special copper return from the water pipes is, the less danger from electrolysis; but the great outlay for copper involved is prohibitive beyond a certain limit. Whether within this limit the electrolysis can be reduced to an unimportant amount is by no means yet demonstrated. The data are still so incomplete as not to warrant a positive inference.

The water commissioners state that many other cities throughout the country are experiencing the same difficulty, and, as it is a subject of great importance, they propose to continue the investigation with the purpose of finding the best means of preventing the corrosion which, although slow in its action, is nevertheless sure in time to cause serious trouble to the water supply pipe system.

Comments and Views of Contemporaries.

BROOKLYN TROLLEY SYSTEM.—The trolley system commands the local transit situation. The increase in traffic on the electric lines surpasses the most extraordinary expectations of the management. The crowding of the cars is not confined to the so-called "rush" hours, when passengers are going to and from their business. It is particularly noticeable in the forenoon, during the time set apart for shopping. Along Fulton street and Flatbush avenue, in the retail dry goods district, it is not unusual to see seventy or eighty cars so close together that they resemble a "solid" train. The demand for seats is so heavy that the rolling stock in use supplies it insufficiently. At the present rate of development the railroad companies will have to largely increase the number of cars. The railroad managers, while extending their lines, could profitably provide their patrons with a few needed improvements. One of these would be a new plan of construction for open cars. The present open car in Brooklyn is an instrument of discomfort, if not of torture, for the public. The seats are too wide for five persons and too narrow for six. When the traffic is active they are packed with sweltering and grumbling humanity. The women are the chief sufferers. Seldom one emerges from the crush without a crumpled costume and a roilled temper. The railroad managers could introduce a highly useful reform in this respect.—*New York Times.*

WHAT THE TROLLEY ACCOMPLISHED IN BALTIMORE.—The people who had been discussing rapid transit for years in a desultory and theoretical fashion had their vague dreams translated into action in an almost inconceivably short space of time. Line after line of railway was provided with trolley or cable, and extended or furnished with branches reaching to the remotest hamlets. The vacant lots in the city were rapidly covered with comfortable residences, and the suburbs dotted in every direction with beautiful villas and cottages. Even to those accustomed to moving about the city and observing the improvements, a ride on any one of the numerous rapid transit lines which have resulted from Mr. Hambleton's initiative will be a genuine surprise. The city seems to have made a great leap forward, which, under the old conditions, would not have been possible in a generation. The entire city appeared to assume a more progressive spirit with the first car that glided over the line; men moved more rapidly, and their minds and energies appeared to be correspondingly quickened.—*Baltimore American.*

STREET RAILWAY ACCIDENTS.—So long as human nature remains unchanged it can be safely assumed that some carelessness will be exhibited on the part of railway employes as well as of pedestrians, and that there will be persons struck down by the swiftly propelled vehicles. So such accidents might be considered as certain to occur on a surface track and it is the part of philanthropy and the duty of public authorities and of railway officials to adopt means to reduce the fatality to the minimum. First, railway companies should by their discipline eliminate as much of the element of carelessness as possible, so far as their employes are concerned, and thus diminish the number of accidents. Then, if any device has been produced which will remove any of the dangers of such accidents it is clearly the duty of railway companies to adopt it.— *Washington Star.*

CARRYING INTOXICATED PERSONS.—Intoxicated men are permitted in cars where sober men, as well as women and children are compelled to ride. Scenes of the most disgusting nature are not infrequently witnessed as the result of this practice, and which amounts to an outrage on the decent portion of the traveling public. Railway companies incur no risks whatever in refusing to carry filthy, drunken and ill-behaved people. Strict orders should be issued to conductors on all street railways to refuse to carry drunken men. Such a policy is no more than justice to the decent portion of the traveling community.—*Scranton (Pa.) Republic.*

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

EQUIPMENT IN EAST BOSTON.—At last the West End railroad has reached that point where it can begin to equip with electric apparatus the street railway system owned and operated by it in East Boston. At present there is not a single car run by electricity on Noddle Island, as that part of the city is familiarly called, yet this section has 40,000 inhabitants. Up to date the West End company has had all it could take care of in equipping the rest of its extensive system. That being accomplished, in response to repeated demands by the traveling public in the island ward, the company has determined to change over to electricity, even though the cost will be enormous. Of course a big power station will have to be erected, and a suitable location is now being sought for. That decided upon work will proceed forthwith, and with the admirable constructing facilities at its command, the West End company will, without doubt, push construction rapidly, so as to have the new order of things complete before snow falls next winter.

CONTEST WITH THE OLD COLONY.—For some time past there has been a bitter fight in progress between the Old Colony Railroad Company and the Rockland & Abington Street Railroad Company. There was quite a riot sometime ago between the employes of the two companies, the steam railway people trying to prevent the electric company from laying its tracks across the steam road at grade. The courts decided in favor of the electric road. Now the supreme court has given its decision against the Old Colony company in a different suit. This company brought a bill in equity for an order of court to compel the street railway company to construct and operate its electric railway across the steam tracks at North Avenue, Abington, with suitable signals, safeguards and appliances. The court has just dismissed this bill, holding that it has no power to determine the manner in which the street railway company shall cross the tracks of the railroad company.

MONTHLY STREET RAILWAY DINNER.—The meeting of the Massachusetts Street Railway Association was held at Young's Hotel last Thursday evening, Col. J. H. Cunningham, president, being in the chair. There were about 30 members present. After dinner two interesting papers were read by members on "the best method of overhead construction for electric railways."

PERMISSION TO LEASE.—The Massachusetts state legislature has ordered the bill to a third reading that authorizes the Lynn & Boston Railroad Company to lease the Boston & Revere Electric Street Railway, and to increase its capital stock.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

A DECLINING MARKET.—With a stock market that has been continually declining for the past three weeks, it is not surprising that there should be a slackening off in the demand for investment securities. This feature of the financial situation is reflected in the narrowing of the bond market, where transactions have fallen off half, thereby fully demonstrating the lessened interest investors are taking in the market for securities. That the dealings in street railway shares and mortgages have not fallen off to a proportionate extent is but another evidence of the favor which these securities have found in investors' eyes.

THIRD AVENUE RAILROAD SHARES are at present occupying a position of unusual prominence in Wall street in connection with an attack made in the general stock market on Manhattan elevated railway stock, based on the inroad that has been made on the elevated road's receipts as a result of the introduction of the cable system on Third avenue. Wall street has been flooded with figures and statements emanating from sources openly bearish on Manhattan that are altogether in the Third avenue road's favor, but the arguments presented are none the less reliable by reason of the bias marking them. It cannot be doubted that the transfer system adopted by the Third avenue and One Hundred and Twenty-fifth street cable lines, whereby a laboring man can now ride from Tenth avenue and One Hundred and Eightieth street to City Hall for one fare has been a source of much loss to other roads, both surface and elevated. The two cable lines are now running 250 cars which turn in an average of \$40 per day each, or \$10,000, an increase of \$4,000 or 80,000 fares a day since the introduction of the cable on Third avenue. More than one-half of this increase comes from the Manhattan company; the balance is a loss to the Second and Madison avenue lines. One of the surest ways of computing a corporation's money-making ability is an insight into its bank account. It is stated that the deposits of the Third Avenue Railroad Company with the National Park Bank have, so far as this year has progressed, been double the amount left with the bank for the same time last year. The confidence of the management in the profitable character of the road is evidenced by a wager just made by one of the directors to the effect that the stock will continue for the year to pay 4 per cent. quarterly dividends. Recent earnings seem to bear out this director's prophecies. For instance, for the quarter ending March 31, gross earnings were \$385,588, an increase of \$42,598, and net earnings were \$132,220, an increase of \$20,166 over the corresponding quarter in 1893. The successful competition with the elevated road, the declaration of four per cent. dividends and the other encouraging features have sent Third avenue stock up two or three points, and it is now held at 182½, which isn't over high for a 16 per cent. stock. In view of the interest at present attaching to this stock, it is well to present herewith a copy of the general balance sheet made upon March 31. Assets are computed as follows: Cost of road and equipment, \$5,853,712; stocks and bonds, \$15,000; other permanent improvements, \$6 835,786; cash on hand \$145,102; total assets, \$12,849,630. Liabilities figure up in this fashion: Capital stock, \$7,000,000; funded debt, \$5,000,000; loans, bills payable and mortgages, \$546,000; interest on funded debt, \$62,500; due for wages and supplies, \$22,368; due individuals, \$92,059; total, \$12,849,630.

OTHER NEW YORK SHARES.—So much attention has been diverted to this one stock, that the other street railroads in this city have been practically neglected. Second avenue shares have held strong on the prospects mentioned herein last week of a purchase by an outside interest, but nothing definite has been developed. The stock will, however, bear watching. All the traction companies report increased business and traffic despite the dull times. It is likely that many of the New York City lines may have a substantial boom in the near future when the results of the contemplated trials of the underground trolley on the Second and proposed Lenox avenue lines are definitely known. In the meantime quotations hold with a firmness very gratifying to officials and interested holders of stock.

LONG ISLAND TRACTION continues weak. Despite denials by officials, their report still holds ground that a further issue of some $2,000,000 second mortgage bonds for improvements and new equipments is contemplated. Then, too, the unfavorable exhibit made by the statement of earnings for the March 31 quarter has had a depressing effect on the stock. The road failed to earn its fixed charges for the quarter by $158,681, interest charges, rentals and taxes calling for $444,455, while the total net income for the quarter was only $285,771. The whole trouble lies in the uncalled for large expenses. The cost of operation, including taxes, was 84.7 per cent. of gross earnings; this is enough to swamp any corporation. The officials feel that some explanation of this extraordinary state of affairs is due security holders, and President Lewis has made a statement endeavoring to account for the losses in revenue. He says that the company has lost in interest on idle property, attending the conversion of the lines into an electric road, something like $100,000. It had lost about $160,000 from the depression in business and about $75,000 more from the extension of the elevated line into South Brooklyn. In all the company had lost over $350,000. Since April, however, receipts have improved, and President Lewis estimated that the year ending June 30 will show a profit of $179,184. This is rather bold calculation as it is based altogether on what the present quarter alone will produce. When the present situation, where in one quarter alone a deficit of over $158,500 is accumulated, is compared with the glowing prospectus issued a year ago when the property was floated wherein a sure dividend of 2½ per cent. on the $30,000,000 Long Island Traction stock is figured, there is no wonder that steady liquidation continues. For the three quarters of the year, the company has earned $37,352 on $30,000,000 stock. It is now quoted at 14 bid.

PHILADELPHIA AND METROPOLITAN TRACTION STOCKS hold very firm on the continued increases in earnings that are reported. Messrs. Widener and Elkins have determined, however, not to give any more statements of profits to bankers and brokers, because the figures find their way into print, and to this the traction magnates object because of the adverse criticism sometimes made by financial experts. Figures on hand, however, show that between May 1 and 10 the average daily increase of the Philadelphia Traction Company was $1,331 and of the Metropolitan Traction $619 per day, both these daily increases being ahead of the estimates made by the management. On the other hand the returns of the Baltimore Traction for the same period are less encouraging, showing, as they do, a daily decrease ranging from $109 to $802 a day, or an average of $469. This decrease is in gross, however; a saving in operating expenses is expected to more than offset these losses.

PAYING FOR THE FRANCHISE.—Apropos of the Metropolitan Traction Company it is noted in this city that it has not yet paid to the city the $150,000 which it agreed to when its Broadway line was completed. The comptroller of the city of New York has demanded the money, but the company refuses to pay on the contention that, as the small loop from Bowling Green to South Ferry along Whitehall and State streets is hardly in running order, the entire road was not completed. Cars are now running around the loop, however, and the company will be obliged to settle up.

Financial Notes.

West End Dividend.—The directors of the West End Street Railway Co., Boston, have declared a semi-annual dividend of 4 per cent on the preferred stock and 3 per cent. on the common stock, payable July 2, to stockholders of record at close of business June 9. Books close June 9 and reopen June 25. The directors passed a resolution that in order to conform to the fiscal year of the company the dividends on the common stock should be paid October and April, instead of July and January. Consequently the next dividend on the common stock, if any is declared, will be for the three months ending September 30. Thereafter it will be in semi-annual periods. The dividends on the preferred stock which are charged every month in expense account, remain as at present. The company has supplied its employes burned out by the Roxbury fire (23 married men with 68 children), with complete household outfits, groceries, etc.

Pittsburg Traction.—The annual report of the Pittsburg, Allegheny & Manchester Traction Company states that bonds and stock of the corporation have been issued to the limit provided by the charter, and that receipts, which showed a considerable falling off in consequence of the financial depression, are now about where they stood at this time last year, and are steadily and rapidly increasing. The gross receipts for the company's fiscal year were $450 912.97; operating expenses and fixed charges, $361,146.71. The dividends paid since the inception of the company to the present time aggregate $257,110 56; the net earnings for the same period were $296,760 24, leaving a balance to the credit of profit and loss of $39,849.68. The cash on hand April 30, 1894, was $45,889.02, and it has been increased materially since.

Oakland, Cal.—Suit has been brought against the Fruitville & Highland Park Railroad by the California Safe Deposit & Trust Company for the foreclosure of a mortgage for $200,000 of the bonds of the road, which the Trust Company guaranteed in April, 1893, taking as security a mortgage on the entire plant, including right of way, rolling stock, etc. The Highland Park road runs from Brooklyn station to Highland Park in East Oakland, a distance of about two miles. The road was a horse line up to two years ago, when the power was changed to electricity.

Buffalo Railway Company.—The earnings of the Buffalo Railway Company for April make a very favorable showing, in that the management, while increasing gross earnings, also succeeded in largely decreasing operating expenses. Gross earnings aggregated $120,592, against $117,082 for the same month last year, an increase of $3,509, while operating expenses were $67,175, a decrease of $6,044 as compared with the same month in 1892. The net result was $53,416, against $43,862 for April 1893, an increase of $9,554.

Philadelphia Traction.—The directors of the Philadelphia Traction Company, at a meeting held this week, adopted a resolution providing for an additional issue of stock not to exceed 100,000 shares at par, $50. The proportion at which the new stock is to be allotted to stockholders was not decided, but as there are already 200,000 shares outstanding it is quite probable the offer will be one share of new stock for every two shares of old. The stockholders will vote upon the new issue June 16 next.

New General Electric Directors.—The General Electric directors have elected Robert Treat Paine, 2d, and Gordon Abbott, both of Boston, as directors to fill the two new seats created by the stockholders at their annual meeting. The old officers were elected with the exception of M. F. Westover, who was chosen secretary, as previously announced. The directors discussed the matter of the impairment of the capital stock, and referred it to the executive committee.

Brooklyn Traction.—Gross earnings of the Brooklyn Traction Company for April aggregated $75,095 64, an increase over the same month last year of $11,063.08. or 17 per cent. As operating expenses were $50,431.46, the profit from operating the road in April was, therefore, $24,664.18, to which should be added $3,375 receipts from other sources, making the total net earnings $28,039.18, a large increase over the same period in 1893.

General Electric Railway Business—The Boston *News Bureau* says: "An officer of the General Electric says: Electrical matters are quieter in the West than East. The principal demand is from street railways. General Electric has on hand orders for 800 motors with prices from 25 to 30 per cent. lower than a year ago; offset, in part, by lower wages and cheaper material. Low prices have stimulated the demand."

Scranton Traction.—Below is given an outline of the operations of the Scranton Traction Company for the month of April:

ITEMS.	1894.	1893.	Difference.
Gross earnings	$18,813 69	$15,316.91	Increase..$3,496.78
Operating expenses	11,442.16	9,784.76	Increase...1,657.40
Net earnings	$7,371.53	$5,532.15	Increase..$1,839.38

Heald & Holliday, of Ironton, O., have secured a ten mile electric or steam dummy franchise in Adams County, O., and are now forming a company to build and operate the road. It is one of the most favorable situations in the state, West Union being the only county seat in Ohio not on a railroad.

It is understood that since May 1 the earnings of the company have continued to maintain the same relative increase, and the outlook for their further increase is excellent, especially during the summer months, when the volume of travel expands in its territory.

Newton Street Railway Company.—A director of Newton Street Railway Company says that the 2 per cent. dividend paid last month was paid from borrowed money. Earnings of the road at the present time are about 10 per cent. less than a year ago.

The Bridgeport Traction Company, of Bridgeport, Conn , has sold to Redmond, Kerr & Co., New York, $1,300,000 first mortgage bonds and with the proceeds will equip its entire system with electricity.

NEWS OF THE WEEK.

Philadelphia Pa.—An additional car shed is being built at the Ridge Avenue Line's depot. It will be very large, and is intended to accommodate the trolley cars of the York and Dauphin streets and Eighteenth and Twentieth streets lines. The Eighteenth and Twentieth streets cars will reach their new depot on York and Dauphin streets. Another power station will be constructed at the same point to operate the Manayunk branch of the Ridge Avenue line, the York and Dauphin streets, Germantown branch, part of the Eighteenth and Twentieth streets, and other lines which will probably be constructed in the future. It will be 143 by 93 feet in dimension, and the contract for its construction has been awarded to Samuel Hart & Sons. The station will contain three 750 horse power Westinghouse generators directly connected to Wetherill Corliss engines.

Philadelphia, Pa.—The Diamond Street Passenger Railway Company, which was granted a charter last week has elected Henry C. Moore president. Mr. Moore is president of the People's Passenger Railway Company, with which corporation the new Diamond street company is affiliated. An ordinance has been introduced in Common Council granting the new company permission to lay double tracks on Diamond street, from Twenty-second to Thirty-third street, the route covered by the charter. The new road is intended to give the Norris street and Susquehanna avenue branch of the People's system, which now runs to Twenty-second street, entrance to Fairmount Park.

Steubenville, O.—The Sprague Electric Railway & Motor Company has brought suit against Orson Adams, G. M. Spier, Jr., James and Thornton N. Mottley, Maurice B. Flynn's estate, Richard S. Newcomber's estate, S. T. Dunham of New York city, stockholders in the Steubenville Street Railway Company and five Steubenville stockholders who hold one share each. It asks for a receiver and that the street railway be declared insolvent, that its affairs be wound up for the benefit of creditors and that unpaid stock be paid in. It is alleged that there is a mortgage of $70,000 on the stock equipment and that the same is not worth $15,000.

Des Moines, Ia.—The Des Moines City Railroad Company has now its case in the Supreme Court in the suit against the city of Des Moines. The city wished to build a sewer in the center of street, the construction of which would have necessitated the removal of the street railway tracks. The company insisted that the sewer could be built on the side of the street and secured an injunction against the city. Its right to the injunction has been sustained by the Supreme Court.

Mahanoy City, Pa.—The Lakeside Electric Railway, running from Mahanoy City to Shenandoah, a distance of 5½ miles, which is to be extended to Delano and Lakeside Park, making a total length of 13 miles, was formally opened for travel this week. About 100 invited guests, including a number of prominent bankers and business men of Philadelphia and New York, and newspaper representatives from the mining towns in the neighborhood, were present and rode over the line.

St. Joseph, Mich.—The Complete Electric Construction Co. has begun work on the new St. Joseph and Lake Shore Street Railway. The line will at present be run a mile and a half to the city limits, but will be extended later to Stevensville, seven miles from here. It will be run by independent motors. A summer hotel pavilion and places of amusement will be erected at the terminus of the line.

Toledo, O.—The Toledo Electric Street Railroad Co. has brought suit against W. H. Simmons and others to recover $40,000. The defendants in 1889 prevented the construction of plaintiff's railway by injunction proceedings. The injunction was declared invalid by the Supreme Court. The suit was instituted for damages caused by the obstructive measures of the defendants.

Monterey, Cal.—The car house of the Monterey and Pacific Grove Street Railway Company was burned to the ground May 12. The house and its contents were valued at $12,000, and were a total loss. The property destroyed included six cars, 110 tons of hay and one horse. The fire is supposed to have been of incendiary origin.

Butler, Pa.—A charter has been granted to the Butler Traction Company, with a capital stock of $75,000. Joseph Hartman, president of the Butler County National Bank, is president. J. V.

Ricts and I. G. Smith, of the national bank, and John Berg, of the banking house of John Berg & Co., form the board of directors.

Hartford, Conn.—D. F. Keenan has been awarded the contract by the Hartford Horse Railroad Company to construct twenty-two miles of road, running from Hartford to Windsor, Poquonnock, Rainbow, and perhaps to South Windsor. If it is decided to go to the latter place the road will be twenty-eight miles in length.

Milwaukee, Wis.—The double-deck car is not be operated this year. The street railway company objects to it because passengers are liable to be hurt on the stairways, and because the conductor must climb to roof to collect fares, and is unable to look after the cars properly.

Boston, Mass.—Henry M. Whitney denies the story, published in Boston, that he has purchased a controlling interest in the Fairfield & Waterville electric road. He also says that he knows nothing about a proposed electric line between Boston and Bangor.

Chicago, Ill.—The Lake Street Elevated Railroad Company has sued the Jefferson & Urban Transportation Company for $100,000 for alleged breach of contract to deliver to the plaintiff corporation a franchise which had been granted by the city.

Leavenworth, Kans.—The Leavenworth Light & Heating Company will continue to furnish power for the operation of the electric railway. Some additional machinery will be installed in the power station to meet the increased demand.

Cleveland, O.—The company which proposes to build an electric railway connecting Cleveland and Akron will be incorporated with a capital stock of $300,000. It will be known as the Cleveland & Akron Electric Railway Company.

Springfield, O.—Interest has revived in the Springfield-Urbana electric railway. An effort has been made to induce every farmer along the line to give $1 for each acre of land that he owns abutting the proposed right of way.

Detroit, Mich.—The United States Supreme Court has granted the city's motion for the dismissal of the street railway company's appeal, and the case now goes back to the court of appeals at Cincinnati, where an early decision is looked for.

Detroit, Mich.—The controversy between the Citizens Street Railway Company and its employes has been settled and there is no longer a prospect of a strike. Wages have not been reduced.

Rochester, N. Y.—The Rochester Railway Company has ordered 300 life guards of the R. A. Crawford Manufacturing Company of Allegheny City.

PERSONAL.

Charles J. Gustafson, superintendent of the Chattanooga Electric Railway Co., has resigned his position and will engage in the manufacture of street railway specialties which he has invented. His headquarters will continue to be in Chattanooga.

TRADE NOTES.

The Mason Electric Company, Pullman Building, Chicago, reports that its business is steadily improving. Among other contracts it has received that of the Green Bay (Wis) electric railway and it is figuring on a large amount of new business. This company handles electric railway supplies exclusively and furnishes everything for the complete equipment and maintenance of all systems. It is the western selling agent of the celebrated Medbery insulation and also for the Safety Clutch Brake Company of Philadelphia.

The National Water Tube Boiler Company held its annual meeting at the main office of the company on the 16th inst., at which gratifying reports were made of the business of the fiscal year. While the financial depression checked the output of the summer months, later and recent business nearly reached that of similar months in preceding years. In corroboration of the satisfactory reports, a cash dividend of five per cent. on the $100,000 capital stock was declared out of the profits, leaving still a surplus for future contingencies.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York City, has issued some finely illustrated trade literature, presenting a fund of valuable information regarding water tube steam boilers in general and the improved Root water tube boiler in particular. The company's information pamphlet will be sent to all who apply for it.

The W. S. Hill Electric Company, of Boston, Mass., has shipped to one company during the present month two orders of switches that weighed over eleven tons. Notwithstanding the hard times the company's gross sales for the past nine months are reported as averaging nearly 75 per cent. more than for the corresponding months a year ago.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued May 15, 1894.

519,714. Cars Provided With Fenders.—Arthur H. Jelly, Cambridge, Mass. Filed Nov. 3, 1893.

In combination with a car a fender adapted to be dropped from a normally raised position, a trip lever the

NO. 519,794.

electrical switching mechanism for cutting out the power, and a cord extending from said lever over suitable pulleys to said switching mechanism.

519,741. Switch for City Railways. Joseph Shutt, East New York, N. Y. Filed Aug. 26, 1893.

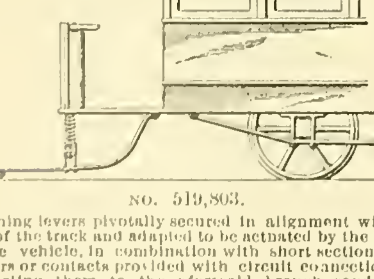
The combination with the switch point of a bent lever, the plate supporting the bent lever and the switch, and the connection between the switch point and the lever, levers upon the main track standing in reverse positions and rods connecting the levers together and to one end of another lever, a third lever upon the turn-out or branch and a rod connecting the same to the other end of the bent lever.

519,772. Substructure for Railway Rails. James M. Price, Philadelphia, Pa., assignor to the Price Railway Appliance Company of Pennsylvania. Filed May 20, 1893.

A metallic support for railway rails, resting upon a wooden sleeper, and spiked to it and provided with a horizontal rib at the top, and a central piece, V-shaped and supporting its middle by a spiked base, as a support to the ends of the two rails meeting upon that sleeper, the support attached to the rails, staples crossing it with their upper feet driven through apertures in the flanges of the rails, and the lower passing under and grazing the lower edge of the support, so as to bind the rails and support solidly together and maintain one level for them.

519,794. Electric Railway System. David Mason, Schenectady, N. Y. Filed June 27, 1893.

In an electric railway system a current main or lead having branch conductors operatively connected with



NO. 519,803.

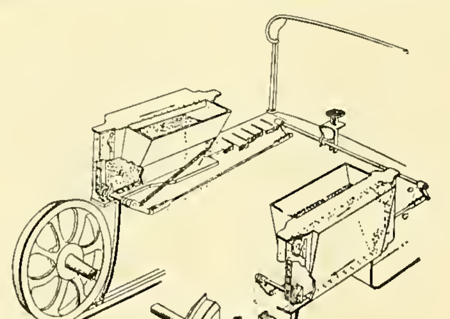
switching levers pivotally secured in alignment with the rails of the track and adapted to be actuated by the wheels of the vehicle, in combination with short sectional conductors or contacts provided with circuit connections for connecting them to the aforesaid branch conductors. (See illustration.)

519,803. Fender for Street Railway Cars. John B. Bailey, Baltimore, Md. Filed July 3, 1893.

In a car, the combination of a fender having a cross bar which is pivotally connected midway of its ends to the cap, curved bars at the sides of the car to support the ends of the said cross bar, yielding connections attached at their lower ends to the fender between the ends of the latter and curved rods attached to the car and supporting the upper ends of the said yielding connections, the said curved rods and bars having a common center which coincides with the vertical axis about which the fender turns. (See illustration.)

519,813. Electrically Governed Switch. Emil H. E. Klatte, Freiburg, Germany. Filed February 29, 1892.

The combination of a railway track, a railway switch tongue, an electric motor connected with the switch tongue for operating it, a circuit breaker connected with



NO. 519,818.

the switch mechanism, and a pole changer connected with said motor and circuit breaker and adapted to reverse the motion of the electric motor for shifting the switch tongue.

519,818. Sanding Device for Cars. Isaac Mowder, Akron, assignor of one half to Thomas H. Mowder, Youngstown, Ohio. Filed, September 30, 1893.

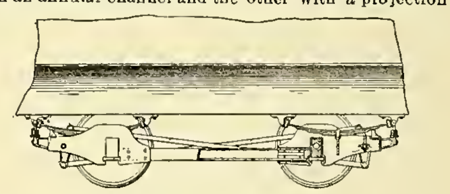
The sand box provided with the endless sprocket chain, shafts, wheels, ratchet device on one of the shafts, and means for imparting direct rotary, motion to the said shaft by a reciprocating device on the platform of the car. (See illustration).

519,824. Car Truck. Louis Warfield, Detroit, Mich. Filed August 7, 1893.

In a railway car, a truck, in combination with a car body mounted thereon by supporting springs, two long rods extending from end to end of the car and crossing each other diagonally between the truck-wheels, and means for connecting the opposite ends of both rods directly to the respective ends of the car body, whereby a vertical movement of one end of the car body will produce a movement in the said direction of the opposite end thereof. (See illustration).

519,837. Trolley Wheel. Van Dyke Cruser, Flatbush, N. Y. Filed February 13, 1891.

A trolley wheel composed of two parts mounted on the same shaft for rotation at different rates of speed, formed with oppositely beveled adjacent faces and the one part with an annular channel and the other with a projection



NO. 519,824.

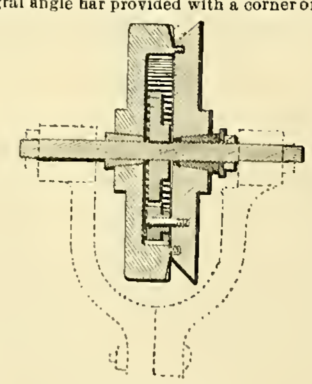
working therein, and an adjustable conical bushing on the shaft for taking up the wear on said parts. (See illustration).

519,858. Constant Current Dynamo. William H. Elkins, Cambridge, Mass. Filed February 3, 1894.

A constant current dynamo comprising a compound wound field with the positive and negative terminals of both portions of the field coils connected to the main brushes, and means for moving the bushes about the commutator, to keep the total current generated always greater than the constant current in the work circuit, and to vary the total current generated as required in order to maintain the current constant in the work circuit.

519,904. Rail Joint. Edward P. Caldwell, Minneapolis, Minn., assignor to the Heath Rail Joint Company, same place. Filed January 21, 1893.

The combination, with a rail or tie plate whereon the rails are adapted to rest and provided with ears having spike-holes, of an integral angle bar formed from said plate and adapted to engage the side of the rail or rails, said integral angle bar provided with a corner or depressed



NO. 519,837.

portion to engage the rail flange or flanges, and bolts for securing the angle bar to the rails.

519,911. Contrivance for Diminishing the Danger to Foot Passengers from Street Railways. Franc Jernetz and Ferdinand Jeulczek, Vienna, Austria-Hungary. Filed October 14, 1893.

In an automatic guard for cars, the lever arranged to support the movable shield, spring-controlled catches arranged to press upon the lever and hold the shield in inoperative position, and means for disengaging the catches upon approaching an obstacle.

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CONTENTS.

Coal Famine and Fuel Oil. The coal miners' strike has already had the effect of causing a suspension of traffic on a few small electric lines, and the announcement comes from several places that street railway companies must temporarily return to animal power if they are to operate their roads at all. Such a result would stimulate interest in the coal famine among quite a large class of persons who otherwise might be inclined to regard the situation very philosophically. When their personal convenience is interfered with they are likely to find their appreciation of rapid transit very materially increased, and they will be apt to join very heartily in the demand that the authorities deal more earnestly with the anarchistic aliens who are so industriously violating the laws in the coal districts of Illinois. Some of the railway companies were prepared for the coal famine, as they had equipped their power stations with oil-burning appliances, and these companies can now regard the situation with complacency. It is more than likely that one of the results of the scarcity of coal will be the more general adoption of oil-burning apparatus, especially in view of the fact that the companies who now possess equipments of this kind seem to favor the change, both on the ground of economy, as well as of cleanliness.

Gettysburg Electric Railway. The Gettysburg Electric Railway Company has been successful in its opposition to the effort made on behalf of the United States to secure the appointment of a jury to condemn a part of its right of way on the battlefield. In the United States Court in Philadelphia last Tuesday, Judge Dallas handed down a decision refusing the motion for a jury and denying the application for an injunction restraining the company from constructing a branch line on the field. The court found that Congress had not explicitly delegated to the secretary of war authority to institute condemnation proceedings, and held that in the absence of specific authority the right to procure the land occupied by the company's tracks could not receive legal sanction. The decision of the court in effect refers the matter back to Congress. In commenting upon the finding of the court the Philadelphia *Public Ledger* makes this sensible remark: "The electric railway on the battlefield is a great public convenience, and not the desecrating nuisance it has been described to be. It is possible that its route might be made less objectionable in some places, but the road itself should be allowed to remain, and if moved from one part of the field, should be given a right of way somewhere else. All this might be amicably arranged to the manifest advantage of Gettysburg and of the old soldiers who visit the field and who need the trolley cars as a cheap conveyance to different parts of the great field."

Cheap Construction. Judging from some of the reports that have reached us recently regarding roads upon which the construction has recently been undertaken, it seems necessary to caution the builders of new roads against the detrimental effects of cheap construction. One road in particular of which we have heard, purports to be putting in a first-class construction, while, as a matter of fact, it appears that nearly all the material used is second hand. Experienced street railway managers know well enough that work of this kind does not pay in the long run, although for a short time it may operate with tolerable success and give fairly satisfactory results. The repairs and maintenance accounts after a year or more of operation, however, will begin to show the folly of selecting such material for a new road. The roadbed will be sadly demoralized, new and heavier rails must be used to replace the old ones, new ties will be required, and the rolling stock will make a very poor showing, while the expense for keeping it in shape is more than likely to make it impossible to pay dividends on the capital invested. Just at the present time, new material can be purchased at ruinously low figures, since competition was never so sharp. Considering this fact, it is absurd to use second hand material purchased at a price not much below that for which the best the market affords can be obtained.

Electricity on the Metropolitan. The official statement is made in the report of the construction company that has been engaged in building the Metropolitan Elevated in this city that electricity will be used for the propulsion of the trains when the line is put in operation, which, according to contract, should be about August 15. It is estimated that the substitution of electricity for steam as the motive power will require an additional initial expenditure of about $400,000, while on the other hand, it is expected that this will effect a saving of $250,000 a year in the cost of operation. It is argued that this reduction of operating expense would be brought about chiefly by the possibility of using soft instead of hard coal, and the consequent reduction in the amount of the coal bill. If these figures have been made by the company's engineers, they certainly represent a showing very much more favorable to electric power than had been supposed would be the case. A saving of between six and seven hundred dollars a day in operating expense will certainly give an electrically equipped road a decided advantage over a competing system, operated by steam locomotives; and this is basing the comparison of the two simply and solely on the net earning capacity of the two systems. There is no doubt, however, that an electrically propelled train would, all other things being equal, carry a larger traffic than a similar train drawn by a steam locomotive with its accompanying noise and smoke. It is highly probable that the equipment of the Metropolitan will follow very closely the lines of the Intramural system, since Mr. W. E. Baker, the engineer of the Intramural, is to have charge of the electrical equipment of the Metropolitan.

Street Car Fenders. Within the last few days reports have appeared in the daily papers of half a dozen different cities, which seem to throw light on the frequently propounded question whether the street car fender is an appliance of much value as a safeguard. These reports are descriptions of tests of fenders in actual service, and they appear to be of significance inasmuch as the six independent accounts relate not to exhibitions taking place under the inventors' eyes, but to demonstrations of the working of these devices in such emergencies as arise in daily practice. In five out of the six cases in which the fenders were brought into service the devices operated with entire success, and accidents were prevented. The five persons who were run down by the cars were either picked up or pushed out of harm's way and were no worse for their experience, if trifling bruises and fright be excepted. In the sixth case a pedestrian was picked up from in front of a car, but the rescue was effected with such violence that the victim suffered from concussion of the brain. Still according to the report the fender doubtless saved a life. If fenders generally operate with such average success as that noted in these reports it cannot be questioned that they may be considered a most desirable part of a car equipment. This fact is the more true inasmuch as by far the greatest number of serious accidents are due to attempts to cross in front of cars. In the statistics of accidents for May which we present elsewhere in this issue it is to be seen that fully one-third of all the casualties noted were due to this single cause, and accidents of this class are those which a fender is specially designed to prevent.

The Detroit Railway Controversy. The Detroit papers contain columns upon columns of news relating to attempts to solve the vexed street railway problem in that city, but the settlement of the controversy seems as far removed as ever. The city authorities offer as compromises different ordinances which, if accepted by the street railway company, would involve the conduct of its business at a loss, but with singular obstinacy it still refuses to consider these proffers of peace. Meanwhile the residents of Detroit pay the penalty by being obliged to patronize horse cars. Just how complicated the controversy is may be judged from the following resume which appears in a Detroit journal: "Everything is in a jumble. First, we have a lot of syndicates tumbling over each other in their eagerness to buy the franchise? Then comes the council with two factions, supporting each a different ordinance. Then the council committees. Then the representatives of the bondholders with their suggestions and the representatives of the stockholders with theirs. And mixed up with them all are sundry 'promoters,' the doughty members of the board of public works, and last but not least, the mayor, filled to the throat with determination to do something beneficial for the people, but never quite able to explain what it is or to get it done. It is really impossible to make head or tail of it all or to tell where the company, the city and the mayor 'are at.'" Under such circumstances the rapid transit outlook in Detroit can scarcely be regarded as favorable. In their desire to take advantage of the company which provides transportation for the public, the authorities are causing the city to appear far behind the times.

STREET RAILWAY ACCIDENTS.

The record of street railway accidents for May is presented herewith. The number of accidents in May exceeds by 35 the number which occurred in April, but the record is not as large as that of March, when 188 casualties were noted. Among the cities in which several accidents occurred were the following: Brooklyn 16, New York 10, Philadelphia 9, Chicago 8, Pittsburg 8, Newark 6, Kansas City 5, Cleveland 4, Indianapolis 5, Baltimore 4, Buffalo 3, Denver 3, Minneapolis 3, Milwaukee 3. The May record is as follows:

Number of places in which accidents were noted	59
Total number of accidents	161
Number of accidents due to electric cars	126
Number of accidents due to cable cars	30
Number of accidents due to horse cars	5
Number of fatalities	47
Fatalities due to electric cars	40
Fatalities due to cable cars	7
Fatalities due to horse cars	None
Number of persons injured	128
Persons seriously injured by electric cars	30
Persons seriously injured by cable cars	12
Persons seriously injured by horse cars	2
Persons slightly injured by electric cars	65
Persons slightly injured by cable cars	14
Persons slightly injured by horse cars	5
Number of passengers injured	27
Number of employes injured	8

CAUSES OF ACCIDENTS.

Attempting to cross in front of cars	57
Collisions with vehicles	27
Fell from cars	10
Alighting from cars	10
Attempting to board cars	7
Collisions with bicycles	5
Collision of cars	2
Passengers fell between motor car and trailer	3
Cars jumped the track	2
Collision with railroad train	1
Collision with obstruction on track	1
Employe coupling car	1
Struck by grip lever	1
Car horses run away	1
Car axle broke	1

NEW YORK RAPID TRANSIT COMMISSION.

The Rapid Transit Commission of New York after an existence of over three years held its last meeting last week. During this time the body has held 218 meetings and has made many serious but unavailing efforts to accomplish the task which it was appointed to perform. Nothing definite has been accomplished in the way of rapid transit, although an elaborate plan for an underground road was prepared and offered for sale. Numerous overtures were made from time to time to the Manhattan Elevated Railroad Company, but the negotiations came to nought.

The last attempt of the Commission to solve the rapid transit problem was Mr. Bushe's scheme for an independent elevated railroad. Public opinion was against this plan, so it, too, was dropped, although much time and money were spent upon it—so much money, in fact, that the Commission is now in debt over $11,000. During the three years of its existence the Commission has expended $128,000. The new Rapid Transit Commission will probably meet for organization at the end of next week. It is thought that either Alexander E. Orr or Mr. Steinway will be chairman.

STREET RAILWAY EXHIBIT AT THE ATLANTA CONVENTION.

The exhibit of street railway apparatus will be made a special feature of the convention of the American Street Railway Association at Atlanta October 17, 18 and 19. N. W. L. Brown of the committee on exhibits announces that it is proposed to make the exhibit more interesting than any of its predecessors. A cordial invitation has been extended to all manufacturers and producers of street railway supplies to coöperate in making the exposition successful. The exhibit will be held in Machinery Hall of the Piedmont Exposition, and as the building has been secured for two weeks commencing October 10 there will be an abundance of time for the installation and careful removal of apparatus. The arrangement of the building is shown by the accompanying diagram; it will be noticed that the convention hall is located in the same structure.

In the circular signed by N. W. L. Brown, chairman of the committee on exhibits, Equitable Building, Atlanta, and W. J. Richardson, secretary of the association, 166 Montague St., Brooklyn, information is given concerning the rules and regulations of the exposition.

Space will be allotted on June 15 to all exhibitors whose applications have been filed with the secretary and accepted on or before that date, and applications received and accepted after June 15 will be allotted remaining space, if any, in the order of their acceptance.

The space will be charged for at the rate of fifteen cents a square foot, and no space less than 100 square feet will be rented, nor more than 2,000 square feet, unless by special arrangement with the secretary.

Space allotted cannot be transferred without permission, and must be taken possession of on or before October 16. Articles placed on exhibition cannot be removed without the written permission of the secretary. All goods shipped to the exhibition should be plainly marked "Street Railway Exposition, Atlanta, Ga." It is advisable to secure a time limit delivery and to allow plenty of time for transportation.

Exhibitors of machinery in operation must have everything in running order, in readiness to start their machinery on the morning of the opening day. Exhibitors must provide all countershafts, pulleys, belting, switches, switchboards, etc., necessary for the operation of their machinery.

On and after October 10 exhibitors and their agents and workmen will be admitted to the building for the purpose of preparing necessary structures. The general reception of articles for exhibition will commence on October 10. All goods intended for exhibition must be on the premises and properly displayed on or before Tuesday evening, October 16.

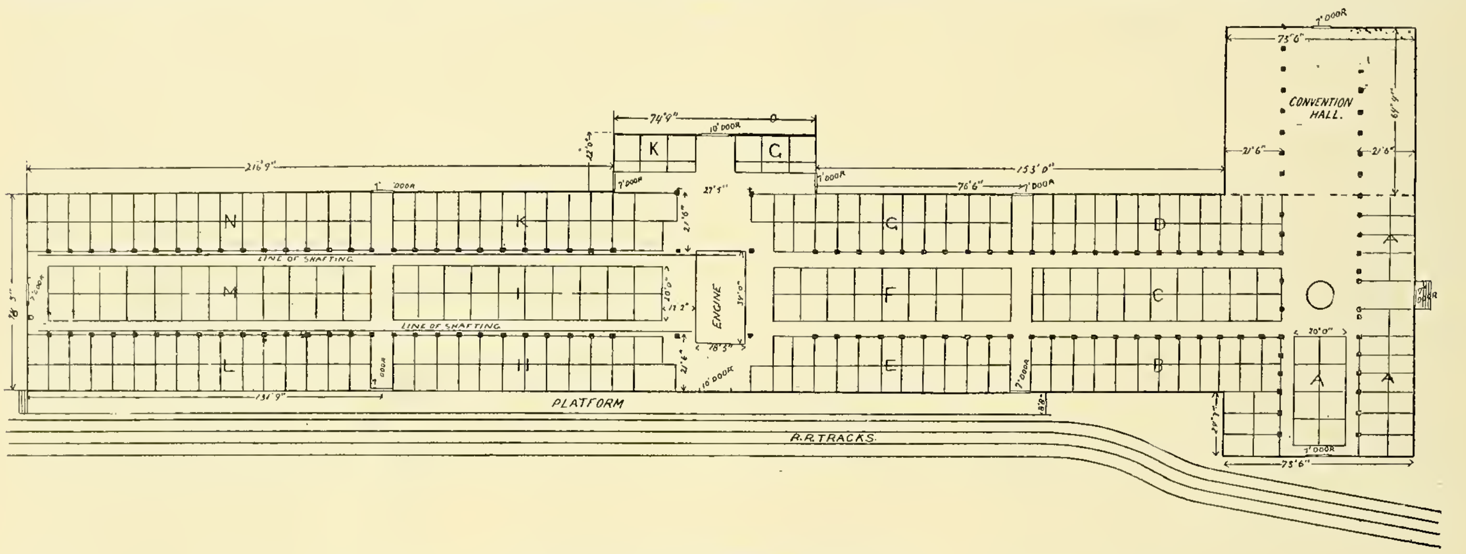
Electric power will be furnished to those who use power. The charge therefor during the entire time of the exposition will be 45 cents per rated kilowatt of machine actually using current. The minimum charge for power will be fifteen dollars. All machinery will, if possible, be exhibited in motion, and should be kept in motion at regular work during the hours 9 to 12 A. M., 2 to 6 and 7 to closing P. M.

No platform or other structure must be nailed to the floors or walls. Exhibitors must not place any sign or circulate advertisements, except such as pertain to their own business (and those only in their own space) without written permission from the secretary.

Exhibitors desiring to sell and deliver in the building any articles whatever must first obtain a written permit from the secretary, for such consideration as may be determined upon. Any permit to sell may be revoked at any time at the pleasure of the association.

Every possible precaution will be taken to guard against fire, and a full corps of watchmen will be on duty day and night; but the association will not be responsible for loss or damage to articles on exhibition by theft, fire or otherwise.

The association reserves the right to charge an admission fee to the citizens of Atlanta should it so determine, but the admission of exhibitors and their agents will be free.



PLAN OF ATLANTA EXHIBITION BUILDING.

Columbus, O.—It is expected that the electric line between Columbus and Westerville will be completed some time in August. The deal by which the Columbus & Westerville Company sells its right and franchises to the Columbus Central Street Railway Company has been completed, and the latter company is now in full possession of all the franchises in the city as well as the right of way between Columbus and Westerville. The company expects to push the work of building, and will hasten to complete the line to Westerville first. It expects to spend over $1,000,000 in Franklin county during the next nine months, for labor and material. Seventy-pound rails are to be used on the line in the country and ninety-pound rails on the city lines. The cars to be vestibuled, will be lighted with Pintsch gas, and furnished with upholstered seats. A heavy mortgage was filed for record with the County Recorder last week, which secures the money with which the line is to be built. It covers $1,500,000 of bonds issued, due May 1, 1913, bearing 5 per cent. interest.

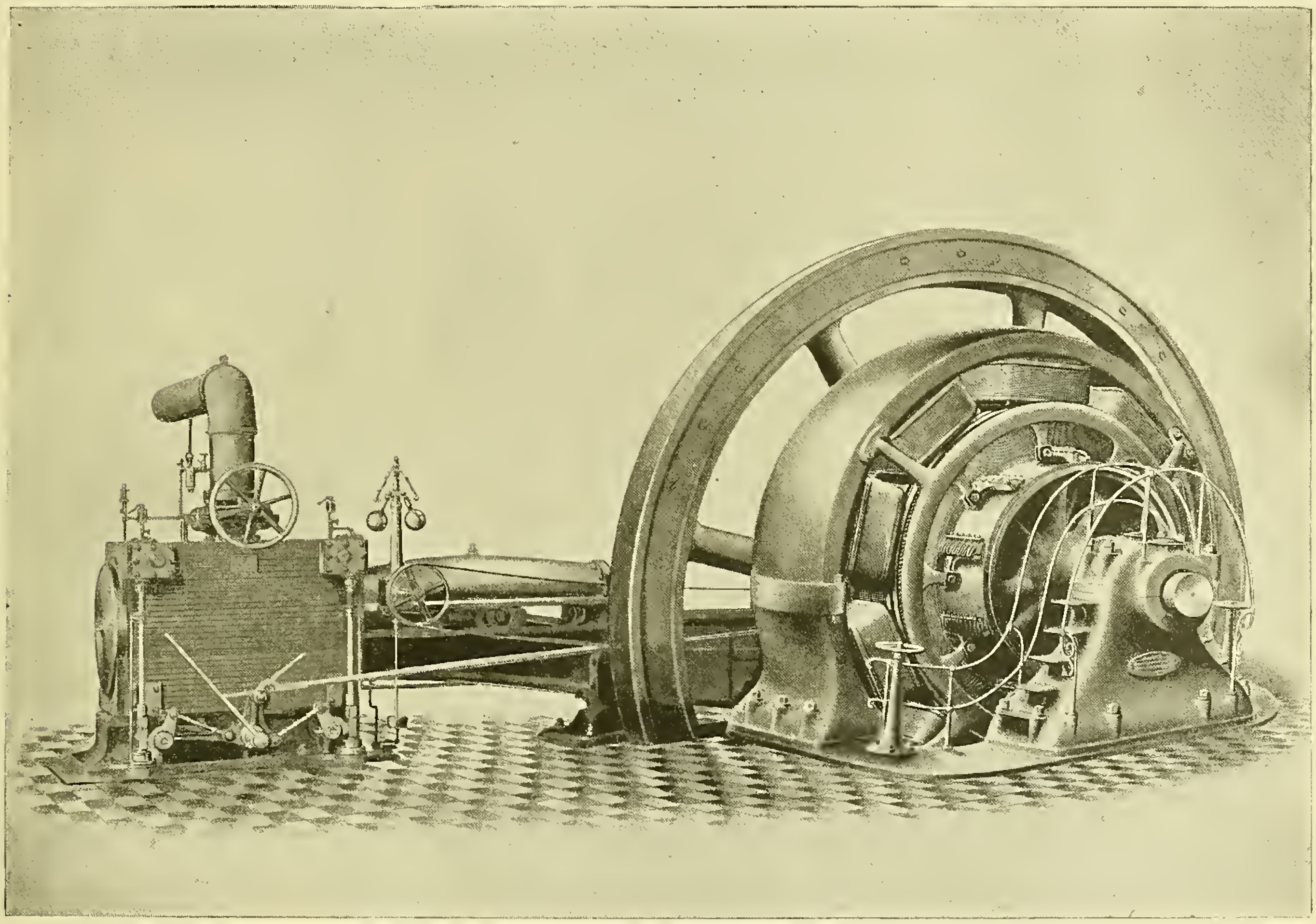
WALKER COMPANY'S DIRECT COUPLED GENERATORS.

The accompanying illustration shows the Walker Manufacturing Company's large direct coupled generators. The machine illustrated has a capacity of 2,000 horse power, has ten poles, and runs at a speed of eighty revolutions per minute. The Walker Manufacturing Company makes three sizes of generators on this plan, namely, 1 500, 2,000 and 3,000 horse power capacity.

The bed plate of the machine is cast in one piece, rests on a solid stone or brick foundation, which is made a part foundation of the engine. From this foundation is built up the masses of iron which go to make up the completed machine. The engine shaft carries the armature and commutator directly attached to it.

The Walker Manufacturing Company also manufactures the large shafts and flywheels for many of the engine builders; and it is very convenient for a purchaser of a direct coupled plant to have the entire engine, shaft, flywheel, armature and steel magnets made at the same place, as they are all fitted together in the shop, and put in good order before shipment.

These are probably the largest power transmitting dynamos made in the world, and no pains have been spared in making them as perfect as possible in every particular. It is claimed that these machines run from no load to full load, and even 50 per cent. overload without the slightest sparking at the commutators, or heating in any of their parts, and without noise. The brushes are all moved at one time by the hand wheel fastened to the base of the machine. The lower brushes and also part of the machine are reached by steps leading down into the pit below, so that every convenience for operation is provided for. These machines are arranged to be direct coupled to either vertical or horizontal engines, and also arranged to be attached to both tandem and cross compound and triple expansion engines. The facilities of the Walker Company for making large castings enable it to make every part of these machines. Each individual casting is made as large as is practicable to carry on freight cars and to erect in plants. This company is now doing special work in large power transmitting machinery for both street railroad work and long distance transmission, and is also going largely into electrical apparatus for elevated railways and interurban and cross country roads.



DIRECT CONNECTED GENERATOR OF THE WALKER MANUFACTURING COMPANY.

ELECTRIC CAR HEATERS.*

A great deal has been said concerning this method of car heating that is misleading. It has been stated that electric railway companies could get a better income by selling their power at 2 cents per kilowatt and heating their cars by stoves. A report written for the Street Railway Convention last fall, urged the adoption of stoves in preference to electric heaters.

In heating public buildings, schools, steam cars and dwellings we have reached the point where an equitable diffusion of heat is demanded, as it is safer, more comfortable, and conduces to better general sanitary conditions. This distribution of heat either by steam or hot water or hot air is easily and economically arranged, where the space to be heated is large. But in a street car where the space to be heated is relatively small such systems are not feasible.

The very fact that makes the operation of an electric street railway possible, makes it possible to secure an equable diffusion of heat by the use of electricity. We find power figured as low as $2.00 per H. P. per month and the figures given as the "cost per car mile" in many instances appear to be figured on a basis as low as this. An expenditure of 100 watts per square feet bronzed or dull black radiating surface will maintain that surface at 135 degrees Fahr. above the surrounding air. The area of radiating surface for proper heating will of course vary with the size of the car and latitude. In cars heated the past winter, 27.5 square feet surface were found sufficient to properly warm a well built 20-foot car.

On a basis of $2.00 per H. P. per month, the cost of operation would be about 27 cents per day. But in practice it was found unnecessary to run more than half the radiating surface provided a considerable portion of the time, bringing the average operating cost at about 20 cents per day. In other words in this case we secured a proper diffusion of heat by electricity and cost of operation was only 20 cents per day, while it is conceded that a stove will cost 15 cents per day to operate. The difference between the two costs surely does not compensate for foul smelling cars, unevenly heated, and a menace to health as when heated by the slightly cheaper stove.

There are many forms of car heater upon the market, but we have seen that diffusion of heat is one of the chief prerequisites of an electric heater in operation. It will generally be found that the heater which fulfills this requirement most completely is the more economical in operation. The greater the expenditure of energy by radiation and the less by convection currents the better. A convenient form in practice is a thin iron pipe with a properly insulated and distributed resistance on the inside, attached to the riser beneath the seat, and heated to about 185 degrees Fahr. Of course if cars were subject to no draughts one form of heater would ultimately be as good as another with same energy expenditure. But thermometers placed in various parts of a car frequently show differences in temperature of 5 degrees Fahr. and while, as a usual thing in space heating, the hotter the source the greater the efficiency, in car heating the greater the percentage of heat we can diffuse in the body of the car, in preference to the monitor, the better.

I therefore claim for the electric car heater the same high grade heating results in small draughty cars as we secure in carefully arranged heating plants of large dimensions; a large quantity of air moderately heated and consequently good ventilation. These factors warrant the use of electric

*From a paper by W. S. Hadaway, Jr., read before the New York Electrical Society, May 10, 1894.

heaters in preference to stoves even at a very largely increased cost.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Twenty-first Article.)

There has existed quite a difference of opinion among electricians as to the relative merits of rheostat and communtated field control, but the discussions which have taken place in the American Institute of Electrical Engineers and in the technical periodicals on the merits of the two systems have apparently resulted in no conversions on either side. They have resulted, however, in making us better acquainted with the demerits of each, many of which both sides are willing to admit; but while it would seem that it makes no difference in the efficiency of a device whether the resistances be external to it as in the rheostat control, or internal as in the commutated field, it is impossible to get sufficient resistance into the field coils for starting purposes without sacrificing other elements of efficiency. Cars equipped on the commutated field principle are therefore liable to start with a violent jerk, because even with all the field and armature coils in series the initial rush of current is too great.

This disadvantage and the advantage possessed by the rheostat control of permitting a perfectly gradual admission of current, together with the economy of current permitted by the commutated field method have led to a combination of the two being employed to great advantage. This combination method, known as the series-parallel method of control, is applicable where more than one motor is employed and consists usually not in commutating separate coils on each field, but in throwing the field coils and the armature coils of the separate motors and various external resistances into various combinations with each other. It is apparent that the greater the number of motors upon the car, the greater the flexibility of the system. It therefore seemed particularly applicable on the Intramural railroad at the World's Fair where the motor car carried four motors, and the experience on that road with the system is reported to have been entirely satisfactory from every point of view.

As before stated it has usually been customary to equip each car with two motors. With this arrangement it is often the practice to cut one motor out of circuit entirely when the work required is small. This enables the remaining motor to be operated at about its most efficient output on loads which would be so small as to render the operation of both motors inefficient.

There are many engineers who object on theoretical grounds to the use of two motors under any conditions, on account of the tendency of any two armatures to work out of unison if there happens to be any disparity between them, either in the armatures themselves or the strengths of the fields in which they revolve. It is very evident that if the two motors fail to work in the most perfect unison, the resultant effect will be less than it should. That the perfect unison of action between two separate motors so essential to the highest efficiency of operation is practically unattainable is, I believe, now admitted by all, but it is approached so closely in modern construction that this method of equipment, on ac-account of the greater facility of gearing to the axles and the greater facility of control by coupling up armature and field coils by the series-parallel method, is still almost universally employed.

There are two systems now on the market, however, which employ a single large motor flexibly geared to both axles, and the promoters of these systems claim a largely increased tractive efficiency for their methods over that possible with two independent motors. The best known of these is the Sperry system for which the claim is made that "the motor being coupled to both axles, a tractive effort is available, which is entirely impossible with separate motors. A perfectly uniform velocity of all the wheel peripheries is obtained for adhesive effect. The great gain in drawbar pull under conditions of coupled axles as compared with the same torque applied to each axle individually is a matter not of conjecture, but of fact, the difference being more than 11 per cent. The fact is that the tendency of one wheel to slip is held back by all the others instead of by its mate only. With separately driven axles, one pair may be in slipping frictional contact with the rail while the other pair is doing the work of adhesive contact." It is also claimed for the single motor system that by substituting a large single motor for two small ones, the number of wearing parts and consequent loss in friction is greatly diminished, the cost of repairs, inspection and general care of apparatus materially lessened, and the commercial and electrical efficiency of the system placed far above that of any double motor equipment.

While most of these claims are theoretically true, the mechanical difficulties of gearing both axles to the same motor have been such that the theoretical advantages of the single motor have not appealed to practical men with sufficient force to cause their general adoption. On the contrary we find to-day but one constructor building motors with this idea in view, whereas several types of single motor equipment, once advertised and pushed with considerable vigor have disappeared entirely from public view. Vandepoele, Daft, Eickemeyer, Rae are names that are all connected with the single motor equipment method, and there are now two more new names that must be added to this list, viz., E. H. Johnson and Robt. Lundell. These latter two gentlemen are now before the public with a single motor car equipment which seems to possess a number of features of real merit not hitherto employed. In the Johnson-Lundell system a single motor is employed, but the armature of this is wound with two independent sets of coils each of which has its own separate commutator. There are thus practically two armatures, but since they are both revolving in the same field they are bound to work in harmony if the coils of the two are exactly similar. This system also permits of control by the series-parallel method by the handling of the two windings as though they were separate armatures—an advantage not possessed by any other single motor system. The successive steps for increasing speeds in the Johnson-Lundell system as given to the author by the inventors themselves are as follows:

(1) Starting, external resistance, $1\frac{1}{2}$ ohms, all field coils and both armature coils in series.

(2) Same as (1) with resistance cut out.

(3) Field coils in series, armature coils in parallel.

(4) All coils in parallel.

To give greater facility in starting and to take up all instantaneous strains, the armature in the Johnson-Lundell system is flexibly attached to its shaft by means of springs which permit a considerable angular motion of the armature in case of suddenly applied strains before the cushioning is sufficient to cause the revolution of the shaft. Besides permitting of a more gradual start of the car, which is effected without jar, it is claimed for this arrangement that it results in economy of current in that it permits of the generation of some counter electromotive force at the moment of starting, when of all times it is most needed and when in other arrangements it is totally absent.

Another novel feature of this equipment is the friction clutch arrangement on the armature shaft. Keyed to the latter is an iron disc and pressing against this are two other similar discs which are forced against the keyed disc by means of a nut and spring under compression. To these latter discs are rigidly attached the two driving gears, which in this case are sprocket wheels. By tightening or loosening this nut a greater or less friction is maintained between the three discs. If the strain upon the motor exceeds this friction limit the keyed disc will slip, allowing the armature to continue to revolve instead of stopping it suddenly as would otherwise be the case. In practice this friction is determined by the maximum current it is deemed wise to permit the armature to take. This having been decided the compression of the spring is adjusted by the nut so that the friction is just sufficient to permit the inner disc to slip when the dangerous current is passing through the armature.

As before indicated, the car axles are driven from the motor shaft by means of chain and sprocket gears. Whether this will prove entirely satisfactory or not in practice remains to be seen. The chain and sprocket have been repeatedly tried before on street cars, and have been abandoned as not suitable—the chief difficulty having been the rapid wear and breakage occasioned by the sudden strains to which they were necessarily subjected. When in good order, however, this method of gear is fairly satisfactory on the score of efficiency, and with the improvements introduced in the Johnson-Lundell equipment for obviating these sudden strains and shocks, and with the improvement in the chain gearing itself the chain and sprocket may again come into favor. It is certainly the most convenient method for gearing to both axles from a single motor.

The Johnson-Lundell system calls for special attention for another reason, viz., that it is the latest attempt to do away with the overhead trolley. It is not, however, a conduit system, but rather a surface contact system, the current supply for the motor being taken from a surface conductor lying midway between the rails and flush with the street paving. This conductor is not electrically continuous, however, but broken up into lengths not exceeding 8 or 10 feet, which are successively thrown into electrical connection with the feeder system as the car passes over them, and disconnected again after the car passes off of them. The switching is automatically accomplished by electromagnetic devices, one of which is provided for each separate section of the trolley rail. These switches are contained in hermetically sealed boxes, usually 3 in a box, buried in the street beside the tracks. On board the car is placed a storage battery which is kept continually charged by the line current. The function of this battery is two-fold—first to furnish the current on starting the car necessary to actuate the electromagnetic switch by which the the feeder current is diverted into the trolley rail section immediately below the car, and second to render the car independent of the power station should occasion require, as in case it should run off the track or where it is required to run the car over insulated portions of the track too long to be conveniently passed by the car's momentum. Since for either use but little drain is made upon the battery, the cells are not required to be of large capacity, and only a sufficient number is required so that when coupled in series their combined electromotive force will equal that of the feeder circuit. On the experimental track now in operation in New York, the electromotive force of the feeder current is about 250 volts—100 cells of the chloride battery are therefore used. These are arranged in series under the car seats, the whole being in parallel with the motor circuit. Whenever their electromotive force falls below that of the trolley circuit, a portion of current from the latter goes to recharge them. On the other hand, should the trolley circuit electromotive force drop they would come temporarily to the latter's assistance.

There is still another new system for electric railways that is destined to come into prominence in the near future, viz., that devised by Mr. H.

Ward Leonard. This system is already in successful use both on electric cranes and on elevators, and in these applications has demonstrated its great economy over all other systems of control. It has been seriously objected to for street car application on account of the multiplicity of machines required and has been unjustly condemned because it has been supposed that it would involve excessive sparking with sudden changes of load or speed. As a matter of fact, however, the machines do not spark at all and the efficiency of control is far greater than is possible even with the series-parallel method.

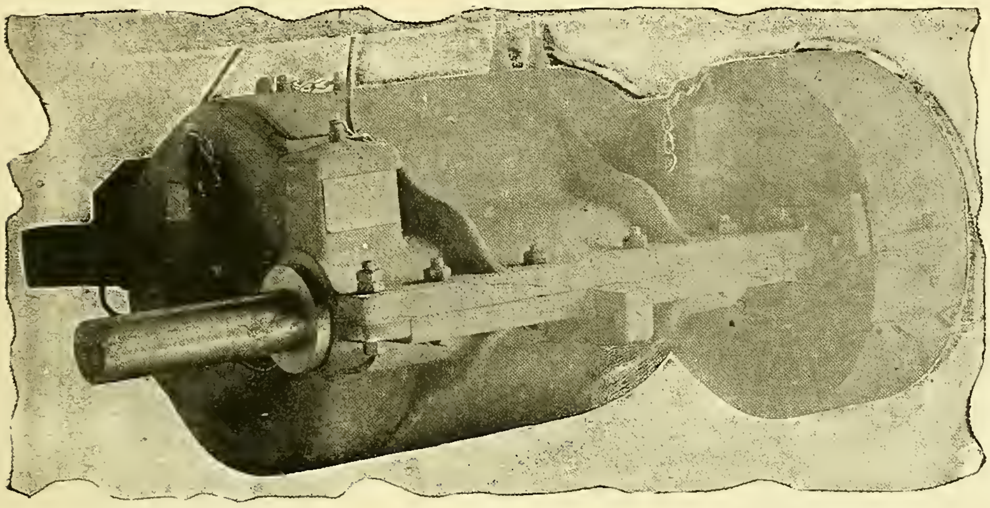


FIG. I. FRONT VIEW OF MOTOR.

CARD ELECTRIC COMPANY'S NEW RAILWAY MOTOR.

The accompanying illustrations show parts of the new railway system placed on the market by the Card Electric Company, of Mansfield, O. Fig. I shows a front view of the motor, with the case closed. It will be noticed that all the working parts are encased within the cast frame of the motor, and are thus protected from dirt or moisture at all times. Attention is called by the designer to the rigidity of the frame, and the impossibility of parts getting out of alignment.

Fig. 2 shows a rear view of the motor. A novel feature is the steel bar for strengthening the cast extensions that form the spring supports. The bar rests in grooves, cast for the purpose, and is clamped down by two eye-bolts fastened by pins between the hinge ribs at the bottom. and clips over the top, dividing the strain equally between four points, overcoming, it is claimed, all danger of breaking after long service, through a gradual crystallization of the cast metal.

Fig. 3 shows the motor with the lower half of the case dropped down, exposing the armature and field coils, for inspection or removal. The method of doing this is quite simple and requires but little time. A small chain block, fastened to a beam of the car body, by means of an eye-bolt, and to the lower half of the motor case at the extension, shown in the center, will enable one man to raise or lower it with ease. If the armature is to be removed, the journal caps are taken off, the case supported from below with a timber, a plank laid one end on the motor case, and the other on a cross support in the pit; on this the armature is rolled out of its bearings, away from under the car and out on the floor. All the screws and bolts are easily accessible, and a socket wrench is provided for their removal from the top side.

The core of the armature is built up of the best magnetic iron and is slotted to receive the conductors. These slots are insulated with mica, as are also the ends of the core. The shaft is hammered steel, is four inches in diameter through the core portion, with a one-inch square key to prevent turning; the ends are reduced to receive the commutator and oil disc, without impairing the strength or rigidity of the shaft, and terminate in bearings of generous size and length for the journals. The pinion is securely keyed on, and is further held by a nut.

The field coils are wound on forms, each one in two parts and separately covered first with muslin saturated with shellac, then with two windings of waterproof tape, and painted with two coats of insulating compound, after which they are bound together with tape and placed in an oven heated by steam to 150 degrees, and kept there until every particle of moisture is driven out. In winding the wire on the forms, each layer is coated with shellac until saturated.

In constructing the commutator (Fig. 4) the segments are set up in a form and over them are driven with a heavy hammer rings of steel until further compression in that manner is impossible, but when the end plates are put on and screwed down, the degree of strain has been limited to a point when further compression will permit the rings being removed without the aid of a hammer. A frequent source of trouble is from oil working its way along the shaft into the armature and destroying the insulation, and only a perfect metallic joint, which is seldom obtained, unless aided by other means, will prevent it. In this commutator, between the hubs of the end plates, is a rubber ring, which is of such size that when the commutator is on the shaft it will fit the shaft snugly and make a perfect union between all parts, and effectually prevent any oil passing through to the armature or working its way outward into the commutator.

Careful attention has been given the gear case, which is made of malleable iron. In the top half is an opening with a hinged lid for inspecting the gears and inserting grease. The rear fastening to the bottom half is made in the form of a detachable hinge, for convenience in lowering and removal. On the front end is a handle. The joints are planed, and the holes bored accurately to fit the axle and other parts.

The resistance box is made of hard, well-seasoned maple, with a tight bottom, and is lined inside with asbestos board. The coils are made of iron wire and fastened to the box with coach screws, which pass through holes in the sides and screw into the coils. Soldered connections between coils are made on the inside; connecting wires are brought out from different parts of the box and terminate at binding blocks on the end where connection is made with the controller. Two boxes are used on each car, connecting together in multiple, which gives a large radiating surface and thorough ventilation.

The controlling stand is very simple. The operating handle is placed centrally on top of the cover and turns a short shaft from which motion is transmitted to another shaft, shown at the left in Fig. 5, by means of two small sprocket wheels and a chain. Immediately under the cover is the reversing switch, the handle extending through the case at the right. On the longer shaft are placed eight cams, insulated from it by heavy hard rubber tubing and secured by hard rubber pins. Opposite each cam is a switch fastened by a suitable bracket or base to the back near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. At the bottom of the stand is a series of binding blocks for making connection between controller, motor, resistance and the line.

FIG. 4. COMMUTATOR.

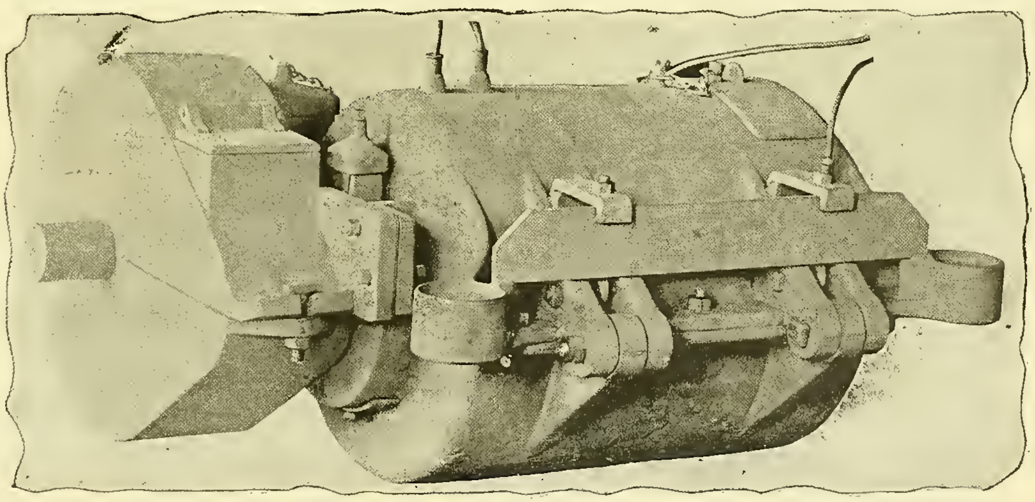


FIG. 2. REAR VIEW OF CARD RAILWAY MOTOR.

The operation of the controller switch will be clearly understood by reference to that part shown separately in Fig. 6. The two springs fastened to the switch arm and the bracket back of the pivoting point, operate to throw the switch in or out when the cam has moved the arm in either direction past a center line, and makes that motion independent of the operator and always at the same speed. The cam gives positive movement to the switch until it is just releasing from the contact clips, when the springs act and throw it quickly. The same thing occurs when contact is made, so that no matter how slow the movement of the handle may be, there can be no drawing out of arcs or burning of contacts. The reversing switch is of the simplest possible form with sliding contacts, and every part is accessible. The leading in wires at the base are protected on all sides, and hook into their respective binding blocks where they are further secured by screws. The commutator cannot be turned off without removing the armature, and be made absolutely true with the journals. The case can be opened and the commutator turned off in no longer time than would be required to take the armature out and place it on the floor. When the motor case and armature are lowered, the pinion is released from the gear wheel and is used as a means for turning the armature. This is done with a leather belt making connection with the pulley and crank handle fastened to the case. The speed can be made anything desired. One attachment will answer for any number of motors. In mounting the motor the rear supports are placed one on each side, with one forward support resting on the truck frame. This equalizes the weight and makes a very elastic suspension. The forward support can be used or not as desired, or be made to conform to any peculiarity of the truck.

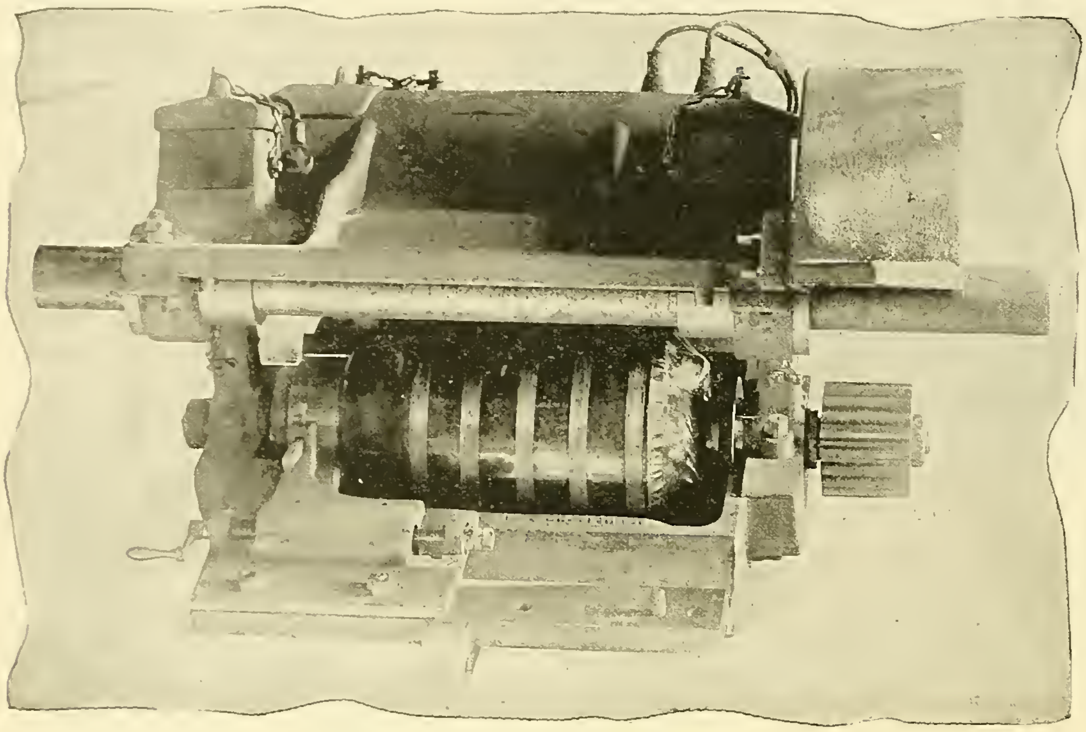


FIG. 3. VIEW OF CARD MOTOR, OPEN.

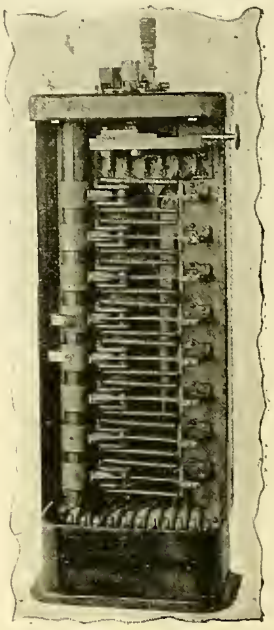


FIG. 5. CONTROLLER.

THE FUTURE LOCOMOTIVE.*

The future locomotive in some cases will certainly be driven, as now by steam, but where very high maximum speeds are needed and grades are to be traveled over at considerable velocity, and on suburban lines and sections where the traffic is crowded, electricity will be the motive power. The reasons are clear from what precedes, as the necessary boiler capacity cannot be given to a locomotive to permit high train velocity on the grades that are now common on main lines. With electricity any reasonable amount of power can be supplied from the central station, where room may be provided for any desired boiler capacity.

It is not at all probable that the immediate future will find electric locomotives taking the place of steam on main lines for regular work, as the expense of installation is out of proportion to the advantages to be gained by the change, but for elevated roads, suburban work, and switching, the change will be rapid after a few actual plants have proved the practical superiority of electric transmission. The present experience with electric motors in England and in this country for quite heavy trains is enough to establish an important conclusion; namely, that the transmission of power from a central station by the electric current, and its transformation into mechanical work at the train by means of electric motors, is a practicable and efficient method of furnishing power to locomotives, while the cost of fuel and repairs is less than with the steam locomotive; but the other expenses, that are made up of interest, taxes, ground rent, etc., are dependent upon a multitude of conditions peculiar to each railroad, and the final relative economies of the two systems must be learned from a study of the conditions existing in each particular case.

To sum up, we are now entering upon an era of change of motive power from steam directly applied, as in our present locomotives, to electric transference of power from a central station to moving trains. The change must necessarily go on slowly, commencing first with the suburban, switching, and elevated services, and finally beginning in main line work where the traffic is crowded. The steam locomotives will not be altered much in appearance or power from the best of the present designs, but improvements will continue in detail so long as it remains in use. We are nearly at the limit of economy with steam locomotives where there are large boilers and compound cylinders, and where the engineer and fireman are competent and the loads not excessive, and the maximum capacity is about as great in some cases as it is practicable to make it; hence, for higher efficiency and greatly increased hauling power at high speed, concentration of power is needed. So far as can now be seen there must be a stationary plant where power can be concentrated, and electricity seems the only practical means of transferring such concentrated power to moving trains.

*From an article by David L. Barnes in *The Engineering Magazine.*

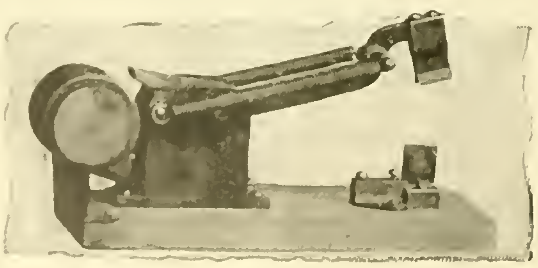


FIG. 6. CONTROLLER SWITCH.

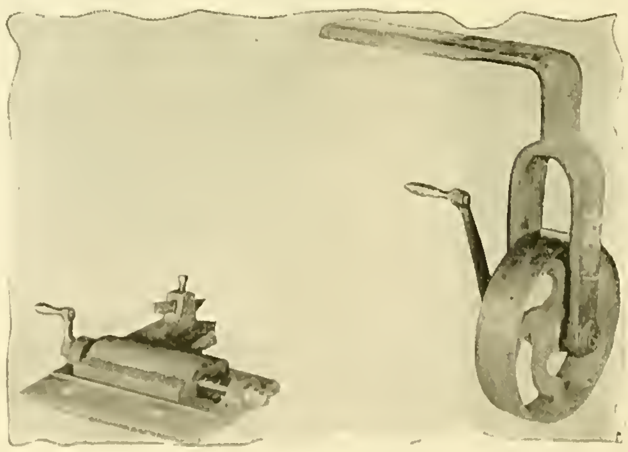


FIG. 7. PARTS OF MACHINE FOR TURNING COMMUTATORS.

CONSTRUCTION STOPPED BECAUSE OF PROBABLE ELECTROLYSIS.

The Springfield Water Company on last Tuesday secured an injunction at Media, Pa., restraining the Philadelphia & Media Electric Railway Company from constructing an electric road on the Baltimore pike. The application was made on the ground that if the road was built and operated the water pipes would be irreparably injured by electrolysis. Affidavits were submitted alleging that this result had occurred in other localities where pipes and trolley lines were in proximity. The company has several thousand feet of pipe buried in the pike. The injunction granted was a preliminary one, and until the question is finally settled all work on the extension to Swarthmore and Media will be stopped.

CONTRASTED COMPLAINTS.

The following complaints which a Newark paper asserts were recently addressed to Manager Young of the Newark Consolidated Traction Company, might have been made to the manager of any one of several scores of street railways. The striking differences of opinion entertained by passengers of street cars are sufficiently familiar and the accompanying contrasting complaints have been urged times without number. The only inaccuracy in the description lies in the arrangement of the incidents in point of occurrence for the sake of contrast. The first complaint is given by a street railway patron in these terms:

"I missed my train to-day owing to the slowness of your electric cars, and could not keep an important appointment in New York. It was a great annoyance. Your company ought to serve its patrons better than that. I thought that the trolley would give us better service, but it is poorer than the horse cars."

"I'm sorry," said Manager Young, "but really we are doing the best we can. You must make allowances for changes. We will do better as soon as our system is perfected. I regret that you had to lose your appointment in consequence of the caution of our employes."

The visitor retired somewhat mollified, and the manager was beginning to look over some letters when another visitor entered. He was in a state of agitation.

"I want to complain to your company," said the visitor, "of the frightful speed at which you run your electric cars. It is outrageous, it is criminal and the company ought to be indicted for it."

"But the public want rapid transit," said the manager deprecatingly.

"Yes, but they don't want locomotive speed in our public streets," responded the visitor hotly. "I have been witness, personally witness, to many narrow escapes from death owing to the recklessness with which your motormen run their cars, and this morning I myself sustained a shock in attempting to board a car in motion. It's shameful."

The indignant gentleman had scarcely been bowed out with assurances that hereafter the motormen would be more closely attended to, when a third visitor bounded in. It was a woman. She didn't waste any preliminary words.

"Doesn't the law require you to give warning at crossings?"

"Yes, madame."

"Then your company constantly violates the law. I was nearly run over this morning by one of your cars because no gong was sounded."

"But, madame, are you sure the gong was not sounded near the crossing?"

"Sure? Of course I am. The gong never is sounded, for I've noticed it every day. The cars steal along without a sound, and you never know that they are approaching until they are right on top of you."

The manager promised to see to it, and the female visitor went out of the door remarking that she would see a lawyer and find out if she couldn't get damages for a severe shock. Five minutes afterward the door was opened again for another visitor. He was a resident of Clinton avenue.

"Is this Manager Young?" he asked. Mr. Young acknowledged his identity.

"Well, I have called to see if the infernal gong nuisance can be abated. It is making life simply intolerable in our section of the town."

"But the gongs must be sounded in approaching a crossing," said the manager wearily.

"Sounded?" retorted the visitor scornfully. "Why, they play on the gong continually; they never let up, and they do it with malice prepense. Your company has no right, sir, to disturb a peaceful neighborhood with such a hideous racket. If it isn't stopped we will go to law about it."

The manager expressed concern. He said he had not known that the gongs were such a nuisance. He would inquire into it at once.

TROLLEY LINES IN BROOKLYN.

It is fair to say that public opinion in Brooklyn in reference to the trolley has undergone a considerable change in the course of the last year, says the New York *Tribune*. When the use of the trolley was threatened on a large scale many people regarded the prospect with genuine alarm. They had heard of it, if they had not seen it in operation in other cities, and knew that trolley cars were often run at high speed, and were a source of great danger to people in the streets. They didn't like the prospect of having their streets lined with poles supporting miles of wire carrying powerful currents of electricity. They had heard of the buzz of the trolley on the wire, and of the "trolley jerk" which the inexperienced motorman knows how to perpetrate with disastrous effects on passengers standing inside a car.

The general attitude of Brooklynites was adverse to the trolley, and for a number of months after the electric cars were put in use experience showed that the apprehensions which had been aroused were far from baseless. Accidents followed each other with alarming rapidity. The trolley cars ran at least twice as fast as the horse cars had done, and people had to be educated up to the point of looking out for them. This was especially the case with children, who formed a large proportion of the victims in the first six months of the general use of the new motive power.

It was by no means the children alone who needed to be educated. The motormen did not understand their business thoroughly; frequently they ran too fast, and they failed to keep a sufficiently sharp watch upon the tracks ahead of them. Several lives were lost because passengers alighted from a car and passed around in the rear of it to cross the other track, without observing that a car was coming down rapidly on that track. Then people took needless risks. A policeman was killed by attempting to board the front platform of a car in broad daylight, and not long afterward a druggist in upper Fulton street met his death in precisely the same manner, although this casualty occurred about midnight.

Gradually, however, the people have accustomed themselves to the new traction agent, and its good points have become recognized. The increase in speed is an important consideration, and, except in the more crowded parts of the city, it is felt that a speed of ten miles an hour is not unsafe. This feeling manifested itself with considerable emphasis when a bill was laid before the legislature a few weeks ago requiring the trolley cars to run no faster than six miles an hour. Undoubtedly the bill originated with the elevated roads, which had suffered a considerable loss of business by reason of the competition of the trolley, and no one appeared to advocate it except the counsel of one of the elevated companies. The opposition to it was so strong, however, that it never emerged from the committee-room.

Since about the beginning of the year there has been a marked diminution in the number of trolley car accidents, although within the last fortnight two or three persons have been killed. In one of these cases at least, the motorman appears to have been running his car far beyond the legal speed.

No one contends that the trolley is perfect. But it seems to have come to stay. Its cheapness is a strong recommendation to the surface companies, and, of course, if it should be found practicable to run the trolley wires underground, the cars would still run as fast as they do now and the factor of danger to pedestrians would not be eliminated. It is believed by a considerable number of people that safety in the operation of these cars would be increased by the use of a jingling bell, which would ring continuously while a car is in motion. Of course there is an objection to this in Fulton street, for example, where a large number of cars are constantly moving, and where the ringing of numerous bells would add to the noise and produce confusion in some minds. But away from the centers of business it is believed that bells of this sort would afford a needed warning in many cases. There is a singing of the wire as the car approaches or recedes, it is true, but this is unsatisfactory and untrustworthy as a signal.

Such a bell would probably have prevented the accidents occurring when persons passing behind a car in order to cross to the farther side of the street have been run down by the car coming, unseen and comparatively silent, on the other track. It would tend to the safety of all people walking, and a bicycle rider says that it would be of great advantage to men of his class, who frequently have difficulty when approaching car tracks in telling whether the way is clear. Of course every rider slows up and proceeds cautiously when coming to a street on which trolley cars run, but if the eye could be assisted by the ear it would be decidedly to his advantage.

It is a question whether anything is gained by placing a gate on the side of the car platform next the other track. It seems reasonable that if a man could get a clear view forward as he was about to alight on that side he would not step off if a car were approaching in the opposite direction. Some accidents, therefore, might be prevented by removing the gate, which is required by the state railroad commission.

On a few of the lines in Brooklyn there is a requirement on open cars of a chain or barrier of some kind on the side nearest the other track, and on the lines soon to be equipped with the trolley by the City Railroad Company, a stipulation has been made that such guards must be provided on all open cars. And yet it is an interesting fact that few, if any, accidents have occurred from passengers alighting from open cars on what is supposed to be the dangerous side. The reason appears to be that they can look out and see whether danger is approaching in the shape of another car.

PROGRESS OF THE METROPOLITAN ELEVATED, CHICAGO.

The West Side Construction Company, the corporation which is building the Metropolitan Elevated road, has made a report showing the condition of affairs May 1. The construction company has contracted to build 16¼ miles of road, about two miles of which will be four tracks and the remainder double track, the whole the equivalent of 17.96 miles of double track. The report shows that the company had received up to May 1, $7,843,975. The expenditures have been as follows:

Land (including legal expenses of same)	$4,128,287.00
Structure (including foundations)	1,746,300 00
Tracks, stations and other construction	289,244.00
Interest on bonds	230,493.00
Taxes and all other expenses	473,682 00
Cash	455,416 02
Surplus land owned (cost price)	367,799 07
Deposited with the City of Chicago (as guarantee) bonds, costing (To be returned the company when five continuous miles of track are completed.)	103,915.76
Other amounts due the company (Including $45,000 deposited in trust on account of the Van Buren street bridge.)	48,836 05
Total	$7,843,975.00

The surplus land was acquired so that large houses on the right of way, of too great value to be destroyed, might be moved to same. This has already improved the value of them and surplus land and houses are now estimated to be worth about $500,000.

The company also has on hand $6,542,700 of M. W. S. E. railroad company capital stock.

All the land for the right of way has been acquired from Franklin street to West Forty-eighth, a distance of 5.83 miles. Also all the land, excepting 175 feet, for the Logan square line from Paulina street north to Wood, a distance of a little over two miles. Land for a total of eleven miles of double track has been acquired, all of which has been paid for except about $700,000 still due for mortgages and other incumbrances.

The structure is entirely erected from Jefferson street to West Forty-eighth. No structure is yet erected on the Logan square line, but steel enough is already delivered along the line to build it as far north as Roby street, and the erection will be soon commenced, as the foundations for the structure are now being put in rapidly.

Contracts have been let for both the foundations and superstructure of the bridges, to be finished ready for use by August 15, 1894, and coincidentally the entire main line and Garfield Park line from Franklin street west to Forty-eighth street, and the Logan square line from Main Line Junction at Paulina street north to Roby street (over ten miles of double track road), will be completed and ready for operation. One hundred passenger cars are now being built by Pullman's Palace Car Company, under a contract requiring them to be delivered by August 1.

Under a subscription dated June 7, 1892, the West Side Construction Company sold $10,000,000 of M. W. S. E. R. R. first mortgage 5 per cent. bonds at 90 per cent. of par, the proceeds of which, it was then expected, would be sufficient to build and proportionately equip the ten and one-fourth miles above referred to. These expectations, it is now found, will be fully realized; for from the final installment of 20 per cent. on the bond subscription (made payable June 15 next) with what is now in the treasury of the company, ample funds will be in hand to complete that part of the contract.

Regarding the adoption of electricity for motive power the report says: The extra expenditure required to complete the electric outfit is estimated by electric engineering experts to be about $400,000 greater than it would be for locomotive engines, but the saving in operating expenses, these experts estimate, will amount to about $250,000 per annum on the entire road. The principal saving will be in the difference between the cost of hard and soft coal.

The company has already received from the M. W. S. E. R. R. Company 65,427 full paid shares of the railroad company's capital stock. Of these shares 25,000 will be delivered to bond subscribers when the final call on the $10,000,000 bond subscription (due June 15) is paid, which will leave 40,427 shares in the treasury. Upon the completion of the ten and one-fourth miles of road this company will be the owner of 75,000 shares of said stock, of par value of $7,500,000, and the surplus real estate before stated.

RELATIVE ADVANTAGES OF TOOTHED AND SMOOTH CORE ARMATURES.*

BY ALTON D. ADAMS

The merits of different methods of construction in the manufacture of dynamo electric machinery, as in other lines, must evidently be decided by their comparative costs, all else being equal. Although questions concerning the relative merits of toothed and smooth core armatures have long been discussed, very little seems to have been written, to show whether actual saving in cost may be effected by one construction over the other, when employed to produce the same results. The practice of dynamo builders in this country, and abroad, embodies both types, and the history of the art records many changes from each to the other. In view of the above, the inquiry, whether in the light of present facts any saving can be effected by the use of toothed core armatures, seems of interest. The limits of this paper do not permit consideration of this question in connection with all classes of electrical machinery, and its bearing on direct current constant pressure machines only will be taken up.

The principal disadvantages of toothed, compared with smooth core armatures, are greater first cost, large change of lead, excessive sparking, when used with too short air gaps, and the production of heat in pole pieces; their advantages are, that inductors are positively driven, large solid inductors, protected from eddy currents, and that a reduction may be made in the length and consequent magnetic resistance of the air gap. Change of lead may be fixed within any desired limits, and sparking abated by such proportions of air gap and teeth, as give them sufficient magnetic resistance. Heat in pole pieces may be reduced by their lamination, by the use of very narrow teeth and slots, by forms of teeth that present a nearly continuous surface of iron to the pole pieces, and still more, by the use of openings in core disks which do not cut through their outside surface, or a continuous magnetic sheath outside the teeth. For any given form of tooth, the heating of pole pieces is less, the longer the air gap.

The mechanical strength of armature teeth, as usually employed, is far in excess of that required to hold inductors in position, even under conditions of short circuit, and driving pins inserted in the core, at proper intervals, are much cheaper and take up less valuable room on the armature circumference. Either teeth or substantial driving pins are, of course, preferable mechanically to the slender bits of hard fibre which have been much used, and frequently give way under the heavy strains to which large generators are subject. When large wires of copper rods are used as inductors, their protection from eddy currents is an important matter, but proper stranding of inductors reduces the eddy loss in them, when used on smooth cores, to a very small amount, and has the further important advantage that inductors may be bent into the proper shape at armature ends, and the joints, necessary when rods are used, avoided.

The chief possible advantage, then, to be gained by the use of toothed armatures, is through a reduction in the length of the air gap, and the consequent reduction in the ampere turns required on field magnet, weight of copper, or energy in winding, and the length and weight of iron core. To make this advantage available, it must be practical to use air gaps shorter than are required for insulation, winding and clearance. As is well understood, the armature winding of a dynamo or motor, in operation, has a magnetizing action which is measured in ampere turns for a bipolar machine, by one quarter the product of all the inductors of the armature, into the total armature current. The ampere turns on the armature evidently tend to set up a flow of magnetism, having a complete circuit through the armature core, twice across each air gap, and through the iron of pole pieces. About half the ampere turns furnished by the inductors under pole pieces, evidently act against the field ampere turns in each air gap at the polar tips, and the ratio between the armature and field ampere turns at this point, necessary to give sparkless reversal there, must determine whether the required magnetic resistance be greater or less than that of an air gap long enough for insulation, winding, and clearance with a smooth core armature.

As an armature coil in an operating dynamo or motor passes under the brush, the current flowing in it must stop, and one in the opposite direction be set up; and if this action is to be accomplished without sparking, a sufficient electromotive force must be provided in the coil while in direct contact with the brush. In the ordinary dynamo or motor, magnetism forced across the path of the coil, by the field ampere turns expended in air gap, must provide this reversing electromotive force. The data of a number of smooth core armature machines of different make, show ratios of field to armature ampere turns in air gap, of from about one and one-half to one, to two and one-half to one, and the writer's experience is that a ratio of two to one will give sparkless operation at full load, with brushes set just outside pole corners.

It is a matter of common experience that the ratio between field and armature ampere turns in the air gap may be so reduced, even in machines with smooth core armatures as to require excessive change of lead to secure even approximate freedom from sparking. If it be desired therefore to build machines having an expenditure of field ampere turns in the air gap not much greater than those of the armature, we need not resort to toothed cores. Take, for example, the case of a 200 ampere dynamo, with 120 inductors on its armature in one layer; an air gap induction of 25,000 lines per square inch, and 80 per cent. of inductors under the pole pieces. An air gap of .45 inch between the armature and each pole piece will be sufficient for insulation, winding and clearance, and the field ampere turns expended in each air gap will therefore be 3,500, while the armature ampere turns, active under each pole tip, will be 3,100. A considerable change of lead and sparking can be readily predicted for this machine.

In some types of small machines, the room required by insulation, winding and clearance, makes the air gap longer than necessary for sparkless operation, and in such machines the utility of teeth seems to depend on their cost compared with the saving to be effected by their use. As the ampere turns, furnished by the inductors under any pole piece, grow less in a machine of given capacity, when the number of poles is encreased, very short air gaps may be used, if the number of poles is sufficiently large. As an increase in the number of poles usually makes a machine of given capacity more expensive, however, the question at once comes up, to what extent the number of poles may be increased without a greater expenditure than the saving of iron and copper to be effected.

In large multipolar machines of four or six poles, such as are commonly used, the length of air gap required for sparkless operation, is considerable, and those who have watched the development of these machines with toothed core armatures during the last four or five years, have seen the air gaps gradually widen until machines of this character are not hard to find in which the copper inductors between the teeth could be taken out, wound outside the teeth, and still leave room enough for good clearance. Additional mechanical security, of course, furnishes a considerable argument for the use of teeth in very large slow speed machines. A number of devices have been suggested from time to time, to enable toothed core armatures to be used with short air gaps, and the consequent saving in iron and copper effected. No machine with these devices, however, have yet stood the test of time and competition with those of ordinary type, and have yet to prove their ability to produce results, as at present attained at a less cost. The seeming opportunity to save material by the use of toothed armatures is very attractive, and we cannot but hope it may some day be practical; in the light of present knowledge, however, there seems little to be gained by their use in medium and large bipolar machines.

*A paper read before the American Institute of Electrical Engineers.

SUGGESTIONS FOR PATRONS OF STREET CARS.

A St. Louis motorman recently suggested the following rules, which if observed by the public would materially decrease the number of accidents:

"Never jump on the rear of grip or motor car when it is moving. A misstep throws you in the way of the trailer.

"Don't jump off a car with your face toward the rear, as most ladies do. The slightest motion of the car may cause you to fall.

"Never cross in front of a car when compelled to run. You may meet some person running from an opposite direction and cause a balk, which is dangerous.

"Be sure you are on the right corner when you signal a car to stop, and wait till it does stop before getting on.

"Never cross car tracks without looking to the right and left where double tracks exist.

"Don't attempt to get on cars in the middle of the block, as they cannot be stopped, and are generally running at their fastest speed at that point.

"Exercise your judgment, and keep your eyes open when crossing crowded thoroughfares, when different lines of cars are running. Absent-minded people are likely to get injured at these places.

"Don't think that a heavily loaded car can be stopped in the turn of a wheel; and remember that it is always easier for a person to stop than a street car.

"When you get off a car don't attempt, if a double track, to cross behind it until the car you get off moves far enough away so you can see whether another car is not about passing on the parallel tracks. This is one thing that should always be observed, as the motorman cannot see you until you get right in front of him.

"Don't send little children to places where they must cross street car tracks if possible. They get easily bewildered in a dangerous position.

"Parents and teachers should admonish children not to jump on running cars, or race back and forth in front of them."

BURNING WASTE COAL.*

BY ECKLEY B. COXE.

In getting power from coal there are three separate and distinct factors to be considered: (1) the furnace, (2) the boiler and (3) the engine; these must be kept independent and the faults or merits of one are not to be attributed to another. The function of the furnace is to convert as large a part of the combustible material as possible into CO_2; if it fails it is because too much carbon has gone up the chimney as CO or into the ash in an unconsumed state. All that is required of a furnace is that it shall deliver to the boiler a good percentage of the heat confined in the coal.

For complete combustion an excess of oxygen must be present and it is a great question in the economical operation of the furnace as to the proper amount of air to be supplied; since five pounds of air must be introduced to obtain one pound of oxygen, a point is soon reached where the heat derived does not offset the heat necessary to raise the air to the temperature of the stack. The solution of this problem of course depends upon the conditions surrounding the furnace under consideration. Analyses of ash and chimney gases will give all information required to ascertain the value of the furnace.

The second factor, the boiler, can well be likened to a sponge; its function is to absorb from the heated gases all the heat possible and transfer it to the water. The heat of the steam depends upon the temperature of entering and leaving gases, which in turn depend upon the position of heating and absorbing surfaces; if the initial and final temperatures of the gases and the amount of coal burned are known, the evaporation can be computed.

Rating a boiler by its horse power is very unsatisfactory, in fact, on account of the diversity of conditions which may accompany a boiler test, and often because of the willful misrepresentation of boiler makers, the "horse power" of a boiler has become a meaningless term. Makers cannot be made to furnish a boiler of a certain horse power unless the definition of a horse power is constant. The purchaser of a boiler should know how and by whom it has been built, also how it is going to work under *difficult* conditions. The horse power obtained from the boiler will depend upon furnace and engine, and the makers have rated it according to its performance under the best conditions of these two factors and quality of coal.

The influence of the amount of unconsumed carbon present in the ash upon the waste, is shown by the formula, $1-\frac{bx}{c}$ = per cent. of carbon actually utilized, where x = ratio of unconsumed portion of ash to consumed portion, c = amount of carbon in coal, and b = amount of ash in coal. As an illustration apply this formula to the following data, taken from an actual test:

ANALYSIS OF COAL. ANALYSIS OF ASH.

Carbon.	Ash.	Volatile Matter.	Carbon.	Ash.	Volatile Matter.	Per Cent. of Carbon actually utilized.
82	12	6	50	48	2	84.75
82	12	6	10	88	2	98.33
82	. 12	6	2	96	2	99.7

$$1-\frac{bx}{c}=1-\frac{\frac{50}{48}\,.12}{82}=84.75$$

It is usually the case that when a good grade of coal is used, more attention is given to the matter of waste than when a poor grade is employed, while from the standpoint of economy, the reverse should be true; that is, it is more important that wastes should be reduced when burning the cheaper grades. It is this question of wastes in general, which constitutes one of the chief problems with which the engineer of the present day has to deal. Modern engineers will not be called upon to invent the telephone or the compound engine. It is the practical, every day question of economy which is the paramount consideration influencing the installation and operation of every power plant built to-day. The young engineer should therefore remember that the fundamental duty devolving upon him will be to avoid waste in every possible way; he who knows best how to accomplish this will be the most valuable to his employer. More failures have resulted from lack of economy in the small details than from any other cause; "have a care for the pennies and the pounds will take care of themselves."

Too much emphasis cannot be laid upon the value of honesty to the engineer; a reputation for strict integrity is absolutely essential for success in his profession, and it is this feature which gives to science the honorable position it maintains unchallenged.

*Abstract of a lecture delivered before Sibley College. From Sibley *Journal of Engineering*.

ELECTROLYSIS IN OMAHA.

The expert recently employed by the municipal authorities in Omaha to report on the electrolysis of pipes has presented his report, of which the following is an abstract:

The rails offer so much resistance at the joints that the current naturally passes through the damp earth to the water, gas or cable pipes in the vicinity, and runs along these good metallic conductors until the rails again present an easier return to the home station. Where it leaves the pipes to pass back to the rails the current keeps eating away the pipes, carrying away with it these minute particles of metal. In a short time little holes mark the places where the electricity escapes. These grow larger and corrode the pipe.

The fact of the rapid corrosion of our underground iron and lead pipes along the route of our electric trolley cars is undeniable. In proof I refer to the ends of broken pipes in the office of our honorable Board of Public Works. That electricity is jumping the rails to water and gas pipes and back to the track was abundantly evidenced by the volt and ampere tests made by a party of competent electricians, to which the writer was kindly invited on Friday last, May 11.

At the Nicholas street power house the difference of potential of the water pipe over the rails where they entered the station was from three and one-half volts to six volts, and the quantity going to waste thirty amperes, making No. 18 wire so hot that it could not be held in the hand and driving a one-eighth horse power motor attached to the water plug. At the Custom house on Sixteenth and Dodge streets, enough current is leaving the cable car rails for the water pipes of the moist foundation to corrode them before the building will be finished and to fire the neighboring buildings. Even on Capitol Hill, near the college, where the ground is dry, a current from four to nine amperes, at a voltage of from one and three-fourths to three and one-half, works its way from the terminal rail to the water plug.

In some instances of pipe corrosion a spot of greater or less extent is singled out by the current and weakened until it becomes detached like a chip. These electrolyzed nodules are extremely light. Four samples examined by me gave a specific gravity of 2.36, 2.06, 1.83 and 1.54, the latter resembling coke in weight and appearance. Bearing in mind that the specific gravity of cast iron is 7.00 we may naturally inquire what has become of the iron and what changes have taken place?

In regard to a remedy he makes this suggestion:

If, besides, in the danger district, the rails are connected at frequent intervals with all pipes and cables along the track there is every reason to expect an abeyance of the evil. Wherever this plan has been tried it is pronounced successful. As we cannot, however, force the current to take one path exclusively when others are open to it, and as one one-hundredth of a volt difference in potential between the pipes and the damp earth surrounding them has been found sufficient to induce electrolysis, I would suggest that frequent voltage measurements should be made all over the line, even after a plan has been adopted, and that such changes in return conductors be made as the measurements may indicate.

Boston.—The West End Street Railway 4½ per cent. bond syndicate has closed out its bonds.

Comments and Views of Contemporaries.

MUNICIPAL RAILROADS.—There is some talk of the city going into the street railroad business. Fortunately the proposition for municipal transportation is on a small scale. The city has not won much fame so far as an administrator. The streets and sewers which fall directly under its management do not exhibit much thoughtful or careful work. There is no evidence that the jails or the hospitals are conducted with skill and method. What is to be expected from the city in running railroads will not be considered to be involved in much doubt. The conductors and motormen likely to be engaged to operate a city railroad will be those who have a political "pull." It will not follow that they will all know their business. Any kind of a political bummer might do for the most responsible position on the city railroads. Every time that there is the slightest chance for a mishap there will be a general smash-up. Neither bell-punch nor clock will be any restraint on political conductors. There is now, as a rule, a deficit in everything managed by the city. There will be a big one if ever a municipal railroad is put in operation. Every mousing politician will have a free pass in his pocket. The people who ride and who pay will receive scant courtesy.—*San Francisco Bulletin.*

TROLLEY SPEED.—Guessing is the chief element in an attempt to judge the speed of trolley cars, and the average man is as likely to be five miles mistaken as he is to name the correct rate. It would therefore be a ticklish matter to attempt to fix the speed and force the company to comply with the rules. Moreover, it is possible that the city, if it fixed a rate, might be held responsible for accidents occurring through a car going too fast. We think it would be wise, therefore, in the city to refrain from arranging a scale and to leave the speed entirely in the hands of the company. For its own protection the company will not attain too great speed and will instruct its motormen to exercise caution. It seems to us that the most satisfactory and safe way is to leave all responsibility with the railway itself.—*Toronto Star.*

NEW YORK RAPID TRANSIT.—New York City should sell the underground transit privilege to the highest bidder and let a private corporation construct and operate the road; or it should construct, maintain and operate the road itself. There should be no partnership between a city and a syndicate. It is bad enough for a national, state or city government to give away a valuable franchise to private p rties; but it is imprudently bad to give them a franchise and then furnish them money to build up and operate the business which it covers.—*Rochester (N. Y.) Post-Express.*

RECKLESSNESS OF THE PUBLIC.—The great public for which the street cars are running, seem to have little or no realization of the danger of a collision with a grip or motor. One has only to note how many chances people take in crossing tracks in front of moving cars, or in jumping on or off to have this fact impressed upon his mind. The cars never move too fast to suit the persons who are riding upon them, but it doesn't seem to make much difference how slow they run or how fast, the people are always dodging them, flitting in front or jumping on and off with reckless disregard of the dangers of such undertaking.—*St. Louis Star-Sayings.*

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

THE BOSTON RAPID TRANSIT ACT of 1893 is in a fair way for being repealed, inasmuch as a bill for that purpose has just been passed to a third reading. This is an unmistakable indication that the people, through their representatives, are by no means satisfied with what has been done thus far in the direction of solving this difficult problem. The protracted debates are stirring up a good deal of bitter feeling among legislators and citizens alike, a feeling growing among the latter that there is a good deal of corrupt lobbying being resorted to both by the supporters and opponents of the movement. The fact that the Meigs system of elevated railways has gained strong support in various quarters and is being talked up for all it is worth gives rise to much comment and, as is always the case, its promoters and friends in general are coming in for a liberal amount of criticism. The two strong arguments against its adoption are that the Meigs people ask for state aid to a certain extent to enable them to construct the road, and further the men who are said to be back of the undertaking belong to an outside corporation. Charges of wanting to "loot the state treasury" are freely made against its backers.

TO HAUL GRANITE.—The granite interests of Northeastern Massachusetts are particularly anxious to have the Rockport Electric Street Railway Company extend its system from Pigeon Cove to Rockport depot, that freight—chiefly granite—may be conveyed over it. As yet, however, the railroad company has not secured the requisite authority. At a town meeting held Monday evening to discuss the subject, it was voted to indefinitely postpone action on the matter, although it is well appreciated what an advantage to the town such an extension would be.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

A Decreased Demand.—The present moment is a time when the investment demand for all classes of securities is slack. It is after the May dividend and interest payments have been successfully placed, while owners of securities are not offering them until the June disbursements for similar purposes have created a more spirited demand for securities.

Considerable Interest is displayed none the less in one or two traction stocks. Third avenue every week manages to furnish some interesting items of news. Now it is said that the company is about to make another issue of $1,000,000 capital, either stock or bonds. Most of the gossip has it that the new issue is to pay for increased equipment and improvements. This is not exactly correct. It will be remembered—and the fact was so mentioned in these letters a few weeks ago—that the Third Avenue Railroad Company has applied to the board of aldermen for permission to extend its tracks up St. Nicholas and down Manhattan avenues to connect with the 125th street line. Nothing definite has yet been done in the matter, but the talked of issue of new capital will be devoted to building this extension when the necessary franchise has been obtained. In the meantime Third avenue stock holds very strong around 183 and 184, with a quiet demand at all times for small blocks of the stock.

Second Avenue Stock is scarcer in the market than ever since the first announcement of an impending change in the ownership of the road. The only hitch in the program now has to do with one large holder of Second avenue shares at present in Europe. Negotiations for the purchase of this block of stock, which will give the syndicate more than a majority of the capital stock, have already been entered into with every indication of a successful outcome, but negotiations carried on at such a distance must necessarily go slow and it will probably be some weeks before a transfer of the block of stock is made to complete the pending deal. The announcement of the new affiliations of the Second Avenue Railroad Company is likely to redound to the appreciation of the stock's value, as the new management are people in a position to more than double the road's earning capacity.

Consolidation.—Not much importance is attached to the consolidation announced to-day of the Metropolitan Street Railway Company, the Metropolitan Crosstown railway and the Lexington avenue and Pavonia Ferry railway, all of New York. The three roads are parts of the Metropolitan Traction Company's local system of road and the consolidation is in line with the traction company's policy to unify operations and earnings. The roads are combined under the title of the Metropolitan Street Railway Company, with a capital of $13,500,0.0. The new road assumes all the debts of the others, amounting to $9,250,000. The shares of the new company are to be given share for share for the shares of the three companies. Mr. Vreeland, of the Broadway line, is president of the new company. Metropolitan Traction itself has not displayed much activity of late. At times a little steam has been injected into the speculation and fluctuations have varied several points, but the dealings have been without significance. The stock is quoted at 113.

Philadelphia Traders, having lost their trade in New York stocks through their inability to operate with the arbitrage element, are mainly directing their attention these days to the traction stocks and a good many buying orders have been received by commission houses as a result of the prominence which these stocks have been pushed into. The new stock of the Electric Traction—it amounts to 50,000 shares or a doubling of the present capital—is now being traded in. It is understood that as soon as the new allotment is all full paid and stock is issued another allotment of $2 500,000 will be made. This will make $7,500,000 capital stock. The new stock of the Philadelphia Traction will not be out for a month to come.

Long Island Traction is again weak, on the reports that the much-talked-of Flynn suit is about to be resumed. When the transfer of the Brooklyn City road was made to the Long Island Traction Company, one P. H. Flynn, a Brooklyn politician and a large holder of Brooklyn City railroad stock, opposed the lease vigorously and threatened to have it enjoined. This same Flynn was interested in an electric road operating outside of the Long Island Traction's territory and the Traction people managed to propitiate Mr. Flynn by agreeing not to invade what he claimed as his territory. The exact arrangement was never made public. On the payment of the first dividend on Brooklyn City railroad stock, Flynn thought he saw a way out of his bargain by insisting that the shareholders of the Brooklyn City Railroad were not receiving their just share of the profits, and threatened to break the lease, when the statement of earnings for 9 months shows that the road has not earned the 10 per cent. guaranteed by the Long Island Traction Company. The lease is undoubtedly weak, as leading lawyers have so pronounced it. In case the lease is broken—and Flynn now threatens to push his case—there will revert to the Long Island Traction Company the odd $4,000,000 collateral pledged with the New York Indemnity and Guaranty Company to secure dividends. This alone gives Long Island stock an intrinsic value of about $15. In consequence of this attack the stock declined this week from 17½ to 14¾@15.

One Fare Agitation.—The inauguration of the one fare rule on the suburban and Manhattan elevated roads has not affected the earnings of the Union ("Huckleberry") road as yet. At least this is what is officially claimed, and quotations do not reflect any different opinion on the part of brokers. A few weeks more, however, will demonstrate whether such is the case or not.

Financial Notes.

Lake Street L Earnings.—The Lake Street Elevated Railroad Company reports that for the month of April the gross earnings were $46,541. The operating expenses were $29,340 and the net earnings were $17,20). The report in a general way will be received as favorable, but there is but little improvement as compared with that furnished for the month of March. In March the gross earnings were $45,500, the expenses $28,500, and the net amount left to pay the month's interest on $6,000.000 in bonds $17,000. There was a margin of $8,000 between the fixed charges and the amount applicable to payment of such charges. The margin for the month of April is only reduced by the paltry sum of $200. The ratio of operating expenses to gross income is about 1 per cent. less in April than in March. The weather conditions in April were not especially favorable to traffic, and on the showing made the friends of the road are predicting favorable reports for May and June.

Street Railway & Illuminating Properties. — The trustees of the Street Railway & Illuminating Properties purchased this week, in accordance with the trust deed, 624 shares of the preferred stock at an average price of $96.09, as against an average price of $97.33 for 667 shares April 27, and $97.54 for 2,054 shares April 2. This makes a total of 9,955 shares of preferred stock purchased to date.

Receiver Appointed in Fort Worth, Tex.—Robert McCart has been appointed receiver of the Fort Worth & Arlington Heights Street Railway Company. The appointment was made on the application of the State Trust Company of New York, which sued to foreclose a mortgage of $100,000 securing the bond issue.

The New England Street Railway Company reports the following earnings and comparisons for the week ending May 19:

	1894.	1893.	Inc.
New Haven	$ 3 814	$2,899	$ 916
Plymouth	548	434	114
Total for week	4,363	3 333	1,029
Previous 2 weeks	7,809	6,447	1,362
Total 3 weeks	12,172	9,780	2,391

Ratio of increase first three weeks May, 24½ per cent.

Cash for New Orleans Work.—The Hollins syndicate now in control of New Orleans traction has furnished the company with $3,500,000 in cash for trolleying all its lines.

Increased Earnings.—The Citizens' street railroad, of Indianapolis, reports April earnings as follows: Gross, $64,208; expenses, $31,812; net, $32,395, an increase of $8,618

Earnings in Columbus, O.—The Columbus street railway report for April shows gross earnings $43,216, a decrease of $1,503; net, $23,129, an increase of $5,870.

Toledo & Maumee Bonds.—The Toledo, Maumee & Perrysburg Electric Railway Company has issued $150,000 6 per cent. bonds.

New Incorporations

New Sioux City Company.—The Sioux City Traction Company, with a capital of $1,000,000, has been formed to succeed the Sioux City Street Railway Company in the ownership and operation of the forty miles of electric street railway which the former secured by foreclosure. The new company is composed of bondholders of the old. Of the stock, $630,000 was paid for in bonds and the balance in cash. D. L. Wright, E. F. Stone and J. C. French, of Sioux City, and M. L. Kohler and J. W. Harner, of Philadelphia, are the directors and corporators.

Goshen, Ind.—The Indiana Electric Railway Company is the name of the new company which has secured control of the old Goshen Electric Street Railway Company's lines in this city. The new company, at the head of which are J. J. Burns, J. H. McHiney and K. G. Ripley, all of Chicago, propose to extend the line to Elkhart, and also to New Paris, where they will connect with the Wabash Railway.

Gardner, Mass.—The Gardner Electric Street Railway Company, Gardner, Mass., capital stock $50,000, has been formed to construct and manage a street railway through Gardner, South Gardner and West Gardner. L. A. Greenwood, J. A. Stiles and Chas. Heywood, all of Gardner, are the promoters.

Pittsburgh, Pa.—The Beltzhoover & Amanda Avenues Street Railway Company has been incorporated to construct and operate a street railway. The capital stock is $9,000. Those interested in the enterprise are James M. Bailey, of Allegheny, and Robt. A. Carter and James H. McRoberts, of Pittsburgh.

Philadelphia, Pa.—The Market Street, Richmond & Frankford Street Railway Company was incorporated May 28. The capital stock is $180,000. Those interested in the road are Milton M. Dorland, Radcliffe B. Mills, W. W. Hirst, Philadelphia, Pa.

Los Angeles, Cal.—The Los Angeles, Pasadena and Altadena Electric Railway Company has been incorporated; directors are: T. J. Barbour, E. P. Carnicle, G. H. Barker, Hervey Lindley, C. L. Strange. The capital stock is $1,000,000.

NEWS OF THE WEEK.

Cable Road Not a Nuisance.—The Missouri Court of Appeals has affirmed the decision of the lower court denying the application of Mrs. Catherine Spencer for an injunction restraining the Metropolitan Street Railway Company of Kansas city, from operating its road in front of her property near the east end of the viaduct by which Twelfth street cars reach the West bottoms. She also asked that the cable road be abated as a nuisance. Mrs. Spencer owns property squarely on the face of the bluff on Twelfth street. When the cable company's viaduct was built it obstructed egress from and ingress to her property. She brought suit in the circuit court for damages and got judgment for $800. The supreme court affirmed the judgment and the cable company paid it, thinking that this would be the last of its litigation with Mrs. Spencer. But when she got the money she brought another suit to enjoin the cable road from operating in front of her premises. In the circuit court her suit was ordered dismissed and she appealed. The court of appeals affirmed the decision of the trial judge, holding that Mrs. Spencer had been compensated for the damage done her property and that she had exhausted her legal remedy when she got judgment in her first suit.

Nashville, Tenn.—The Union Light & Power Company has been organized and has elected the following directors: Joel D. Harvey of Chicago, Gilbert F. Brown, R. F. Jackson, E. G. Connette and Andrew Clark. The organization is for the purpose of generating light and power by electricity, and especially to furnish power for operating the cars of the Nashville Street Railway. J. D. Harvey is president, R. F. Jackson vice-president, Thomas Taylor secretary and treasurer. The Nashville Street Railway Company has made a contract for four years by which the new company is to furnish power for operating cars. The new company will take charge of the present plant of the street railway and either use it or exchange it for new and improved machinery. This part of the machinery, however, will be owned by the street railway, and if the operation does not prove satisfactory the company reserves the right to take the machinery and operate it for itself.

New York, N. Y.—A certificate of the consolidation of the Metropolitan Street Railway Company with the Metropolitan Cross-town Railway and the Lexington avenue and Pavonia Ferry Railways, has been filed at Albany. The amount of the capital stock of the new corporation, which is to be known as the Metropolitan Street Railway Company, is $13,000,000, and its directors are Herbert H. Vreeland, Thomas F. Ryan, R. S. Hayes, Albert W. Fletcher, H. S. Beattie and Ralph L. Anderson Jr., of this city; Daniel S. Hasbrouck and Charles F. Warren, of Brooklyn, and Henry A. Robinson of Yonkers. The new company assumes all the debts of the roads in the combination, which aggregate $9,250,000. The stock of the new company is to be given share for share for that of the companies combined, and the capital stock is equal to the combined stock of the three.

Resolutions of Gas Association.—At the recent meeting of the Western Gas Association in Cleveland the following resolutions were adopted: "*Resolved*, That it is the sense of this association that the electric street railway companies can and should promptly adopt such measures as shall insure to all other interests immunity from the injurious electrolytic effects of their operation, and that failing to do so they should be held liable for all damages and loss resulting from said operations; and be it further *resolved*, that the gas companies represented in the membership of this association should unite with the water and other interests affected with them in securing from the electric street railways prompt attention and action in the directions indicated in the report of the committee on electrolysis."

Chicago, Ill.—Judge Ewing has issued an injunction restraining the Grand Crossing and Windsor Park Railway Company and William V. Jacobs from laying street railway tracks on Seventy-fifth street, between Stony Island and Railroad avenues. The injunction was granted on the petition of Frank H. Clark and Belton Halley, who say that they and others sold the capital stock of the company to Jacobs August 11, 1892, on the understanding that he should construct the road by May 1, 1893. This, they say, he did not do, and as the franchise of the company expired on January 14 last complainants asked that Jacobs be enjoined from laying the tracks, which work he has now begun.

Baltimore, Md.—James G. Ford, agent of the Barrows electric street car system, has made a proposition to the Randalistown, Harrisonville & Granite Rapid Transit Company to build and equip its road with the Barrows system. It was proposed to furnish the power and to operate the road for one year in consideration of the company raising $10,000 and allowing the builders 20 per cent. of the receipts of the first year. It is said that the cost of building the road will be from $12,000 to $15,000. The Barrows system is a single rail system, and is the invention of Mr. C. H. Barrows, of Willimantic, Conn.

Springfield, Mass.—The street railway directors have decided to build at once a new car house on Bond street, east of the engine house. The structure will have a front of 200 feet on Bond street, run back 130 feet and be one story high. The company has just given an order for six closed cars to the Wason car company, which intends to begin the manufacture of street cars. The company has ordered 500 tons of rails from the Pennsylvania Steel Company for extensions, and have ordered five open cars of J. M. Jones Sons, of Troy, to be delivered in June.

Oakland, Cal.—The Superior Court has granted the petition of Ira Bishop, receiver of the Piedmont Consolidated Street Railway Company, for permission to borrow $2,000 more on receiver's coupons, making about $11,000 borrowed on the $16,000 allowed by the court. The receiver's report shows that during April the receipts amounted to $8,020, while the disbursements were $9,574.87, the latter amount including $1,192 paid out for taxes, the expenses being $1,554 in excess of the receipts.

Pottstown, Pa.—The grading and track laying of the Ringing Rocks Electric Railway, extending from Pottstown to the famous Ringing Rocks, was completed this week by Contractor H. E. Crilley, of Allentown. The usual ceremony of driving a silver spike was performed by the engineer, Ralph E. Shaner. The new railway is nearly four miles in length, with a large park and lake at the Ringing Hill terminus. The line will be ready for travel in two or three weeks.

Oshkosh, Wis.—It is announced that the company which recently secured a franchise to build and operate an electric street railway in Oshkosh have definitely decided to construct an interurban line between Oshkosh and Green Bay, taking in all the intervening towns. The proposed road would connect the cities of Oshkosh, Neenah, Menasha, Appleton, Kaukauna, Depere, Fort Howard and Green Bay, which have a combined population of considerably over 100,000. The franchise in Oshkosh was granted to J. K. Tillotson.

Cleveland, O.—At a meeting of directors of the company which proposes to build the Cleveland-Akron road Capt. T. K. Dissette, one of the promoters of the enterprise, stated that the line would not be built until a bonus of from $20,000 to $50,000 was secured because the company wished, before offering bonds for sale, to be able to assure the buyers that the interest on the bonds was guaranteed. He thought there would be little dfficulty in obtaining the required amount.

Kansas City, Mo.—The jury in the case of Mrs. Hattie Mudd vs. the Metropolitan Street Railway Company for $1,999.99 damages for personal injuries returned a verdict in favor of the defendant. The plaintiff was eating peanuts in a car and throwing the hulls on the floor. The conductor remonstrated rather sharply and the suit was brought to recover for damages to her feelings on account of his alleged insulting language.

Philadelphia, Pa.—The Manayunk, Roxborough and Wissahickon Inclined Plane Railway Company has awarded to Stern & Silverman the contract for building the new power house at Shawmont, and the full equipment of the road from Wissahickon to Barren Hill, the work to be finished within 60 days at a cost of $60,000.

Bridgeport, Conn.—The contract for constructing between thirty and forty miles of electric railway has been awarded by the Bridgeport Traction Company to Thomas Murray, of New York. A contract for two engines was awarded to the Watts-Cameron Company, of Newark.

Allegheny, Pa.—The committee on corporations of Allegheny Councils has granted the right of way for an extension of the Union line branch of the Pittsburg, Allegheny and Manchester Traction Company from Woods Run to the new Watson park.

Rochester, N. Y.—An electric fountain similar to the one used at the World's Fair, will be placed in position at Manitou Beach in a fortnight. The Grand View Beach Railway Company will furnish the electricity and the water will be pumped from the lake.

Port Huron, Mich.—Col. William Nichols, of New York, and E. H Brennan, are interested in the enterprise to construct an electric railway between Port Huron and Lexington. It has been announced that if a bonus of $20,000 is raised in Port Huron the road will be built.

Indianapolis, Ind.—The new West Side power house of the Citizens Street Railway Company is now under roof. A track has been laid to it to enable the company to get the heavy motors, dynamos, etc., to the buildings more readily.

New Haven, Conn.—The Fair Haven & Westville Company's line will be equipped with the trolley system by fall. The piling work for the power house near the Barnesville bridge is completed.

Alpena, Mich.—W. P. Williams, W. A. Comstock and others of Detroit, have presented a petition to the common council asking for a 30-year franchise to build an electric street railway.

Columbus, O.—The Ohio house has failed to pass the Abbott bill, which provides that the street railroads of the state be put under the supervision of the commissioner of railroads and telegraphs.

Sherman, Tex.—The electric railway power station was destroyed by fire last week. Five cars burned also, and the loss is $10,000. The company will rebuild at once.

Newark, N. J.—The Newark and Wayne County Traction & Power Company has presented a petition to the board of trustees for a franchise for an electric railway.

Westerly, Conn.—The Pawcatuck Valley Street Railway Company has been granted a franchise to build an electric railway from Westerly to Watch Hill.

New London, O.—An electric railway from New London to Ashland is projected. Among those interested in the enterprise are Ex-postmaster Starbird and John Beattie.

Franklin, Pa.—Construction has been begun by the Franklin Street Railway Company. The line between Franklin and Oil City will follow the river route.

Indianapolis, Ind.—The Indianapolis & Broad Ripple Rapid Transit Company has been granted a twenty years' franchise by the County Commissioners.

Westerville, O.—It is stated that the proposed line from Worthington to Westerville, a distance of five and one-half miles, is almost a certainty.

Burlington, Vt.—The electric street railway is to be extended to Queen City Park. The extension will be in operation in the latter part of June.

Buffalo, N. Y.—James H. Small has made application to operate an electric railway on Grand Island.

PERSONAL.

G. S. Johnson, chief engineer of the Grand Rapids & Indiana Railroad Company, has been appointed general manager of the Consolidated Street Railway Company, of Grand Rapids, to succeed James R. Chapman, who has accepted the position of manager of the electric railway department of the North Chicago Street Railroad Company.

A. W. Field, of the Peckham Motor Truck and Wheel Company, has resigned his position as vice-president to take charge of the Boston office of the company. Mr. H. C. Soop of Kingston, N. Y., has been elected vice-president in Mr. Field's place.

Joseph Hicks has been appointed superintendent of the Rochester Railway Company of Rochester, N. Y., to succeed William Rosborough.

TRADE NOTES.

The W. S. Hill Electric Company, of Boston, is to be congratulated on the phenomenal prosperity it is enjoying. Without a single representative on the road and solely through the merits of its high grade specialties this company is doing a prosperous business. For several weeks past it has been working its entire force of employes nearly night and day filling a single order for switches the aggregate weight of which when completed exceeded eleven tons, all to be used in one power station. Last Saturday the company shipped over six tons of these goods as one consignment. And this order was only one of many. As a fact the business done by the W. S. Hill Electric Company during the last nine months was close upon 75 per cent. more than during the previous nine months.

A. Groetzinger & Sons, manufacturers of dermaglutine, of Allegheny, Pa., report that their trade continues to be first-class in every particular, as it has been since the first of the year. Orders are numerous and the company has its facilities taxed to the utmost to fill them. Recommendations are constantly received for the company's dermaglutine pinions. Present indications are that the trade for the current year will far exceed any previous year's business.

The Carpenter Enamel Rheostat Company is moving its factory from Bridgeport, Conn., to Hoboken, N. J., in the new factory building erected by John C. Crevier, at the 14th Street Ferry Terminal. The company's factory will be very accessible in its new location, being less than 15 minutes' distant from Union Square. This will be a great convenience to its various customers having offices in New York City.

The Electrical Association of Waterbury, Conn., has placed the contract for its new power station with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 66 feet in width and 183 feet in length; the side walls of brick and the roof covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

The Independent Electric Company of Thirty-ninth street and Stewart avenue, Chicago, has issued a descriptive circular and price list of tested fuse wire and links. This gives some useful tables and an article issued by Charles A. Pratt, electrical engineer for the company.

The Independent Trolley is the title of a little pamphlet issued by the Independent Electric Company of Chicago. As its name indicates, it consists of a description of the details and operation of a new trolley placed on the market by this company.

Walter H. Adams, president of the Crescent Electric Company, Chicago, reports that the business outlook is very encouraging, particularly with armature and commutator work. This company makes a specialty of street railway work.

The General Electric Company has closed the contract for the Poughkeepsie & Wappingers Falls railway of Poughkeepsie, covering two 200 K. W. direct connected generators, 40 G. E. 800 motors and type K controllers.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued May 22, 1894.

520,050. System of Electrical Conversion and Distribution. Thomas H. Hicks, Detroit, Mich. Filed December 15, 1892.

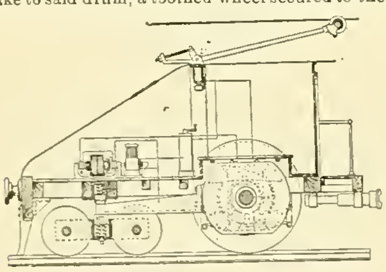
In a system of electrical distribution and conversion, the combination of an electric motor and a converter, the converter having two conductors which terminate respectively in separate commutators, the motor field magnets being wound with supplemental coils connected in electrical circuit with one of the converter commutators.

520,111. Electric Locomotive. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed April 25, 1893.

In an electric locomotive, the combination of the driving axle and wheels, an electric motor supported concentrically with the driving axle and having a revolving portion adapted to rotate the axle directly or without the intervention of gearing, forward wheels and axles, a pivot connection between the electric motor and the forward wheels and axles, and a main frame or car body supported upon the driving axle and also upon the electric motor or an extension thereof. (See illustration).

520,134. Car Starter and Brake. Ralph Clegg, Longsight, England. Filed July 30, 1891.

In a car brake and starter, the combination of a brake drum and a brake applied thereto, a spring contained in said drum to be charged with power by the application of the brake to said drum, a toothed wheel secured to the said



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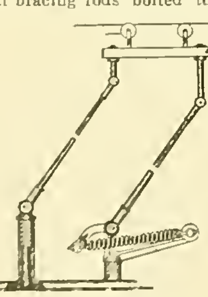
drum and gearing into suitable gearing by which when the drum aforesaid ceases to be retarded by the brake the rotation of such drum is transmitted to the axle upon which the said drum is mounted.

520,156. Electric Railway Trolley. Thomas M. Brown, Cleveland, O. Filed September 28, 1893.

In a trolley device, in combination, a base plate, two vertical posts pivoted thereto, a contact device carried by another plate, two vertical posts pivoted to the under side of this second plate, two parallel trolley poles, and horizontal pivots which connect the lower ends of said pole with the posts. (See illustration).

520,163. Elevated Railway. Francis J. Korff, St. John's, Mich. Filed March 3, 1893.

In a railway, the combination of an opposite series of upright supporting pillars, longitudinal and transverse pairs of diagonal bracing rods bolted to and connecting



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each successive pillar and the transverse pairs thereof, horizontal braces connecting each transverse pair, and the track rails bolted to the upper ends of the opposite series of supporting pillars.

520,169. Brush Holder for Dynamo Electric Machines or Motors. Andrew L. Riker, New York, N. Y. Filed March 31, 1891.

A brush holder comprising two contact plates connected and movable with reference to each other so that their contact faces retain parallelism in all positions of the plates, and means for clamping the brush between the plates with yielding pressure.

520,192. Railway Crossing Track Cleaner. Ferdinand C. Stendel, Chicago, Ill. Filed January 6, 1891.

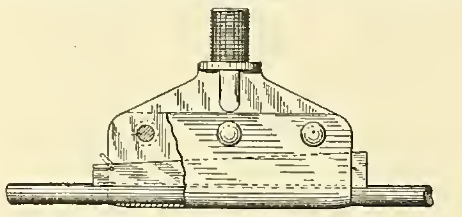
A railway crossing track cleaner comprising, in combination, a handle and a head fastened to the handle and formed with a shoulder at one side, a deflector at the opposite side having the curved outer edge and generally convex front surface, and an intermediate scraper tongue concave along its front surface.

530,213. Trolley Wire Hanger. Thomas J. McTighe and Summer W. Childs, New York, N. Y. Filed January 23, 1893.

In a trolley wire hanger, the combination of an ear having an inclined bottom edge, a clip adapted to embrace the trolley wire and ear, means for holding the clip in engagement with the ear, and a wedge adapted for insertion within the clip between the ear and the trolley wire. (See illustration.)

520,228. Electric Locomotive. Rudolph Eickemeyer, Yonkers, N. Y. Filed June 1, 1891.

In an electric locomotive, a motor casing or shell of magnetic metal, for the reception of an armature and field coils, having its sides integrally extended and connected, and affording box seats for the armature shaft, and a bottom which is integral with said sides, and is extended into



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integral connection with said ends, the said sides, bottom, and ends, constituting not only a seamless cup-like structure, but also an armature frame, which is strengthened and braced by its union with the bottom of the shell or casing. (See illustration).

520,230. Railway Car Fender. John W. T. Gilliam, Baltimore, Md. Filed January 4, 1894.

An individual and detachable car fender, wheels supporting and guiding said fender, mechanism operated by said wheels, and a continuous line of cushions movably supported by said fender and movable across the track and said fender, and having motion imparted by said mechanism with the movement of said fender. (See illustration.)

520,233. Safety Attachment for Street Cars. Henry A. Howe, Albion, assignor to himself and Joseph Norwood, Brooklyn, N. Y. Filed September 21, 1893.

The combination with the car platform, of a guard, a pivotal connection between the guard and the platform, a rubber spring acting to hold the guard in its normal position, a lever pivoted upon the platform and extending upwardly and provided with a shield that is adapted to being acted upon by a lateral movement of the driver or motorman, and a connection from the lever to the guard.

520,253. Electric Heater for Car Sand Boxes. John M. Christopher, Baltimore, Md. Filed June 13, 1893.

The combination with the electrically propelled car provided with a sand distributing box, of an electric heater applied to the exterior of and inclosing or partly inclosing the sand box; and wires connecting the heater with the motor circuit of the car.

520,255. Safety Car Fender. Frank I. Clark, Baltimore, Md. Filed January 29, 1894.

In a safety fender for street cars, the combination of suitable hangers attached to the car; a fender frame or platform which is normally raised above the street surface; two links pivotally connected by one end to each hanger and by the other end to the fender frame or platform, the pivotal points of attachment to one of said parts being of a greater distance apart than the pivotal points of attachment to the other part—the said links serving to swing the fender backward and incline the front edge thereof downward when an object is encountered; and a spring to automatically raise said fender from the lowered inclined position and maintain it so that its front edge will be elevated.

520,259. Grip Mechanism for Cable Railways. Charles I. Earll, New York, N. Y. Filed June 12, 1893.

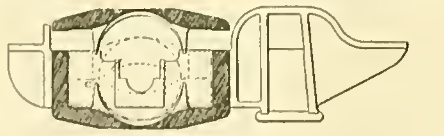
In a grip mechanism the combination with a stationary and movable jaw; of a shank carrying the movable jaw, a tumbler and links connecting the said tumbler with the shank a lever operated from the car and a pawl carried by said lever and engaging the said tumbler, whereby the movable jaw is operated to grip and ungrip the cable.

520,274. Electric Railway. Ernst W. Von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed September 30, 1892.

In an electric railway system, the combination with an overhead tubular conductor extending along the line of railway and having a longitudinal slot, of a movable contact within said conductor and comprising two longitudinally arranged parts flexibly connected, said contact having an electrical connection extending through the slot to an electrically propelled car.

520,304. Conduit Electric Railway. William R. DeVoe, Shreveport, La. Filed January 30, 1891.

In an underground electric railway system, the herein described trolley comprising a two part, flexible frame, a series of horizontal conducting wheels journaled in said frame and having removable tires, a series of non-con-



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ducting wheels also journaled in said frame, hollow axles forming the bearings for said wheels, and adjustable springs connecting the parts of said frame.

520,323. Block System for Trolley Railways. Willard F. Lewis, Swampscott, Mass. Filed July 20, 1893.

In a block system for trolley railways, the combination with the trolley wire, and a contact maker arranged at one end of a track section and comprising a pivoted angled arm, suspended normally below the line of the trolley wire and arranged to be operated by the trolley wheel and an electrical contact piece against which the arm is swung when operated, of an electromagnetic releasing device arranged at the other end of the section and controlled by the contact maker, and a circuit closing device arranged to close a signal circuit when released by the electromagnetic device. (See illustration).

520,329. Overhead Trolley Conductor. Robert Muir, Brooklyn, N. Y. Filed March 3, 1894.

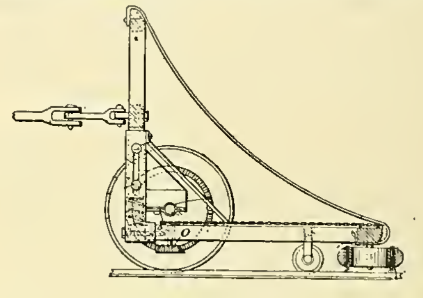
A trolley conductor comprising a casing having a concave recess upon its inner face, and diverging flanges extending from the ends of the said recess, an insulating material held in the said recess, and a hollow conductor properly arranged within the recess and in contact with the insulating material, the inner face of the conductor being essentially parallel to the concave face of the recess.

520 335. Car Fender. William J. Rau, Galveston, Tex. Filed January 17, 1894.

In a car fender, the combination of opposite connected guard shoes adapted to be arranged directly in front of the truck wheels, a front recessed roller support, a vertical point roller journaled in said support, and the convergent fender boards attached at their inner ends to the guard shoes and at their outer ends to said roller support.

520,340. Electric Traction Apparatus. Paul Schoop, Zurich, Switzerland. Filed October 30, 1893.

In an electric railway, the combination of an electric generator, a secondary battery charged by the generator through an automatic switch, an auxiliary electric gen-



NO. 520,230.

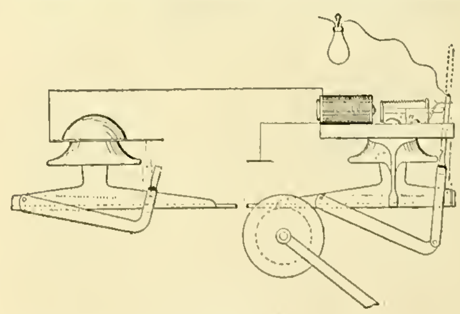
erator connected to regulating cells on the secondary battery by an automatic switch connecting them when the tension of such generator exceeds that of the said cells, and a regulating switch with sliding contacts working between the two poles of the railway, so as to include or cut out regulating cells of the battery for the purpose of maintaining the tension of the electric railway practically constant with a varying load.

520,354. Car Fender. Bernard Cron and Werner von Munchhausen, New York, N. Y. Filed December, 8, 1893.

The combination of a car with a catch, a movable yielding buffer engaged by the catch, propelling springs and a spring actuated rod put in action by the rearward movement of the buffer and adapted to open the catch and liberate the buffer when pressed backward.

520,356. Conduit Electric Railway. Guarantee Trust and Safe Deposit Company, administrator of Charles Wm. Siemens, deceased, Philadelphia, Pa. Filed October 19, 1893.

In an electric railway system, a continuous underground chamber having a slot at its upper side, channel irons located at intervals within said chamber, chairs carried by said channel irons, a continuous slotted tubular conductor



NO. 520,323.

extending through the chamber and insulated from and supported by said chairs, and an electrically propelled vehicle having a yielding traveling connection with said conductor.

520,364. Transferring Cable Cars at Intersecting Points. John Kratz, Baltimore, Md., assignor of one-half to Joseph H. Pfister, same place. Filed April 6, 1893.

In a cable transfer system, the combination of the main cable having a laterally extending loop; a transverse cable; a canted pulley at one end of the loop and an upright pulley at the other end of the loop; a device at one end of the loop for shifting the main cable, and a similar device at the other end of the loop, for shifting the transverse cable.

520,384. Car Brake. Thomas H. Allen, Toronto, Canada. Filed September 19, 1893.

The combination of the wheel brake having means whereby a rail brake is jointed thereto, the rail brake jointed to said wheel brake, the coupling bar secured by its ends to the opposite rail brakes of each pair of wheels, the strut bars connected as specified to the coupling bar near its ends, and the rocker shaft having the opposite ends of the strut bars connected thereto so as to operate the said strut bars reciprocally.

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CONTENTS.

Municipal Ownership not Popular. There is apparently but little popular interest in the municipal ownership of street railways in New York York City. A meeting in Union Square was announced last week at which a rapid transit system "built, owned and run" by the city was to have been advocated, and a big labor demonstration was expected. A large squad of policemen was on hand to preserve order but their services were not required, as the attendance was so small that the speakers determined not to waste their eloquence.

Street Railway Accidents. Horse cars do cause accidents and motormen are not always responsible for the damage which their cars occasion. These statements are somewhat at variance with the ordinary teaching of the daily press, but the following sentence from the Philadelphia *Public Ledger* contains the proof of the assertion: "Seven accidents on railway lines of this city were reported as having occurred on Saturday, but five were on horse car lines, and the trolley cars were not responsible for the accidents in which they were engaged."

Stopping at Crossings. When the lines of the Philadelphia Traction Company were equipped with electricity, it was decided by the management that the cars should stop at the first crossing instead of at the second of intersecting streets. The plan was adopted by the management because, in its opinion, the danger of accident was materially lessened. The new system has now been tried for several months in Philadelphia, and according to all accounts it is favorably considered on all sides. There are objections to the plan, but as far as safety of passengers is concerned it seems to be decidedly successful in Philadelphia.

Eyesight of Trainmen. The Consolidated Traction Company of Newark has arrived at the conclusion that accidents on its lines are directly traceable to the defective eyesight of employes. The company has determined to follow the example of steam railroad companies in causing its employes to submit to an examination by an optician. If their power of vision is not accurate, present employes and applicants for positions on cars will not be considered competent trainmen. The principle is certainly correct. Every motorman or gripman should possess strong, reliable eyes, but the standard of visual accuracy need not be as high as in the case of steam railroad employes who must necessarily be free from color blindness.

Trolley Safeguards. The city council of Philadelphia has been considering the advisability of passing an ordinance compelling the electric railways of that city to equip their stations with automatic circuit breakers, so that whenever a trolley wire is broken and forms, by falling to the ground a short circuit, the circuit breaker will open the line and cut off the current that might otherwise produce injury to persons or property. At the hearing given by the committee, one engineer testified that he did not believe that circuit breakers would effectually prevent the occurrence of such accidents, since he was convinced that should a trolley wire break during dry weather, and fall on an asphalt pavement, a circuit breaker at the power house would not perform the service for which it was intended, and the broken wire would remain alive. Under certain conditions this might be the case, since it might easily happen that the pavement upon which the wire might fall would so insulate it from the earth that no short circuit would be readily formed; but in most cases, however, the wire is likely to come in contact with one or both of the rails, and in such a case a short circuit would be instantly formed and the circuit breaker would be opened. Instances of the failure of the circuit breaker to act because of the insulating properties of the street pavement would certainly be extremely rare. The most remarkable feature of this matter, however, is that it should be necessary for a city council to compel by ordinance the equipment of a modern central station with automatic circuit breakers. Certainly no railway power plant ought to be considered complete until it is provided with every modern appliance that will add to its efficiency and to the safety of persons and property.

Gettysburg Electric Railway. The National House of Representatives has adopted a joint resolution giving to the Secretary of War authority to condemn land on the Gettysburg battlefield and the measure will doubtless pass the Senate. The fact that this authority had not previously been expressly conferred caused the recent rejection in the United States Court in Philadelphia of the application made on behalf of the United States for the appointment of a jury to condemn property belonging to the Gettysburg Electric Railway Company. The railway company resists the efforts to secure part of its right of way and alleges that while its land is essential to its own purposes, no historical significance attaches to it and it should not be acquired by the United States. It is to be supposed that when the resolution passes the Senate proceedings will again be instituted against the electric railway company, but it would be the part of wisdom, as the Philadelphia papers say, for the Secretary of War to come to an amicable understanding with the company so that the battlefield may be preserved, and that the economical means of reaching it may not be materially interfered with. There has been a vast deal of nonsense and pinchbeck sentiment in the outcry against the electric railway on the field. A good deal of the opposition seems to come from the d'sgruntled hackmen whose industry is likely to be badly interfered with. No wonder they consider the road to be a piece of vandalism; but the most conservative of the Philadelphia papers, which should be in a position to appreciate the facts and which are not likely to be influenced by prejudices in favor of trolley lines, speak with favor and consideration of the electric railway at Gettysburg. We are inclined to distrust every step taken by Gettysburg landowners, as they seem more often influenced by motives of intense selfishness than by any spark of patriotism. A good deal of the land was purchased by speculators who as a local paper says, "hope, by taking advantage of the genuine sentiment that exists among patriotic people to make a large part of it a national park, to get an immense price for their holdings, and are, in consequence, among the foremost shouters about the sacredness of the soil, while persistently pressing for an appropriation and shouting for the flag."

Express Service on Electric Roads. The number of street railways now doing an express business in addition to the regular transportation of passengers is very small compared with the number that will be engaged in this business at the end of another ten years. The experience of the roads that have undertaken to derive revenue from this class of business has been on the whole exceedingly satisfactory. So far, however, business has usually been limited to the transportation of express matter on suburban and interurban roads. It will not be many years, however, before the business is so extended as to include in a general system for the handling of express matter, all the street railways of any single large city, such for instance, as Boston, Cleveland, Chicago or St. Louis, where the volume of business of this kind is sufficiently large to warrant the investment of a large amount of capital. There is no good reason why an express company could not handle city and suburban business in any one of these cities over the street railway lines in much the same way as the national express companies handle their express business on the steam railroads throughout the country. This company could secure from the different street railways the right to haul express matter over their lines, giving in return either a certain percentage of the gross receipts, or paying a certain price per car mile to each of the companies for hauling its express cars. At the downtown terminus, stations could be established to which city wagons could bring the collected express packages and when the cars were loaded they would be hauled to the suburbs over the different connecting lines. Along the line, substations could be established where packages could be left for delivery to the car as it came along; while at the suburban terminus the packages would be taken by wagons and delivered exactly as they now are by the wagons of almost hundreds of suburban express companies. Wagons at both ends of the line would do nothing but collect and deliver, while the transportation of the goods would be done much more cheaply and rapidly by the express car service over the electric and cable roads, than it now is by the almost universal method of delivery by horse and wagon. There is no good reason why the existing facilities for the rapid transportation of passengers should not be made available for the rapid collection and delivery of the thousand and one varieties of express packages and light freight that are now so inconveniently and unsatisfactorily handled by a slow and out of date process.

MICHIGAN STREET RAILWAY ASSOCIATION.

Representatives of the street railway companies of Michigan met at the Morton House, Grand Rapids, June 5, and organized the Michigan Street Railway Association. A constitution and by-laws similar to those of the American Street Railway Association were adopted and the following officers were elected:

President, W. L. Jeaks, City Electric Railway Company, Port Huron.

Vice-president, W. Worth Bean, St. Joseph & Benton Harbor Electric Railway Company, Benton Harbor.

Secretary, B. S. Hanchett, Jr., Consolidated Street Rail way Company, Grand Rapids.

Executive Committee, Ex-Gov. David H. Jerome, City of Saginaw Street Railroad Company, Saginaw; Strathearn Hendrie, Wyandotte & Detroit River Railway Company, Detroit, and the officers.

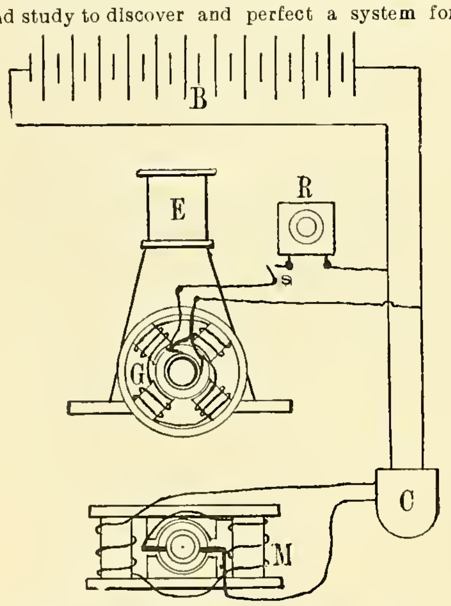
The next meeting of the association will be held in Grand Rapids September 19. Among the subjects to be considered at that meeting are these: "Suburban Electric Railways and Their Possibilities," and "Insurance—Accident and Fire."

THE PATTON SYSTEM OF STREET CAR PROPULSION.

BY CHAS. DESMOND.

The Patton street car motor that is now in operation on the Calumet electric railway lines at 67th street, Chicago, promises a happy solution of the rapit transit problem, as it is equally well suited to the crowded city streets and the long lines through sparsely settled districts, as the smaller cost of insulation and the economy of operation, together with its independeuce of a base of supplies, or a central power station, fit it for all kinds of rapid transit lines.

This motor is the result of several years' work and study to discover and perfect a system for



PATTON SYSTEM OF STREET CAR PROPULSION.

intramural traffic which would supersede the trolley and be devoid of objectional features.

The perfected motor consists of a combination of gas engine, electric generator, storage battery and an electric railway motor, all arranged in the most compact and convenient manner, making a simple, reliable and economical locomotive. The machinery is enclosed in a portion of the car and after being once started requires no particular attention during the day's run, as the engine is entirely automatic and the storage battery serves to control the generator when the motor is not taking current.

The gas engine is of the vertical type and is located in the center of the car and supported directly by the truck, the floor of the car being cut away for this purpose. The electric generator is connected to the engine direct so that the two machines take up but little space and there is no loss in transmission by belting or other gearing.

The generator is of a well-known type and shunt wound, a principle which makes this system possible and to which it owes its great economy.

The storage battery consists of cells of the Plante type and the number will be regulated by the requirements of the road on which the motor is to run; in the present instance there are 110 cells.

The motor, of the ordinary railway type, is placed on the truck in a manner similar to that employed in all electric cars; it is controlled by a standard controller.

It is in the arrangement of the machines that the novelty and high efficiency of this system lies. The arrangement of the machines and the electrical connections may be understood from the accompanying sketch where the gas engine is shown at E, the generator at G, the battery at B and the motor at M. The controller is shown at C, at R is a rheostat or starting box connected between the generator and battery, and a switch, S, in this circuit completes the arrangement.

It is well known that a shunt-wound generator, when used to charge a storage battery, will act as a motor and revolve in the same direction, without any change in the connections, if current from the battery is passed through the generator. This principle is utilized for starting the engine. The generator has a voltage of 250 and the storage battery is of 220 volts, from which it will be seen that as soon as the generator is up to speed current is made to pass through the battery where the energy is stored; but if the motor be started it will take current from the generator only, the surplus of current going to the cells so that the battery remains fully charged, or nearly so, at all times. All the actions so far described take place while the engine is still running and without any change in any of the switches or resistances, except the usual manipulation of the controller, and there is no loss of power, as the surplus energy is stored in the battery for use when required.

The power of the engine need not be near y so great as that required by the heavy grades on the line, for there is the storage battery to furnish the extra power required. So soon as the demand on the generator is beyond its capacity the engine slows down and the voltage of the generator is reduced. As soon as this occurs, current from the battery, also, flows to the motor and this addition of current from the reserve enables the car to easily overcome the increased resistance and it mounts the grade with but little decrease in the speed. From the above description it will be seen that neither engine or motor is required to be as heavy as the grades of the road would require if the cars were operated on any of the other systems now employed.

This motor has been in daily operation on this line for some time past, giving general satisfaction to passengers and the management of the road. On this line there is an 8 per cent. grade which the car pulling a trailer of ordinary size mounts with ease, even when started from the foot of the grade, which shows a large surplus power. Its regular rate of speed is 15 miles per hour, but it can be geared to run at any speed desired, that being merely a subject of equipment.

When in operation the motion of the car is as smooth as that of any vehicle and there is no disgreeable noise from the working of the machinery. The motor car seats comfortably 36 persons although it is but 16 feet in length. The power required when pulling trailer is not great, as the engine consumes but 20 gallons of gasoline during the 12 hours. The dynamo has a capacity of 65 amperes and that of the battery permits a current of 40 amperes to be taken from this source.

It is the intention to build these cars as locomotives designed to haul as many trailers as may be required, this being the best plan where the traffic will warrant or there is any objection to combination cars.

This car weighs 15,000 pounds as against 12,000 pounds for a trolley car of the same capacity, while the operating expense is only about one-half. The car on 67th street is running at an expense of about $1.00 per day.

The motor car is the invention of W. H. Patton of Chicago, who has patented it in the United States and Europe; it is being introduced by the Independent Electric Traction Company, whose office is in the Old Colony Building, Chicago.

RECEIVERS FOR FORT WAYNE ELECTRIC.

Two events of no little general interest occurred in Fort Wayne last Wednesday. Receivers were appointed for the Fort Wayne Electric Company and a new company was organized to carry on the business heretofore conducted by the former company. The new organization, which will be wholly a Fort Wayne institution, will be known as the Fort Wayne Electric Corporation. Articles of corporation were filed on Thursday last. The capital stock is $1,500,000, and the objects of the corporation according to the papers are the manufacture and operation of machinery and apparatus for the generation, transmission and use of electricity in all forms and for all purposes. The affairs of the company will be managed by five directors, and for the first year Ronald T. McDonald, Charles C. Miller, M. C. Gross, Sidney C. Lumbard and Charles S. Knight, all Fort Wayne men, will be the directors. R. T. McDonald is the president of the company.

The application for the appointment of receivers was made on behalf of Mr. McDonald in the Superior Court. Henry J. Miller and Edward J. Hathorne were appointed and took immediate charge of the business. The receivers have made a contract with the new corporation, with the approval of the court, in accordance with the terms of which the latter will carry on the business formerly done by the Fort Wayne Electric Company. The matters have been so arranged that there will be no cessation of business, and the apparatus of the Fort Wayne system will be furnished as heretofore to the public. It is understood that the assets of the Fort Wayne Electric Company are sufficient to pay all of its debts and to leave a considerable surplus for distribution to its stockholders. The capital of the new company is ample for its purposes and the arrangements it has made are such that no sacrifice, in respect to the assets in the hands of the liquidators, will be necessary.

The following explanation of the application for receivers and the organization of the new company is given by the Fort Wayne correspondent of the *Indianapolis Journal*:

The cause of this complication has been the determination by the Eastern managers of the General Electric Company to move the works from this city to an Eastern city. R. T. McDonald opposed and threatened to withdraw from the company. Then came the fire that destroyed the works and an order to reinstate the local plant in Brooklyn. Mr. McDonald refused and laid the matter before Fort Wayne citizens, and $25,000 has been raised to rebuild the works. The company was compelled to accept the donation and to continue the industry at this point. Last year the general business depression caused a great falling off in business everywhere, and the Boston concern and other branches were shut down. Mr. McDonald received orders to temporarily close the Fort Wayne factory. He refused, and showed that the works here were full of work, and he wouldn't make harder the lot of workmen whose hours had been reduced. The relations between McDonald and the managers of the General Electric Company, which held a large portion of the stock in the local company, became strained, and the annual election was approaching and the imminent danger of the loss of the works forever threatened Fort Wayne, and upon application of McDonald E. J. Hathorne and Henry J. Miller were appointed receivers of the old company. There is money to liquidate every dollar's worth of indebtedness, and every debt will be met and paid promptly. The new company will absorb all current contracts and business of the old company, together with that of the Fort Wayne Jenney Electric Company.

THE CAPITAL RAILWAY OF FRANKFORT, KY.

In the great distillery district of Kentucky, or "Blue Grass" region, as they call it, little or no attention has been given to the matter of transporting the output or supplies of the distilleries. Their whole idea in the location of these plants has been given to a pure and sufficient supply of limestone spring water, this being one of the prime causes that has made this section so famous for its output of superior whiskies, and the Capital Railway of Frankort is to be congratulated on being the initial enterprise in Kentucky to give these distilleries cheap transportation for their grain, coal, and wood to their plants, and their output of whiskies to the steam railway connection. In the City of Frankfort, daily, long lines of heavy wagons could be seen handling this business which is now being done in an entirely satisfactory manner by the little "Lightning Bug" shown in Fig. 1.

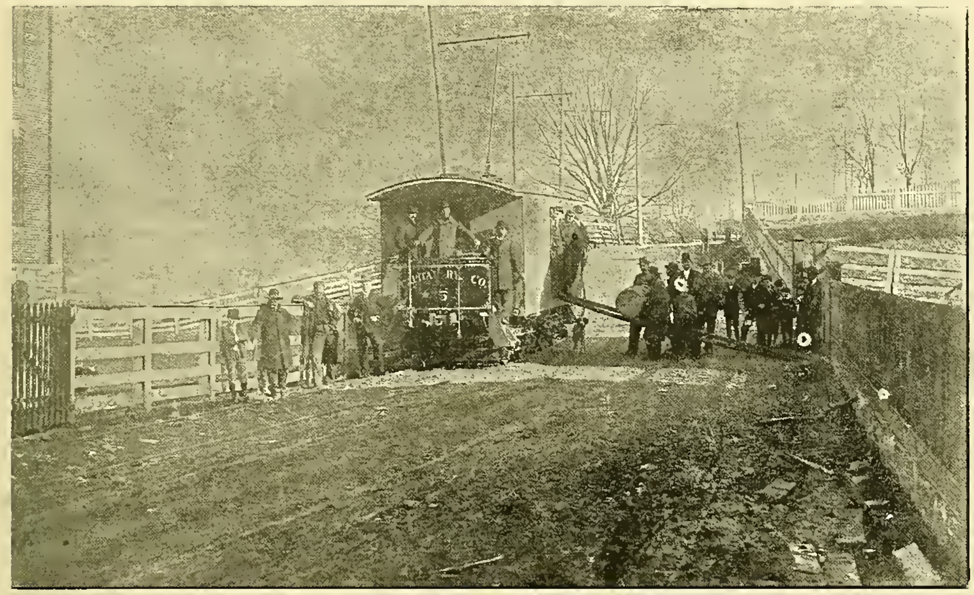


FIG. 1. THE CAPITAL RAILWAY AT FRANKFORT, KY.

The power house illustrated by Fig. 2 is a substantial brick building 52 by 125 feet, with a double track car barn 26 by 125 feet attached. The boiler room, which is separated from the engine room by a brick partition, is 35 by 52 feet and contains 200 horse power capacity, boiler plant, with heater, boiler feed pumps, etc.

Fig. 3 illustrates the engine and dynamo room in which two 100 H. P. Jenney dynamos are driven by one of the latest type of Dick & Church tandem compound engines of 200 H. P. capacity.

The switchboard is of the improved Jenney type with marble panels, and all connections are made from rear of board. The instruments used are of the Weston make. The electrical station equipment was furnished and installed by the Jenney Electric Motor Company of Indianapolis. Tests of the generating plant have been made with very heavy overloads, the apparatus showing remarkable results in the way of regulation and capacity.

The freight motor car is of a special design 28 feet in length mounted on a pair of heavy trucks with 5-foot wheel bases, the body being extra heavy built to withstand the severe strain of having loaded freight cars as trailers, and in appearance is very much like an ordinary baggage car as used on steam roads. Fig. 4 illustrates this car hauling three box cars around a curve.

Four 25 horse power motors controlled by a single specially designed controller, are attached one to each of the four axles of this car, making each wheel a driver. The total weight when empty of this car and equipment is 15 tons, and when not used for handling full loads is used for handling small shipments, barrels and boxes.

Besides the freight motor car described above three 18-foot closed passenger cars, handsomely finished, painted a light and attractive color, are used. These cars are equipped with 25 horse power motors and haul trailers. The cars were made by the Barney & Smith Car Company of Dayton, O.

The track is a 56 pound "T" rail laid on 6x8x8 white oak ties, 2 feet between centers and ballasted with crushed blue limestone rock. Heavy cuts and fills are numerous, the nature of the country through which this road runs being very mountainous and the grades very severe, being in some instances as heavy as 8 per cent. and in one instance a reverse curve was necessary on a 7 per cent. grade; but even here absolutely no difficulty was experienced in handling from one to three heavily loaded box cars with freight motor car.

The overhead line is of the Creaghead flexible side bracket construction specially made for high speed roads in the suburbs, but in the city is side pole and span wire construction using No 0 trolley wire.

Frankfort is a city of about 10,000 people, capital of the state, with numerous manufacturing establishments and so situated that it covers a large area, making the four miles of track used for passenger traffic very profitable, in addition to which the management have a beautiful park containing about 40 acres situated on an elevation of about 500 feet overlooking the city and river, with a base ball and foot ball ground and grand stand, dancing pavilion, band stand and numerous summer houses, nice walks, rustic seats and other attractions.

The design and construction of this road was done for the contractor, Frank Whitley of Springfield, O., by the Creaghead Engineering Company of Cincinnati, under the personal supervision of George B. Scrugham, and reflects great credit on everyone connected with this enterprise.

The stockholders of the local company are the principal business men of the city, of which Pat. McDonald is president and John T. Buckley is secretary and general manager.

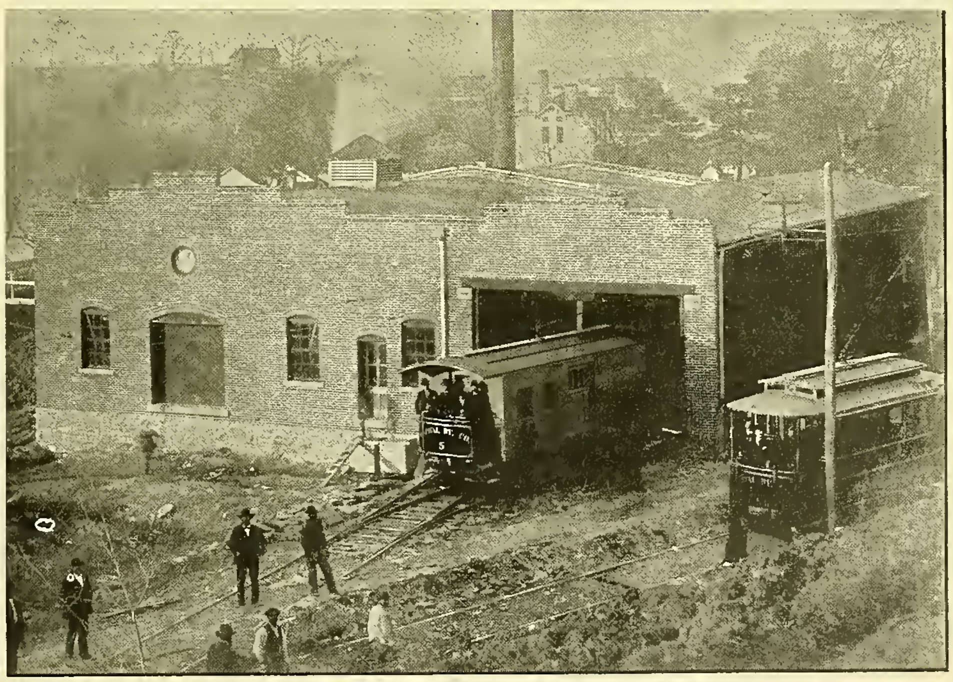


FIG. 2. THE CAPITAL RAILWAY AT FRANKFORT, KY.

ELECTRIC DISTURBANCES ON THE BROOKLYN ELEVATED RAILROAD STRUCTURE.

We have recently published some account of how damage is done to underground pipes and cables by electrolytic action due to the presence of the strong electric currents of the street railroads near by; but the trouble is not all underground, says the *Railroad Gazette*.

In building the extension of the Fifth avenue branch of the Brooklyn Elevated Railroad to the city line at Sixty-seventh street and Third avenue the company found difficulty in securing certain property rights between Thirty-eighth street and Fifth avenue and Fortieth street and Third avenue. Pending the settlement of this matter the structure south from Fortieth street was erected. Upon its completion the work of joining the two parts was pushed forward, commencing at Thirty-eighth street, the former terminus. While hoisting into position the first of the last four 65-feet longitudinal girders necessary to connect the two sections, the end not yet in position came in contact with the transverse girder. Immediately the metal was melted and an electric arc was formed, and the melted iron fell to the street. After several attempts to swing the girder into position, Mr. Stuart, the engineer of construction and maintenance, who supervised the construction work, succeeded in locating the trouble. The insulation of one of the positive current feed wires of the Brooklyn City Railroad's trolley line, which were strung on one side of the elevated posts, had worn so that the live wire came in contact with and charged the structure. The negative current, which completed the circuit, reached the iron work from underground, at a point on the other side of the unfinished section, and the contact between the two parts of the structure completed the circuit and caused the fusion. After diverting the course of the current by means of copper wire the work of completing the road progressed. As the columns of an elevated railroad structure are not built to serve as ground wires, and their conductivity for that purpose is an uncertain quantity, this incident shows that dangers of unknown magnitude must be looked out for, whenever one is in the vicinity of such powerful currents.

Once in a while we hear of an elevated station taking fire from the trolley lines. This sometimes occurs in a way similar to the incident related above. On other occasions the fire has originated from the circuit caused by the shifting of the trolley of a passing car. So far these fires have been in most cases easily extinguished with a bucket of water, and the damage done has been slight.

Although in many other ways (such as the corroding of foundation bolts, water-pipes used for supplying stations, and angle bars attached to the transverse girders, etc) the escape of electric currents of the trolley roads has proved damaging to the elevated structure, it has also benefited them by saving the amount necessary to maintain batteries for operating the telegraph lines over the roads. The Brooklyn Elevated Railroad uses nothing but a borrowed current for operating its telegraph wires. This is accomplished in most cases by running a wire into the ground and connecting it with a gas or water pipe, which readily appropriates a sufficient current from the street car line. But the Brooklyn Heights surface road (which controls more than 200 miles of single track trolley lines in Brooklyn) is fast paralleling its feed wires by equally heavy return wires, so that the elevated road officials who, but for this, might successfully plan to light the stations and even operate the road as they run their telegraph, will probably have to fall back on their own resources. In time the officers of the elevated roads will probably regret (if they have not already done so) that they allowed the trolley lines to connect their wires with the structure. Great damage is being done to the large bolts used in the foundation work on which the iron pillars rest. These bolts will need constant watching, as those corroded will have to be replaced by new ones in order to maintain the strength of the structure.

Metropolitan Construction. — The Metropolitan Traction Company has been employing about 7,000 men in the construction of the cable roads in Lexington avenue and Ninth avenue, but has posted a notice that for the moment the force of laborers on cable construction is being reduced, owing to the fact that electricity is likely to be used instead of cables. While this does not change the form of construction to any great extent, special castings are required, and it will be at least sixty days before they are obtainable.

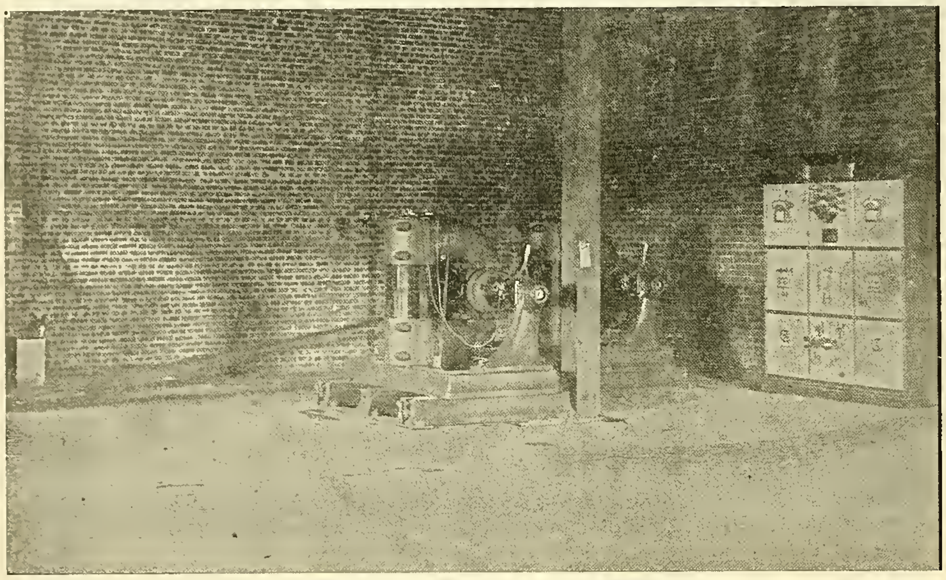


FIG. 3. THE CAPITAL RAILWAY AT FRANKFORT, KY.

MR. BARNES ON ELECTRIC RAILROADS.*

BY FRANK B. LEA.

There is no small pleasure in reading the opinions and comments of a well-informed and unprejudiced railway man upon the question of employing electric energy for locomotive purposes, and one can hardly avoid such a feeling after a perusal of Mr. Barnes' notes respecting the use of electricity in heavy railroad service, as given in abstract form in the last issue of the *Electrical Engineer*.† Mr. Barnes is a well-known authority throughout the United States upon all railroad topics, and whilst, of course—like all others in his position—his training and experience have been more particularly in the direction of steam locomotive work, yet he approaches the subject of electric equipments for railways in an unbiased manner, which offers a strong contrast to the blind prejudice too often characteristic of railway officials against any new devices or improvements made available by the progress of invention.

The mere fact that a leading railway man should bring before the meeting of a railroad officials' club some speculations upon the possibilities of electric working for the heavy service of main lines—not to speak of its actually replacing steam locomotion—is in itself enough to show a disposition to discuss the matter fairly upon its merits, and not to dismiss the whole question with a wave of the hand as a visionary madness too much in the air for sensible men to entertain for a moment.

While, however, speaking thus favorably of the tone characterising Mr. Barnes' remarks, and of the final conclusions which he draws, electrical engineers must not be contented with allowing his figures to pass without question, and as though they represented the utmost, or even average, powers of electrical working in railway service. Mr. Barnes is perhaps not very far wrong in taking the average consumption of fuel in good stationary engines and in steam locomotives as being respectively 1.8 pounds and 4.2 pounds per horse power hour, although the latter is by no means too high a figure. What requires pointing out, however, is that these amounts of coal consumption refer to the *indicated* horse power in the cylinders, and not at all to the actual brake horse power at the driving axle on the line. Yet if Mr Barnes deducts 15 per cent. up to the dynamo terminals, and 10 per cent. for electric waste on the line, he ought at least to make some reduction in the steam locomotive efficiency as between indicated horse power in the cylinder and the drawbar pull.

Even the much abused Prof. Kennedy went so far as to give the steam locomotive a drawbar efficiency of only 80 per cent. of the cylinder indicated horse power, and in average working 20 per cent. waste in engine friction, hauling dead weight of engine, etc., would not prove a bit too much to assume. For Mr. Barnes to take the full efficiency of indicated horse power in the steam locomotive is therefore hardly fair to the electric motor when instituting comparisons between drawbar pulls. Moreover, the percentages of loss which he gives for an electric line are higher than is actually shown by daily working. An efficiency at the electric generator terminals of 85 per cent. of the engine indicated horse power has been exceeded in practice for some time now, while the line conductor is poorly arranged indeed when the loss thereon is as much as 10 per cent. of the energy put into it. Five per cent. is nearer the mark, as the South London and Liverpool lines have practically shown. The motor loss cannot with any attempt at satisfactory results be averaged, for obviously it must vary in a great degree with the character of the line and traffic.

But even with the three alterations thus proposed in Mr. Barnes' figures, a much more favorable result is secured for electric working. In the first place, the steam locomotive burns at least 5¼ pounds per horse power hour, reduced to drawbar pull, while on the electric line the corresponding coal consumption should not be more than about 3 pounds, full load being assumed in both cases. In one of his concluding paragraphs, however, Mr. Barnes puts the whole matter very neatly, the kernel of the nut being this: "The conditions which regulate the price (of fuel) control almost entirely the saving in fuel cost incident to the use of electric motors."

If a moral is to be found, let it be the following: "Look after your coal bill, and the dividends will look after themselves."

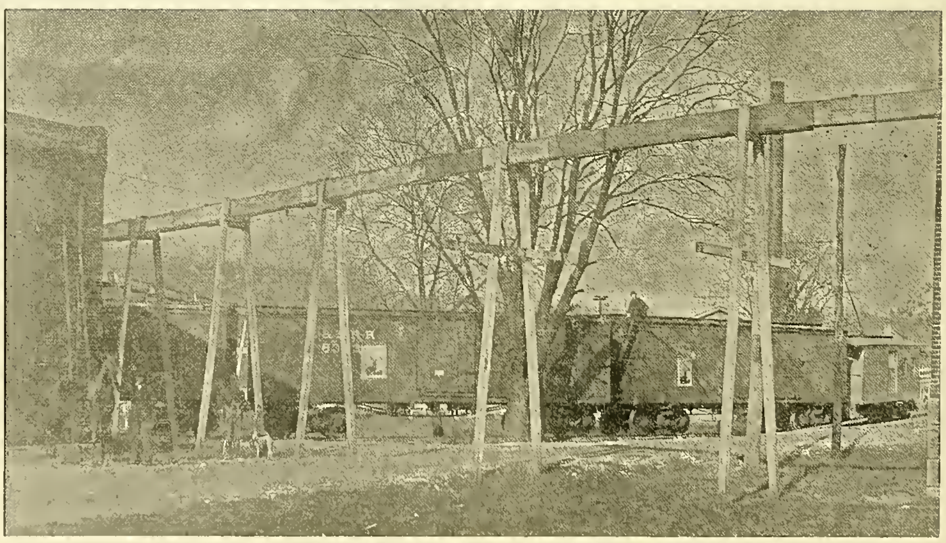


FIG. 3. THE CAPITAL RAILWAY AT FRANKFORT, KY.

*From the *Electrical Engineer*, London.

†See the STREET RAILWAY GAZETTE of March 5, 1894, for very full abstract of Mr. Barnes' paper

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Twenty-second Article.)

THE LEONARD SYSTEM.

As before outlined, in speed regulation it is necessary to vary the electromotive force as the speed, and the torque or effort as the current. In the previous methods of control this is attempted and imperfectly accomplished by various methods of commutation of field coils and external resistances. In fact some such method as this is all that is available where a current of constant potential, such as that now universally employed on electric railroads, is used. Mr. H. Ward Leonard, however, has taken a very bold step in his system, which consists in placing on each car a separate generator from which the car motor is directly operated—the generator itself being directly driven from the trolley current by a motor. By reference to Fig. 60 the following explanation of the system will be readily understood. We quote from a paper read by Mr. Leonard before the American Institute of Electrical Engineers, June 8, 1892:

"Each axle is driven by a gearless motor, either directly or by means of a connecting rod. The fields of these motors are excited directly from the constant E. M. F. of the line and independently of the armature circuit. Beneath the car and between the axles there is suspended a motor generator, each armature winding being in a separate field. The motor portion of the motor generator is shunt wound and connected just as a shunt motor is for use upon ordinary constant potential circuits. The field of the generator portion has its field connected across the line and has inserted in it a regulating and reversing field rheostat. This field circuit is independent of the armature circuit. The generating armature of the motor generator is in metallic connection with the armatures of the gearless propelling motors. It will be noticed that this circuit, including the armature, is a distinct and separate metallic circuit having no connection with the line in any way.

"Suppose now that our shunt motor is running at full speed and that our controlling rheostat in the generator field circuit is at its central position, so that the generator field circuit is broken. Although the generator armature is being driven at full speed it is revolving in a field having no magnetism except the residual magetism, and hence produces practically no volts. Let us now move our controlling switch so as to place the generator field across the line, but with a resistance in series with the field, of ten times the resistance of the field coils. We now give a slight excitation of the field and a development of volts at the brushes of perhaps 40 volts. This voltage will produce a current through the armatures of the driving motors dependent upon the ohmic resistance of this circuit only; and hence, even at this low voltage, a large current will be produced, which being in a field of full strength will cause a torque sufficient to start the armature. The speed of the armature will, of course, be governed by the counter E. M. F. which its revolution produces in its strong field; and hence, just as in the case of a shunt wound motor, its speed will be practically constant so long as the E. M. F. supplied is constant.

"If we now gradually increase the magnetic field of the generator by cutting out resistance by moving the controlling switch, we will gradually raise the E. M. F. of the armature circuit, and with it the speed of the driving motors. Since these armatures are revolving in a constant field, the torque they produce will be exactly proportional to the current in them, and the current will automatically flow exactly as is required to produce the necessary torque to maintain a speed such that the counter E. M. F. will approximately equal the E. M. F. supplied by the power converter. Thus it will be seen that the speed of the car will be dependent upon, and proportional to the E. M. F. supplied by the power converter, and the torque or tractive effort will be dependent upon, and proportional to, the current supplied by the power converter."

While this method has not as yet been actually introduced on electric street railroads, its feasibility and economy and the facility of control afforded have been amply demonstrated on numerous electric cranes, elevators and hoists and in connection with machinery of various kinds requiring the greatest nicety of speed control under widely varying loads. In such applications economy of space has not been the prime requisite that it is in street car traction, and the fact that the arrangement seems necessarily bulky, with the three machines involved, and the erroneous idea which has been general that the sparking would be excessive under working conditions, has militated greatly against the introduction in street railway work. As before stated, those who have examined into the workings of the system, among whom may be included the author, aver that there is practically no sparking even under the most favorable conditions for the same, and the author is advised that changes in detail (though not in principle) have already been partially perfected which will obviate the real difficulty that now exists viz., bulkiness.

Mr. Leonard has also adapted this same system to the operation of cars from alternating current circuits. In this application a synchronous motor generator is substituted for the direct current motor generator employed in the direct current method. Those who wish to read a full

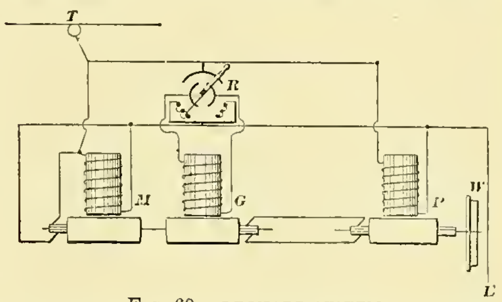


Fig. 60. LEONARD SYSTEM.

T, trolley. M, motor portion of power converter. G, generator portion of power converter. P, the propelling motor for the car. R, the regulation and reversing rheostat in field of G. E, the connection to ground. W, the car wheel.

description of this system are referred to Vol. XI of the transactions of the American Institute of Electrical Engineers under the title "How shall we operate an electric railway extending one hundred miles from the power station?" by H. Ward Leonard.

Thus far the method of distributing current for electric traction has been that by constant potential. That is to say the pressure at the dynamo terminals has remained constant and the current in amperes delivered to the moving cars has varied as the requirements. This method as a whole has thus far proved the most flexible, but with the increasing distances to which our electric roads are constantly reaching, it is becoming less and less satisfactory. We have already adverted to the drop in potential at the further end of the line where the current is used by the present methods. This drop can be obviated in either of two ways, either by placing sufficient copper in the feeders to reduce it to a bearable amount, or by increasing the potential. If the potential be raised sufficiently to operate a car properly at the further end of a long line, it will be too high for the same car when nearer the power station, so recourse is had to additional copper. But the amount of copper that can be thus used with an initial pressure of 500 volts is soon limited by commercial considerations beyond which it becomes more expensive than to erect and operate another power station at a distant point. Just how far it is profitable to operate a road from a single station must be decided for each particular case, but it is probably within the truth to say that where the distance to be reached exceeds six or seven miles it will be cheaper to build a second power house than to put sufficient copper in the feeders to render those greater distances practicable. In the constant potential method of distribution the varying demands for energy are met by a varying quantity of current, yet our conductors which are fixed in size are properly proportioned only for a given current. For that particular current they are of exactly the proper size; but for any other current, be it larger or smaller, the conductor used is not the most economical; it will contain either more copper or less than that which can most economically carry it. If, however, we should use a constant current and vary the energy transmitted by varying the electromotive force, we could proportion our copper to that current once for all, and since by the conditions imposed the current does not vary in quantity the size of our conductors need not vary whatever the amount of energy they are required to carry or whatever the distances to be reached. Illustrations of this method of distribution are seen in our arc light circuits. Many of these already extend upwards of 20 miles and carry from 60 to 100 or more 2,000 C. P. lamps, yet the conductors on such circuits are no heavier than would be necessary for a circuit 1 mile or 5 miles in length carrying but a single lamp or four or five. To render the same sized conductor equally economical for the transmission of large amounts of energy to long distances, it is only necessary to raise the electromotive force correspondingly. Large amounts of energy can thus be much more economically transmitted to long distances by the constant current method, than by the constant potential method, the economy becoming particularly conspicuous where the demands are variable and where the distances are also variable, as is preeminently the case in electric traction.

On account of these and other advantages of the constant current method of distribution many attempts have been made to adapt it to street railway purposes. But there have been difficulties in the way of its adaptation to this use which until they were removed introduced greater objections than were the benefits sought to introduce. The writer, however, has invented a system which he believes obviates all the difficulties hitherto thought to be inherent in the constant current method and which at the same time sacrifices none of the advantages sought to be gained. His improvement over previous methods consists simply in supplying to the railway circuit the same device by which the series arc-light system was converted from a failure to a commercial success, viz., an automatic cut-out by which on the failure of an operating device it is automatically cut out of circuit. Without this invention the practicability of even two or three arc lamps in series was uncertain; with it any number may be practically operated.

Prof. S. H. Short experimented quite extensively a few years ago with the constant current method of distribution for street cars and had for a time two roads in more or less successful operation—one about 3 miles in length between Huntington, W. Va., and Gyandotte, and the other of about the same length in the city of St. Louis. He had not conceived the idea of the automatic cut-out and found it impracticable to operate more than three cars simultaneously on his lines. He however demonstrated the economy and efficiency of the system up to its practical limit. With the addition of the cut-outs and the other radical changes introduced by the writer it is believed that the new system possesses all the flexibility of the multiple arc method with the additional advantages of the series method, and in recognition of these claims the Franklin Institute of Philadelphia recently awarded him the John Scott Legacy premium and medal.

This system may be briefly described as a double trolley system, divided up into sections of greater or less length according to the headway of the cars provided for. Each of these sections is fed independently from a common feeder wire, by means of electromagnetic devices inclosed in hermetically sealed boxes along the side of the track very similar in design to those employed in the Johnson-Lundell system described above. They are not nearly so numerous, however, as in the suburban districts where the distances between cars is great; not more than one or two to the mile are required. In the cities, however, where the headway of cars is much less, their number must be increased proportionately.

But one car can operate on a section. If a car runs onto a section already occupied, both cars will become inoperative until one of the two pulls down its trolley—thus constituting this a perfect automatic block system. All cars on the system are in series with each other, and since the current strength by which they are operated is invariable, their speed may be checked on descending a grade or in bringing them to rest, by reversing the connections. This reversal of the brushes converts the motor into a dynamo, which being in series with the one at the power house, contributes energy to the line to the last turn of the wheels. In this way the energy absorbed in ascending grades or in starting from rest is thrown back on the line for use elsewhere, instead of being frittered away in heat on the brake shoe as in present methods. The method of control of cars operated by this system is ideally simple. There are neither commutated fields nor external resistances to be considered, so that with this system the advocates of both methods of control join hands, since the method involves the disadvantages of neither. In the series system the car is started, speeded up, slowed down and reversed by simply shifting the position of the brushes on the commutator. The equipment of the generating or power station is also extremely simple, requiring for each unit nothing more than a voltmeter, an ammeter and a line switch by which the circuit can be closed or opened, no rheostats, bus bars or complicated switchboard systems being required. This system is thought to be peculiarly applicable to long lines, such as suburban and interurban lines and it is believed that the time is not far distant when its advantages on such lines will be fully appreciated.

STORAGE BATTERY TRACTION.

A self-contained car or one that is self propelling would be an ideal were there not attendant disadvantages of such a serious nature as to overshadow the advantages possessed. The storage battery seemed to hold out such bright prospects of success that many earnest efforts have been made almost from the first invention of the storage battery by Plante and its improvement by Faure, down to the present day. It, however, has been a disappointment in every case, in this country at least, where it has been tried, notwithstanding the fact that neither engineering skill of the highest character, nor expense has been spared to make it a success. The causes of these failures are many and seem to be inherent in the battery itself as at present constructed. We know of no more efficient method of storing electricity* than by means of lead plates. These are so heavy that a street car equipped with sufficient battery capacity for its successful propulsion must carry in this form alone more weight than it is possible to put upon it in the shape of passengers. The empty car is therefore handicapped on starting out with a non-paying load greater than that from which it can expect to derive revenue. This means not only additional expense for haulage, but is destructive to track and cars alike. Since at least two sets of battery equipments must be provided for each car, which will greatly exceed the cost of motor equipment, the fixed capital investment upon which interest must be earned is excessive. Another disadvantage of the battery is that not more than about 70 per cent. of the energy put into the battery can be drawn out of it again for use and even this amount is available only when the batteries are new and in good condition. When they are old the percentage of energy used for charging that is available for use is very much less than this, running down to 50, 40, 30 per cent. and even less. The deterioration of the plates, too, is very rapid in street car work owing to the jarring of the cars and the swash of the liquid, causing a loosening of the active material, its falling out and causing short circuits resulting in the destruction of the plates. The wear and tear or depreciation account is, therefore, excessive, and taken altogether, experience has almost conclusively pointed to the inadaptability of the storage battery to traction purposes.

The storage battery, however, permits of the most economical speed control of any known, as by commutating the cells into groups in series and in parallel, by using some for separately exciting the fields while various other combinations are used for feeding the armature, an ideally economical speed regulation is obtained somewhat similar to that advocated by Mr. Leonard but without the multiplicity of apparatus or external resistances used by him.

Should a lighter and more durable storage battery than the present type ever be invented it is not unlikely that it would come into general use for traction purposes, but with our present types it seems exceedingly unlikely that it can make much progress in this direction.

CONDUIT SYSTEMS.

The unsightliness of the overhead trolley and its obtrusiveness in the streets are its chief objectionable features. To overcome these, many attempts have been made to carry the wire underground in a conduit similar to that used in cable railways. It would seem, at first blush, a very simple thing to place the trolley wire in such a conduit and have it work at least as well as it does overhead, for that is all that is asked of any conduit system, but difficulties have arisen that have militated against the success of the conduit system thus far, that have brought it into disfavor. The chief difficulty to my own mind is the greater expense involved in such a plant. It is but natural that parties having railway franchises should desire to avail themselves of them by the least expensive and most efficient means where those two qualities are not incompatible. It so happens that the overhead trolley does possess both of these qualities, hence since there is no advantage to the investor in putting the trolley wire below the surface of the street, but on the contrary a disadvantage in the way of greater expense. Capital has not had the incentive to investment in conduit systems that have been offered by the overhead trolley. In our larger cities, however, the public is already clamoring for the burial of the wires and with this incentive many inventors are at work endeavoring to devise a practicable conduit system which shall not at the same time be too expensive either in installation or in operation.

The chief difficulties to be overcome in conduit work are to maintain an efficient insulation of the trolley wires from the ground or conduit itself to prevent the insulation of the trolley wire from the trolley contact by dirt entering through the slot and to provide an efficient contact between trolley and wire under conditions which prevent the entrance of dirt into the slot.

The two best known examples of successful conduit construction are the Siemens and Halske and the Love systems in both of which the principle of the overhead trolley is followed closely, the conductors, however, are not placed directly beneath the slot but off to one side where they are protected by the roof of the conduit from in-falling dirt, water or snow. The traveling contacts are made of proper shape to reach around to the conductors with which they are brought into contact when desired. In the Siemens and Halske system, which has now been in successful operation for several years abroad, and which is now to be introduced tentatively into New York City, the conduit and slot are at the side of the track. In the Love system, which has been tried in Chicago and is now in successful operation in Washington, the conduit is in the center of the track. While these two systems differ considerably in details, they are the same in principle, which is exactly that of the overhead trolley, special attention being given to the insulation of the trolley wire from its surroundings to the adequate drainage of the conduit itself and to adapting the trolley to its new requirements.

Other inventors have endeavored to solve the insulation problem somewhat on the same lines as those adopted in the surface contact system of Johnson and Lundell, namely by dividing the trolley wire up into short sections which are normally dead, but which are successively thrown into electrical connection with the live feeder wires as the trolley passes onto them and thrown out of connection with them as the trolley passes off from them. By thus having only that portion of the trolley wire actually in use active, the tendency to leakage of current is of course greatly lessened, but there is introduced in its stead a multiplicity of switches upon whose proper working the success of the system depends, which is of course a source of weakness or possible weakness scarcely less desirable of avoidance than leakage itself. Great ingenuity has been displayed in designing systems on this plan, but none of them has been in practical use long enough to demonstrate beyond question its absolute practicability.

Still another type of conduit known as the closed conduit has been devised in which by various means, usually by electromagnetic devices, the passing car maintains a supply of current by attracting to short surface conductors the live conductors buried beneath the surface of the street. Sometimes this contact is made by the pressure of the car wheels or their flanges upon spring contacts over which they pass, but in all cases the methods of speed control are identical with those employed on the overhead trolley systems.

*It is not *electrical* energy that is stored in the storage battery, as is popularly assumed, but *chemical* energy. The term "electrical storage" has come into such general use, however, and it is so convenient, that with this explanation I may use it without creating confusion.

DEFECTIVE CONSTRUCTION.—To say that the railway current is being tapped all over the city for lighting, operating motors, telegraph circuits, etc., is to give some indication of the wretched conditions existing. To the unquestioned danger from fire due to leaks, there is added the equally important destructive effect of electrolytic action, not only on water and gas pipes but on the elevated structure itself, which shows a difference of potential to ground, exceeding 100 volts in spots. Attempts are being made to remedy these evil effects by putting up heavy overhead return conductors, but these cables, with the feeders as thick as one's wrist, simply cast into the shade the old familiar sky-obscuring electric light lines. We are not among those who stickle for the æsthetic in engineering, but we submit that good engineering of itself would have precluded the putting up of such conductors on poles in city streets. There can be only one outcome of this outrage upon public decency and insult to the profession of electrical engineering; and it is to be hoped that, for the sake of both, these monstrosities may soon be wiped from the face of the earth. It is not without reason that the Fire Underwriters have raised their rates beyond the Harlem River in New York and a similar action which may be expected to involve Brooklyn will raise such a storm of public condemnation that further delay in placing all feeders and returns underground will be impossible. Even the acknowledged popularity of the electric cars in Brooklyn will not be able to avert the storm which is gradually but surely gathering.—*Electrical Engineer.*

ELECTROLYSIS CAUSED BY STREET RAILWAY RETURN CIRCUITS.*

Your committee, to whom was referred the matter of electrolytic corrosion of gas and water pipes by the return currents of electrical street railways, submit the following report as the result of their investigations:

A thorough appreciation of the principles of electrolysis being necessary to the proper explanation of the effects observed, your committee may be pardoned for repeating some details which may be already familiar. Practical employment of the phenomenon of electrolysis is made in electro-plating, in the Edison electric meter, in the reduction of aluminum and other metals from their oxides, in the purification of sewage, etc., but the condition of its application most similar to that which we are now considering is exhibited in the well-known laboratory experiment of analyzing water by the passage of an electric current between poles immersed in the acidulated liquid, for electrolysis literally means a loosening or dissolving by electricity. These poles are called electrodes, the positive pole being the anode and the negative the cathode, while the liquid is termed the electrolyte. In the instance cited, if the object of the experiment were the production of hydrogen and oxygen, platinum poles would be employed; but if a more easily oxidizable substance were used for the electrodes, the conditions present in the analagous system of electro-plating would be produced—that is, there would be a perceptible wasting away of the substance of the positive pole, and a gradual accretion at the cathode or negative terminal. The electrolyte must be a compound substance, and in a liquid state, either by solution or fusion. When a salt is electrolyzed, the acid always appears at the positive pole and the base at the negative. In the case of water, the collection of the hydrogen at the negative pole is but another instance of its metallic behavior, and the oxygen always collects at the positive pole.

Turning now to the phase of electrolysis which we have to consider, we may briefly summarize its history by remarking that telegraphic practice has led electricians to think the earth's resistance practically nothing; hence in the earlier electric traction installations, no special attempts were made to provide for returning the currents to the power houses. But the necessity for such provisions was soon apparent, and a form of bond wire for connection at rail joints was introduced, the tracks being relied upon as return conductors. The use of a supplementary wire between the tracks, larger bond wires, and more attention toward securing electrical contact, followed, but with increased experience in electric railway work, came the realization that these attempts had been little better than makeshifts, and that owing to imperfections and consequent resistance, a large proportion of the current was seeking other avenues of return, and was causing injuries by so doing.

The realization of this condition by no means came all at once, for railway managers were at first loath to believe the operation of their dynamos responsible for the reported damages to the telephone cables and gas and water pipes, but ascribed the corrosion to chemicals in the soil or other causes, and doubtless looked upon the loss of their current as a necessary evil attendant upon the method of propulsion employed. Some of the earliest experiments to locate the source of this corrosion were those* of Mr. I. H. Farnham, of the New England Telegraph & Telephone Company, Boston, who exposed short lengths of cable to all the conditions affecting the corroded cable except that of connection with the system of wires, and found them unaffected after an exposure during which the neighboring connected cables were badly injured. Many other tests have been made, and there is now a full agreement by both the owners of the buried pipe and wire systems and the street railway people as to the cause of the trouble, all uniting in ascribing it to the earth returns of the enormous currents used in electric traction.

Having agreed that the grounded current is responsible for the injuries we have observed, let us see the manner in which it acts. No effect is produced where the current reaches the pipes, for this is a negative electrode, and would be receiving a deposit from the rails and bond wires, if any action were apparent. Neither is there likely to be any damage in the body of the pipe, unless a small connecting line should be encountered whose greater resistance would cause heating, or the presence of joints of higher resistance (due to leaks, or the use of cement) should force the current out, to return a few inches further on. But the injurious action occurs at the point where the current *leaves* the pipes to enter some conductor offering an easier path. This will usually take place opposite the power house—where the current is also greatest in quantity owing to the accumulated returns from the entire line—and at points where pipes cross beneath the tracks, the current returning to the rails with especial readiness if the direction of the pipes no longer coincides with that of the railway. Here the conditions of our laboratory experiment are reproduced. Of two points where rails and pipes are equally distant, the greater flow of current will take place where the greater moisture exists. This moist earth then is our electrolyte, made specially effective by the gas, ammonia from animal refuse, salt from melting snow, or other chemicals present in the ground; the pipe is our anode; and the rail or other objective point of the current the cathode. The metal of the anode or positive pole is gradually carried in the direction of flow† of the current; and the electrolysis once begun, the oxygen and ozone of the electrolyzed moisture collect at the positive pole and aid in attacking the pipe. The rapidity of its destruction depends on the quantity of current passing rather than upon its voltage; and instances are on record and in the knowledge of your committee where a single month sufficed to destroy new service pipes.

Verbal expressions from several sources, as well as certain published discussions, seem to indicate that the full extent and effect of this electrolytic trouble is but vaguely realized by many of us. Some of us may think that not having found any ill effects ourselves, the question, though an interesting one, deals with a matter that does not touch *us* directly. Your committee would emphasize this statement, that no city in which an electric road is operating with any part of the return through the ground, has its gas and water pipes wholly free from electrolytic action; the fancied immunity is the security of incomplete information. To draw attention to the widespread nature of the trouble, a portion of the appendix accompanying this report is devoted to published accounts of damaged pipes. The greater number of complaints come from the water interests, for two reasons: first, greater conductivity; for the water mains range greater in size than gas mains, the absence of cement joints decreases their resistance, and the contained water may add to the conductivity; and second, the greater pressure carried more quickly occasions a break. But the gas mains are beginning to indicate the action upon them, and will do so more and more unless effective remedies are soon applied. When we realize not alone the immense capital buried in our water and gas distributing systems, but the fact that street improvements have made repairs to our pipes additionally expensive, we may begin to appreciate the serious character of a condition which divides by 5, 10, 50, and even 100, the life of a pipe, and which, until the cause be removed, may repeat the operation on the replaced line in an equally short time, or accomplish a similar injury at another point where its action will be less readily located.

Coming now to a consideration of the remedies, we will first notice those which have been suggested for adoption by the gas and water companies. Probably the earliest of these was that of coating the pipes with non-conducting paint or a covering of similar purpose. A parallel of this is the use of drain pipes of slightly greater diameter than the metal ones, slipped over the latter and cemented at the joints and at ends. These have been adopted with especial convenience for service pipes crossing under the rails, but their value is dependent upon the local circumstances. If the corrosion at such a place is caused by the current flowing downward through the earth and so entering and leaving the service at about the same points—placing it in an electric bath, as it were—such a covering should prove a true protection. But if the current had reached the line through some imperfection at a point farther away, and caused the corrosion by leaving the pipe to return to the rail, any insulation, if locally effective, would cause the current to seek a different avenue of exit and so merely transfer the point of corrosion. A determination at such places of the direction of the current, whether from or to the rail, would show whether or not a non-conducting covering would be effective. Incidentally, the adoption of insulation at the current's points of departure would increase the resistance of the mains and so decrease the proportion of current carried, but complete relief by the plan suggested would require encasing of the entire distributing system, and as a final curative it may be dismissed as impracticable.

The same reasoning applies to the method adopted on certain lines of water pipe in Los Angeles, which were laid in conduits filled with sawdust, and also to the use which has elsewhere been made of a covering of pitch, kept in place by boxing of convenient form. All these protectives are too costly for general adoption, and no partial installation of any of them would wholly cure the trouble.

A similar statement may be made regarding the device of winding or protecting the pipes with copper wires attached to plates buried below. This was tried in Cambridge, Mass., but relinquished because of the rapid destruction of the copper ground plates.

The paralleling of gas mains on each side of streets occupied by electric roads, that there may be no crossing service pipes, has been suggested; and in Aurora, Ill., circumstances have left the Gas Light Company with their mains thus duplicated, and hitherto no trouble from electricity has been experienced. But it would seem that while crossing mains at intersecting streets could be insulated, some electric leakage or induction must occur from the long parallel lines of uninsulated conductors, rails and pipes, thus placed comparatively close together. The British Committee on the electrolytic subject seem to regard the interposition of six feet of dry earth as a sufficient shield, but under the conditions existing in most cities the absence of moisture would be difficult to guarantee; and the great cost of such a method of protection, even if effective, would put it out of the question.

The use of cement joints for gas mains is in a measure an advantage as a protection, for any tendency to increase the resistance of our pipes is helpful so far as it goes. This remedy, though, does not apply to the water mains, and should the pipes have been connected to the dynamos or cross-bonded to the rails as will be described later, the presence of cement joints would be a positive source of danger.

It is plainly apparent from a consideration of the foregoing devices and the conditions which limit them, that no remedy can be applied by the gas and water interests which will be wholly effective. We now come to consider the preventives whose adoption devolves upon the railway companies.

In the earlier days of the "broomstick trains," the practice as to current direction was not as uniform as it generally is now, for in some plants the dynamos were run with the positive pole to the trolley wire, and some with the negative. In the latter cases, electrolytic effects were produced along the entire line wherever the current would find a ready path from pipes to rails, so that locating the injuries was a much more difficult task. As the car motors take current either way, however, reversing the current's direction was an easy matter—especially in places where but one electric road is operating—and has been very generally done. The liability to corrosion is thus brought to within a narrower range, and largely localized in the neighborhood of the power houses.

Most prominent in point of number among the remedial devices adopted by the railway companies are those for securing additional electrical contacts at the bonds, and obtaining a bond conductivity approximately equal to that of the rail itself. The necessity of greater attention to this latter point is shown in the tables which have been published of relative conductive areas of the several sizes of rails and bonds in use; it has been customary to bond 56-pound rails, for instance, with No. 0 B. W. G. copper wire, whose relative conductivity is but one-twentieth as great. The use of the customary sizes of supplementary wires between the rails is by this comparison shown to be equally ridiculous and ineffective; one writer remarks that it is "laying a twelve-inch water main and then putting a one-half inch pipe alongside to help it out;" and it has been well said that the weight of copper now used in supplementary ground wires would be much better employed in the form of heavier bonds. A contributor to the *Engineering Record* states that "a section H, 60-pound Lewis & Fowler box rail has about the same resistance as a copper wire one and one-eighth inches in diameter. No such amounts of copper have yet been used to make bonds, and until they have, the possibilities of rail returns have not been exhausted." The same writer refers to some experiments by Messrs. Warner & Thayer on track resistances, which showed that the resistance of the rail section was so slight that the calculated resistance of the bonds accounted for nearly all of that observed.

In order to decrease the cost of bond wires it has been suggested to make them twelve inches long instead of thirty inches, as is usually done, which would also reduce the bond resistance, and to use rails sixty or one hundred feet long instead of thirty feet. The suggested use of bonds of equal conductivity with the body of the rail and of greater rail lengths is still a step short of

*Report of a committee to the 17th annual meeting of the Western Gas Association, at Cleveland, Ohio.

*STREET RAILWAY GAZETTE, April 2, '94, p. 181.

†Mr. Allyn's account of the coatings of a gas pipe by lead electrolytically deposited from a water service will be found in the proceedings New Eng. Assn. Gas Engnrs, Am. Gas Lt. Journal, Mch. 2, '94, p. 364.

welded joints and continuous tracks, which have been adopted on several lines. The principal objection to the use of continuous rails has been the fear that changes in temperature would induce alterations in their length, previously allowed for by spacing between abutting joints, and that buckling or deflection of the tracks would thereby ensue. But careful tests on a practical scale seem to have shown that in a well laid track of this character linear expansion may be disregarded, and that changes in temperature produce their effects "in a minute enlargement and reduction of the sectional area of the rail." *Such a line of double track, three and one-half miles long, is now being laid on the north Broadway extension in St. Louis, the object of its introduction being the desire to decrease the jolting of cars by doing away with rail joints; but the manager of the roads has remarked that an incidental advantage is expected from a more efficient return of the current.

The use of the "three wire system" on electric roads has been advocated by Mr. W. Nelson Smith as a deterrent of electrolytic corrosion, and has been in operation in Portland, Ore., for the past two years with reported success. In its application for this purpose on a double track road, the trolley wire above one track serves as the positive, the other as the negative, and the rails and earth as the neutral wire. There may be a potential difference from earth of 500 volts to each trolley wire, and of 1,000 volts between them. The rails or neutral wires merely carry the current required by the difference in load on the two sides of the line, which is only considerable when cars are darting out or going in, and in the morning and evening business and home travel, or in cases of "bunching." The difficulties in overhead construction and insulation are increased, but it is said that only one-fourth or one-half the overhead copper is required as for a two wire all copper system, such as the double trolley.

A common practice is to bury at certain points on the car line old car wheels, rails, or other forms of plates to collect the ground currents, connected by supplementary wires to the power stations. But instances are known where such supplementaries have been used of so great length and consequent resistance, that instead of carrying the current back to the dynamos, they were found by test to be actually positive to the earth. Their insufficiency is more explicitly shown in the experiments† of Mr. J. D. Rastron, chief engineer Union Railway Company, Chester, Pa., whose tests showed in one instance that the track and ground supplementary wires were carrying 235.5 amperes of current, the city water mains 12.8 amperes, and the plates, though connected with an unquestionably thorough ground in a creek, but 0.5 amperes. This was doubtless a case with exceptionally unfavorable conditions; but even under propitious circumstances, no great proportion of the current could be expected to reach the isolated ground plates, of relatively small earth contact, as compared with the quantity following the long and heavy lines of pipe so widely to be encountered by earth currents.

Recognizing that the currents must follow the main pipes to some extent under existing conditions of railway practice, and that the injurious effects are produced at their points of leaving, the water department in Cambridge, Mass., has had heavy copper wires attached to the water mains and carried to the negative generator terminals of the electric roads, that the currents collected by the mains might leave them by a metallic circuit. The water pipes were also connected to the rails, and the water and gas services wired together within the cellars along the route of the road; intentional use thus being made of the pipes as conductors. In Milwaukee the railway company connected their rails to fire hydrants, but provided no means for the departure of the current until prevailed upon to supply an attachment near the power station. Elsewhere it has been proposed to run feeders to the power houses from the mains in various sections of the city, but not to connect the mains directly to the rails, in other words, to employ the mains, but only as a huge system of collecting ground plates.

Of the three grades of this arrangement, the last is preferable, but even that is by no means desirable, for it serves to increase the conductive power of the pipes and so invites the approach of currents; and while no especial harm might be done to a perfectly tight water main so wired, a pipe having leaks or loose joints, or a gas main with cemented bells, would be speedily affected injuriously. Nor should the suggested attachment to water mains alone be permitted without protest by gas companies, for if the water mains be made better conductors than before, more tendency will be manifested by such vagrant currents as may have reached the gas pipes to leave them and enter the water mains, so spreading the likelihood and locality of electrolyzation.

Mr. I. H. Farnham, in a recent paper before the Institute of Electrical Engineers, gives the following description of still another plan:

> Prof. Elihu Thomson suggested placing motor generators along the railway line wherever the cables and pipes are found to be in danger, to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor generators would, so to speak, pump the current out of the cables and force it into the rails whenever the potential of the former should rise above zero. This plan has not yet been put into operation so far as I am aware.

Among the devices described in the foregoing paragraphs are most of those which have been adopted to any extent by the railways as preventives of electrolytic action. As deterrents or diminishers, many of them assist, but not one fulfils the requirement of complete protection, nor can any system do so which uses the rails to any appreciable degree as conductors. On many of the lines of electric railways—perhaps on most of those within the cities—the rails lie parallel for long distances with lines of gas and water mains, much better conductors than equal columns of earth, and in cases of poor bonding often exceeding in conductivity even the rails themselves. Separated from the latter only by a strip of earth, more or less moist, the *capacity* of the rails to conduct all the current is subject to the conductive law of inverse resistances, for so long as the rails offer any resistance at all, some current will also follow the lines of higher resistance. The pipes will be called upon to bear a portion of the current under the most favorable circumstances, and so doing, will be injured, for it has been shown by experiment under conditions identical with those existing in practice, that electrolytic action may occur with differences of potential of 0.5 volt.

It has been claimed that the perfection of the alternating current motor in its application to street railway work would solve the problem of electrolysis; and the advantages of this system for long distance power transmission have caused it to be considered for adoption on the Erie Canal trolley line. But though faith in the inability of alternating currents to exert electrolytic effects is not universal, we need not consider the pros and cons, for the motor in satisfactory form is not yet on the market, and the immediate solution of the question before us must be sought apart from its improvement.

A system which many large roads are now adopting as a means of decreasing their current leakage is that of using insulated track feeders designed to carry the entire current, joined to the rails at short intervals, each 400 or 500 feet, for instance. The rails are thus employed as conductors only between the feeder junctions, and the liability of leaking currents is very much reduced. The system is certainly a step in advance of anything we have yet considered, and having been adopted in Boston, Brooklyn, Cleveland, etc., we should soon hear if by its use destruction of the pipes is wholly avoided.

A series of well planned and exhaustive tests of storage battries, conducted upon a specially equipped road in Washington, showed that no successful accumulator had yet appeared for railway work. Other suggestions have been considered, and as the insulation of the rails themselves may be at once dismissed as impracticable, the absolute and complete prevention of electrolytic corrosion thus narrows to the use of such a system as shall convey the current without the use of the rails or earth for any portion of the distance. Of this character are the double trolley lines of overhead construction, like those in Cincinnati, etc., or underground, like the conduit systems in Washington and Chicago. Either plan offers full and complete immunity from electrolysis, at a cost for copper no greater than that of a single trolley system with all-copper return. The double overhead design was one of the earliest forms employed, but was generally abandoned for the simpler single trolley on account of the difficulties of construction and insulation. That it is not impracticable is evidenced by its extensive employment in Cincinnati; and were the value of the destroyed pipes added to the costs of single trolley operation, very little argument might be needed to convince railway managers of the superior advantages of the isolated metallic return.

As to the double underground trolley, or conduit system, invention has been rife in its direction, and many designs are offered, though but few have received practical test. The Love conduit system at Washington and Chicago appears to be operating satisfactorily, and doubtless a number of others of the plans proposed also possess the elements of success. With the saving of ten to twenty-five per cent. in the cost for current—which we are assured would follow the introduction of an all-copper circuit—the probable deterioration of overhead work, relief from the liability for damages to pipes, and the fact that the trolley lines cannot long escape attention in the clamor for putting the wires underground, the prospects for the extension of conduit installations seem favorable.

Another class of injuries from the same general source as the electrolytic has been brought to the attention of your committee, namely, arc effects caused by short interruptions in the continuity of the metallic lines made to serve as conductors. Of this character were the cases in Boston, where the yarn was ignited in the bells of pipes which were being laid, and in Indianapolis, where the leaking current followed down a trolley pole and burned a hole in the natural gas main close by, the escaping gas from which returned through the hollow pole and was lit at its top, destroying a considerable extent of the neighboring overhead wires. There the railway's system was the greater sufferer; but such poetic justice as this seldom follows. The solution of the electrolytic question, however, will largely carry with it the prevention of this class of effects, so that they need not be specially considered.

In detailing the several plans which have been tried or suggested for the abatement of the troubles which we are considering, your committee have endeaved to show warrant for their belief that the full remedy for the difficulty cannot be applied by those who are suffering from its effects, but *is* attainable by the railway companies, and must of necessity rest with them. That they will endeavor, if assuming the cost of the work, to adopt the cheapest method which offers a measure of protection to the pipes, is of course to be expected. But their responsibility and liability once fixed, we may insist upon their adoption of an absolute preventive, or their rendering of adequate indemnity for all electrolytic injuries to our systems.

The regulations adopted by the special joint committee of the two English houses of parliament, to be applied to electric traction companies installing their systems under the jurisdiction of the board of trade, are much more stringent than any which have been proposed in this country. Our object is to secure the proper protection from injury by systems already in operation, of a quasi-public nature and occupying the streets like ourselves, whose extension we would not seek to hinder or whose methods to question except as they entail danger or expense upon us in our exercise of rights and duties equally important with theirs, and materially antedating them in introduction.

Mr. H. H. Humphreys, in his paper on this subject before the Electric Club of St. Louis, remarks:

> "The courts have decided, in numerous telephone cases, that the street railways have a right to the use of the earth as well as other people; but the question whether they would allow the railroad companies to use the gas and water pipes, and by using them, use them up, has never been decided that I know of."

The supreme court of Tennessee has held,* however, in an issue on behalf of a telephone company whose operation was affected by induction at the advent of electric traction, that it was not the legal duty of the telephone company to protect itself, but that it devolved upon the railway company to refrain from causing injury.

In several places where the water supply is conducted by a department of the municipal corporation, the commissioners have notified the railway managers that their companies would be held accountable for damages to pipes, and that the supply of water to their power stations was liable to interruptions unless the source of danger was removed. With the realization of the actuality and extent of the danger, water companies and departments all over the country are taking steps toward obtaining an understanding with the railways causing the trouble; and especially in the cases of such cities as include water supply as a function of the municipality the gas companies cannot do better than co-operate with them for mutual protection. If personal and corporate interviews and correspondence with the railway people fail of their object, the courts may be appealed to for restraining orders. Application for a stay of the injunction would doubtless be made on behalf of the railway, and the equity of the question would then be brought to a hearing. But meantime the deterioration of the pipes would be progressing, and even with the installation of a double trolley system decided upon by the railways, some time would elapse before it would be completed. Your committee would then recommend the insulation of all renewed pipes in places found to be injured—the drain-tile casing being probably the best for services and small mains, and boxing filled with pitch for larger

Journal Assn. Engnr. Soc. Feb. '93, p. 55.

†*Street Railway Journal*, Dec. '93, p. 810.

*Street Railway Gazette, March 24, 1894, page 131.

mains—and the use of cement joints in any new main being laid. The detection of leaks and the determination of unaccounted-for output are so much easier to gas than to water companies that any marked losses on the gas pipe lines at least are likely to be signalized in some manner readily recognized.

In justice to the railway companies it must be said that they are fully alive to the serious character of the problem which confronts them, and are equally anxious with ourselves to remedy and avert the trouble. They have a vital interest in the matter apart from the liability under which they rest for damages to other underground metallic systems, for the solution of the electrolytic question means to them a marked reduction in operating expenses, greater efficiency of the motors, and relief from the menace of interrupted water supply. But they naturally hesitate to accede immediately to demands which would involve the reconstruction of so considerable a portion of their plants; and as one of the electrical journals states, while the double trolley would remove all cause for complaint, the railway companies will exhaust every other means before going to the expense which that remedy would involve. But with recognition of the justice of claims for indemnity for injuries to our distributing lines, and a clear demonstration—such as is now being afforded in several directions—of the futility of any half-way measures, we think that the street railway world will eventually concede the superiority of the double trolley and its kindred systems.

Your committee, then, summarize their findings as follows:

First: Electrolysis from the grounded currents of electric roads is rapidly injuring gas and water pipes, and it is admitted by street railway people that the injury does proceed from their operations.

Second: Complete relief from its action *cannot* be reached by any device applicable by those injured, but *is* attainable by certain changes in the electric railways.

Third: The gas and water interest should unite in demands for remedial measures which shall secure the adoption of systems undoubtedly effective, and which will thereby avoid a revival of the question a few years hence.

Fourth: Pending the discussion or completion of the relieving systems, the pipes should be protected at the exposed points, at which the policy of increasing the resistance by insulation should be followed rather than that of increasing the conductivity by wiring.

ELECTRIC RAILWAY LITIGATION.

Mention was recently made of a suit instituted against the Philadelphia Traction Company by William M. Schlesinger, for himself and as trustee for Susan E. McDuffee and Alfred H. Williams, for alleged infringement on patented improvements in electric railways. Answer in the action was filed in Philadelphia this week. Denial of an infringement is made, and also that Schlesinger was the first inventor of the thing patented, or any part thereof, claimed as new by him. It is stated that the alleged new inventions were known and used long before by divers persons, among them being M. Daniel Connolly and Samuel M. Plush, at Philadelphia, and Stephen D. Field and Frank J. Sprague, at New York. It is further stated that the Westinghouse Electric & Manufacturing Company, also defendant in the suit, and the company from whom the Traction Company purchased the apparatus alleged to infringe on Schlesiger's patent, has filed an answer, in which it sets up many instances of knowledge, use, patenting and publication of the apparatus in question, prior to Schlesinger's alleged invention thereof. The Traction Company asked to have the benefit of these instances, the same as if it had set them out again in its own answer, and desires to be allowed to add, if necessary, other parties and other matters relative to the various patents. It was then stated "that the description and claims of said letters patent of the United States, numbered 339,018, are not in such full, clear, concise and exact terms as to enable any person skilled in the art to which they appertain to make and use the thing described, and that the patentee has not explained the principle of his said alleged invention and the best mode in which he has contemplated applying the principle, so as to distinguish it from other inventions, and that he has not particularly pointed out and distinctly claimed the part, improvement or combination which he claims as his alleged invention or discovery."

In conclusion, it is asserted that Schlesinger's patent does not describe or specify or claim any subject matter that is patentable under the statutes, and it is therefore null and void. The court is asked to dismiss the suit.

PHILADELPHIA ELEVATED RAILWAY PROJECT.

In the last issue of the STREET RAILWAY GAZETTE appeared a mention of the incorporation of the Market Street, Richmond & Frankford Passenger Railway Company of Philadelphia. The organization of this company has excited no little interest in Philadelphia, for it is no secret that it was organized as a result of the recent supreme court decision which declared that elevated roads could not be operated under existing Pennsylvania laws. Some months previously the Market Street, Richmond & Frankford . Electric Elevated Railway Company was formed to build an elevated road from Ninth and Market streets to the city line beyond Frankford.

It was announced that the construction of the road would soon commence and that the equipment would be similar to that of the Intramural road at the World's Fair. When the decision of the supreme court was made public it seemed apparent to a number of those interested in the project that construction was out of the question and that it would be the part of wisdom to abandon the enterprise. Others believed that the obstacles could be overcome and that the road could be built. Three officers of the company—Theodore Cramp, the president, and G. Frederick Keene and G. Frederick Jordan, directors, withdrew from the management.

John Dougherty, of New York, and Mr. McManus, of Chester, remained in the management, and A. S. Buchanan, of Philadelphia, W. H. Woolverton and H. J. Fitch, of New York, formerly Philadelphians, succeeded the directors who withdrew.

It was decided to incorporate the new company which has for its ostensible purpose the construction of a surface road along the same streets which the old company intended to occupy by its elevated structure. The decision of the supreme court against the building of elevated passenger railways left the old company with a charter that was practically worthless, an ordinance of councils, the privileges of which could not be exercised, and options upon valuable property, failure to purchase which meant the loss of thousands of dollars, together with the loss of profit which the projectors deemed likely to accrue from investment in the enterprise.

Under the circumstances it was decided to secure the new charter to build a surface railway and take the chances of securing additional legislation enabling the building of elevated railroads. An ordinance giving the franchise to the surface company was introduced in the select council last week. The introduction of the ordinance was in line with the scheme to utilize the old options and to be in readiness to build a surface railway in the event of failure in the Legislature. The gentlemen interested in this matter are, however, sanguine of success in this direction. The company will endeavor to secure the passage of a law enabling street railway companies now operating surface railways to elevate their tracks if they so desire. In the meantime the company has acted upon all of its property options but one, and these are now in process of being transferred.

The project, contemplates the erection of a handsome terminal station and office building. This will be on the site now occupied by the Central Avenue Hotel, near Ninth and Market streets, and plans for the structure are nearly completed. The building will be eight stories high, will have a frontage of 69 feet on Market street and a depth of 156 feet.

PEOPLE'S TRACTION ELECTRIC SYSTEM, PHILADELPHIA.

Electric cars of the People's Traction Company of Philadelphia will be in operation within a few days. Cars will first be started on the Fourth and Eighth Streets branch, and on the Germantown and Chestnut Hill extension; and soon after cars will be started on Girard avenue, Green street and Fairmount avenue, Norris and Susquehanna, Callowhill street and Indiana avenue extension. At the company's yard, at Twenty-third and Washington avenue, the finishing touches are being given to the electrical equipment of 300 new cars for use on the system, of which 135 are closed and 165 open summer cars. The cars were constructed by the St. Louis Car Company and by the Lamokin Car Company. The box cars are finished inside with light mahogany, and the ceilings are covered with a veneer of bird's-eye maple, giving the interior a bright, cheerful appearance. Light is furnished by ten incandescent lamps, of which nine are inside the car and one on the rear platform for the convenience of the conductors and passengers. The summer cars are finished inside with white ash and are lighted in the same manner as the closed cars. They are fitted with ten seats running crosswise, each seating comfortably five persons.

Under the direction of Chief Engineer William J. McIntyre and his corps of twenty assistants 1,500 men have been employed night and day for several months past equipping sixty miles of track with trolley wires, rails and subways, and work has progressed simultaneously upon the central power house on Delaware avenue above Green street. Plans have also been prepared for car houses at Mount Airy, Twenty-seventh and Girard avenue, Twenty-fifth and Fairmount avenue and a handsome two-story building covering the entire block at Eighth and Dauphin streets, in which cars will be stored, both upstairs and down, being carried to the second story by means of elevators run by electricity. This building will not only be roomy and substantial, but more ornate than any ever erected for a similar purpose.

NEW PUBLICATIONS.

THE TELEPHONE PATENT SITUATION.—A series of articles reprinted from the *Electrical Engineer*, New York; pamphlet, 52 pages; price 25 cents.

This series of articles appeared in five issues of the *Electrical Engineer* in January and February of this year. The writer's name is not given, but the articles have evidently been written by one who thoroughly understands the subject, and who has carefully followed the litigation over telephone patents during the last decade.

ENGLISH METHODS OF STREET RAILWAY TRACK CONSTRUCTION.—By James More and Alexander McCallum; reprinted from the *Street Railway Journal*, New York, 1894; pamphlet, 26 pages; price 35 cents.

This pamphlet will be of interest to American engineers who are engaged in this special line of work. Track construction in England has received considerable attention, and this opportunity of comparing English with American practice will prove of value.

USES OF COMPRESSED AIR.—By Addison C. Rand, New York, 1894; 138 pages, with 94 illustrations; price $1.

This little volume is issued to present a comprehensive account of the important uses which have been found for compressed air within a very short period, and the utility of air as a motive power. The author has endeavored to describe the principal uses of air in a common sense way, and has explained, though less at length, many possible uses. One of the chapters treats of the use of compressed air for the operation of street car brakes, and for propelling the street car itself. Mr. Rand, the author, is a recognized author ty on the subject of compressed air and as one of the principal constructors in this country of air compressors, he is abundantly qualified to discuss the subject.

ENGINEERING EDUCATION, being the proceedings of Section E of the World's Engineering Congress, held in Chicago, July 31 to August 5, 1893. Published by the Society for the Promotion of Engineering Education, as Volume I of its proceedings; 342 pages; price $2.50.

This volume contains a number of exceedingly valuable and interesting papers by well-known engineering educators, among whom may be mentioned Professors Carpenter, Johnson, Burr, Jacobus, Marx, Merriman, Thurston and others. While most of the subjects treated are purely educational in their score, they cannot fail to be of interest to all intelligent and progressive engineers.

Dynamo and Motor Building for Amateurs, with working drawings. By Lieut. C. D. Parkhurst, U. S. A., New York; The W. J. Johnston Co., Ltd., 163 pages, 71 illustrations. Price $1.

In this book clear and concise instructions, accompanied by working drawings, are given for the construction of such forms and types of motors and dynamos as are simply made and yet will produce fairly efficient results. While primarily intended for the amateur, the detailed information, particularly in the chapters on armature windings, connections and currents and on the design of a 50-light dynamo, will be of value to every electrician.

Full descriptions and working drawings are given for the following machines: A small bipolar shuttle armature motor of simple construction, capable of driving a small ventilating fan with current from a primary battery; a small motor for driving a sewing machine, for which no castings or patterns are needed; a sewing machine motor of more finished appearance and of greater efficiency than the above, being of a regular factory made type; a dynamo of modern type, capable of lighting fifty 16 c. p. lamps of 125 volts. A chapter on armature windings, connections, and currents gives minute instructions, illustrated by drawings, in regard to these subjects, and based upon the latest and best practice. The chapter on the 50 h. p. dynamo will be found instructive aside from the construction of the dynamo, as all of the technical points involved in the design are very fully treated, such as the proportioning of the armature and the armature wire, the calculation of the magnetic circuit, etc. In an appendix data of some high-class dynamos and motors are given that will be of assistance as guides should the amateur wish to design any other types than those treated in the books.

STREET RAILWAY AFFAIRS IN ENGLAND.

(From Our Special Correspondent.)

The Legal See Saw.—Quite the most important event that has transpired in the English street railway world during the past month or two has been the decision of the Court of Appeal on the "municipalization of tramways," as the question is sometimes expressed. The tramway companies are, however, making up a joint purse to carry on the matter to the House of Lords—the last court before which they may bring arguments to bear; but it is considered doubtful whether the final decision in such a case will be any more favorable. Not being a matter of much public interest, there is no quotation of odds on the result; private opinions—whether backed up or not—seem in favor of the final result being to exclude the idea of local authorities paying so many years' rental for profits, etc., when taking over any system of tramways already in operation.

The Cable Scores One.—Electric traction is not the only great improvement which England has more or less yet to enjoy; there are plenty of instances where a good cable road ought to be equipped with private profit and public benefit. They are discussing the matter to some extent at Newcastle-on-Tyne, where hills are heavy and traffic great, while the streets are not of the widest. The tendency is in favor of cable working, and in that respect the "canny" and hardheaded Newcastle men have got hold of the right idea, for it is a typical town for cable roads. At Leeds there is not the same chance for its success, and electric working, as already started by the Thomson-Houston Company, would prove much more profitable.

Eight Hour Day.—It is doubtless a serious libel on the British workman, but he has been said to embody his idea of an earthly paradise in the following expression: "Eight hours' work; eight hours' play; eight hours' sleep and eight shillings a day." A couple of dollars doesn't seem very outrageous pay for a skilled workman; the division of time between play and sleep is a matter entirely for his own taste to decide upon; but the "eight hours' work" is not as yet a definite arrangement well recognized among employers. The Leeds Corporation has, however, decided to adopt this system on all the street railway lines recently taken over by it from the Tramway Company. This will necessitate taking on another score or two of drivers and conductors, with a corresponding rise in the wages bill.

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

Judging from the amount of busines at present being done in Boston in electric railway supplies, there must be quite a little construction under way throughout New England. A few months ago work ceased at various points, but a better, more hopeful and more confident feeling again prevails and the work of railroad extension is being renewed at a rate and to an extent that is quite gratifying to the supply houses and indeed to all parties concerned. Before next winter many miles of new track will be laid.

It is doubtful if there is another place in the country where it is possible for a passenger to board an electric street car and take a ride of no less than 37 miles, covering an entire county. Yet this is a trip that is frequently taken through the county of Essex, Massachusetts, and the passenger enjoys some of the most beautiful scenery in New England. Starting from old Salem, visits may now be made to several popular seaside resorts which are reached by way of lonely country roads and through wood and meadow.

A bill is now before the Massachusetts State Legislature providing that street railway companies heat their cars in winter. It stands a good chance of becoming law. If it does, the estimated first cost to the West End Railroad Company of Boston will be $125,000.

There is little or nothing to report about the Meigs system as the solution of the rapid transit problem in Boston. The promoters keep busy, so do the opponents. It seems, however, as if the promoters had full faith in the system, for they have shown a willingness to omit from their demands for a charter about everything that any reasonable person could object to, and this fact is telling in their favor unmistakably.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

A Broadening Demand.—The market for street railway securities is just at the present moment devoid of any particular defining characteristic. The eagerness on the part of brokers to acquire the one or two issues that have recently been the subject of particular comment has about disappeared, but the doing away with a market confined to a few stocks has had its counter effect in bringing about a broadening demand that is evidenced by the steadiness of quotations.

Street Railway Mortgages.—Brokers unanimously report that the investing public is devoting more attention just now to the mortgages of the different roads than to the shares whatever dividends they may be paying. The present time is one of exaggerated unrest and disquiet and the disposition is to acquire securities on which some sure return is allowed than those where the profits of investment are subject to business conditions, and therefore variable. All the Broadway mortgages, the Third Avenue 5s, bonds of locally-owned out-of-town roads like the Rochester, Buffalo and Columbus street railway companies, all find a ready market and good prices are easily obtainable for such securities of this class where a good show of security is assured the investment. One of the largest bond dealers in New York notes an especially good foreign inquiry for street railway issues. He gives it as his opinion that at no distant date investors abroad will come into our markets and actively bid for blocks of these bonds with the merits of which, as yet, they are not thoroughly familiar. For that matter local investors have not been made fully acquainted with the big earning capacities and value of street railway securities, but the market is increasing in the number of securities available and transactions consequently are becoming more and more frequent.

A Question of Earnings.—There has been a disposition to bear street railway issues of bonds and stocks on the assumption that the continuation of the depressed business conditions must have an effect on street railway earnings, but any such loss of traffic is disclaimed by people in a position to know whereof they speak. Colonel Thomas Cunningham, president of the Massachusetts Street Railway Association, which is in close communication with similar associations all over the country, is quoted as saying: "Most of the street railway officials tell me that gross earnings for the fiscal year beginning last October are ahead of last year and that the street railways are doing well except in the large manufacturing towns." An instance of this is furnished in Syracuse, N. Y., where the losses in revenue have caused a default on the bond issue of the local traction company. But street railway reports for the most part bear out Mr. Cunningham's words by showing increases when comparisons are made with earnings for the same period of last year.

In the Local Market for Stocks.—Third Avenue still leads in the demand. The price has advanced a couple of more points to 186 on reports that daily earnings are showing bigger earnings than ever. Second Avenue shares are somewhat neglected, a failure of further development in the plan to sell out to the Metropolitan Traction Company causing a slackening in interest in the road's doings. Union Railway stock (the "Huckleberry" road) despite the inroad made on its earnings by the inauguration of the one-fare on the suburban and city elevated roads, shows a tendency to advance on the bright future ahead of the company. It is extending its trolley lines in all directions in the annexed district, and will soon inaugurate competition on a cheaper basis with the local train service of steam railroads like the New York, New Haven and Hartford and New York and Northern companies. For instance, it will soon run trolley cars to New Rochelle, 17 miles out, for a 10-cent fare either way, where the New Haven road now charges a 25-cent round trip fare. Sixth and Ninth avenue shares are quiet, but quotations do not decline.

Rivalry Between Third Avenue and Metropolitan.—Just at present the most interesting feature of the local situation is the rivalry between the Metropolitan Traction and the Third Avenue companies to secure the franchise for a cable road on St. Nicholas and Manhattan avenues from 125th street up. The Metropolitan Traction Company is now the biggest surface car line combine in New York City. It now operates 170 miles of single track and 20 miles more are being built, while other extensions are projected. All of the lines now operated by horses and proposed extensions will be operated by means of the underground trolley as soon as it has been demonstrated that the new system is all that is claimed for it. The recent consolidation of three of the local lines results in a most effecient concentration of operation that will be of great value in arranging for transfers as a bid for popular favor. The Metropolitan Traction has proved by the ease with which it has gained all hitherto desired extensions and privileges that it exercises a tremendous pull with Tammany Hall, but this time the Third Avenue is likely to win the day, as it was first in the field with its request and also possesses close affiliations with the powers that be.

Long Island Traction has recovered somewhat from the depression of the previous week. Mr. P. H. Flynn has, as intimated in this correspondence, brought his suit to break the lease of the Brooklyn City Road to the Long Island Traction Company, but the steadiness of Brooklyn City Railroad stock denotes that no fear is felt as to the outcome of Mr. Flynn's suit. It is hinted in some quarters that the suit will never be brought to trial, that it was brought with the consent of certain insiders to frighten small holders of Long Island stock into selling and thus lead to the acquiring of a lot of cheap stock, and that the whole thing is a stock jobbing scheme. Long Island would sell a deal higher were its quotations removed from the suspicion attached to the actions of certain speculative members of the management.

Financial Notes.

Reorganization in Leavenworth.—The Leavenworth electric railway, which has been under the control of a receiver, was sold on June 2. The purchasers were H. N. Smith, M. Summerfield and J. P. Edmington, trustees. The price paid was $80,000, the purchasers assuming the debts of thé receiver which aggregate about $50,000. The value of the road, which has been recently reconstructed and newly equipped, is estimated at $300,000. It is thirteen miles long, runs through the city between the Soldiers' Home and Fort Leavenworth, and on one of the principal streets of the city. Immediately after the sale the purchasers met and organized a new company, with Newman Erb, New York, president; Herbert Smith, Boston, vice-president; J. P. Edmington, Denver, secretary and treasurer. Louis M. Erb, who superintended the reconstruction of the road, was elected manager. Newman Erb has been the receiver of the road.

Earnings of the West Chicago Line.—Director Lawson says: "The earnings of the West Chicago Street Railroad Company are running along about as they did in 1892. This talk of the effect of elevated railroad competition is greatly exaggerated. Suppose the Metropolitan does carry 50,000 persons a day. The city is growing, and by the time the Metropolitan gets into operation the increase in population on the West Side will make up for any inroads on traffic by the elevated roads The history of competition of this kind everywhere has been that surface roads were able to take care of themselves. The short haul traffic has grown to such an extent that such securities have been more valuable than ever in a short time, and the earnings actually increased after the competition had once been digested."

West End Land Company's Railway Stock.—The trustees of the West End Land Company, Boston, will distribute July 10 the 62,500 of West End street railway common stock now in the treasury. The holders of four shares of the land company can subscribe for one share of the railway company at $10 per share. Books close June 26 to July 10, both inclusive. Rights to subscribe go to the stockholders of record June 26, and subscriptions must be made or before July 10, at 2 P. M. The West End Land Company intended to make this distribution January 1, but it was postponed, owing to the financial situation at that time.

Baltimore Traction.—The Baltimore Traction Company has placed on record at Baltimore two mortgages for $350,000 each, one on the Pimlico and Pikesville road, the other on the Curtis Bay Electric road; they represent $700,000 in bonds, to be placed in the coffers of the company, not be marketed now. This is done on account of the fact that the company has been making extensive improvements on both roads, and expending large amounts of money thereon, which it is desirable should be represented as assets in its treasury.

Street Railway & Illuminating Properties.—The trustees of the Street Railway & Illuminating Properties purchased this week, in accordance with the trust deed, 513 shares of the preferred stock at an average price of $97.41, as against an average price of $96.09 for 624 shares May 20, $96.33 for 667 shares April 27, and $97.54 for 2,054 shares April 2. This makes a total of 10,468 shares of preferred stock purchased to date.

Receivers of the Atlanta Traction.—Judge E. B. Rosser and Mr. W. C. Hale were appointed receivers of the Atlanta Traction Company last week by Judge Newman in the United States court. The Traction Company's system is one of the longest in the south. It runs through the center of the city and has branch lines to McPherson Barracks, Grant Park, East Lake and Decatur.

Denver City Cable Railway.—The holders of more than a majority of the first mortgage bonds of this company have signed the agreement dated March 1, 1894, for the reorganization of the company. Copies of the same may be obtained from any of the committee, and the bonds should be deposited with the Central Trust Company of New York.

A Chicagoan's Opinion.—R. C. Crawford, ex-secretary of the West Chicago Cable Company, who has just returned from New York, says: "Sell Manhattan for a great big break and buy Metropolitan Traction stock. The Broadway cable line will cut the life out of the elevated road."

Battle Creek Railway Sold.—The Battle Creek Electric Street Railway Company of Battle Creek, Mich., was purchased at foreclosure sale by the bondholders for $110,000. The work of putting the line into good operating condition will be begun at once.

Pennsylvania Steel Company.—The creditors of the Maryland and Pennsylvania Steel companies have practically decided upon a plan to submit to the stockholders by which it is expected an adjustment of the affairs of the two companies will be effected.

Dividend.—The Chicago City Railway Company has declared the regular quarterly dividend of 3 per cent.

New Incorporations

Council Bluffs, Ia.—The Council Bluffs & Lake Manawa Electric Railway has been incorporated. The capital stock is $50,000 and the incorporators are: Jeff. W. Bedford, L. H. Kent, J. P Finley, H. B. Coryell, D. D. Gregory, E S. Rood, Isador Gluck, C. A. Starr and C. W. Reed. All but the two last named will constitute the first board of directors. The company will build and operate an electric railway from a point on South Sixth street, in the vicinity of the Rock Island depot, to the town of Manawa.

Port Huron, Mich.—The Port Huron & Lexington Railway Company has been incorporated with a capital stock of $200,000 to build a road between the two places mentioned in the corporate name. The incorporators are Edgar H. Brennan and T. W. Bainbridge of Toledo, Ohio, and William C. Maybury, George Schaffer, William Nichols, C. W. Harrah and Eldwood T. Hance of Detroit.

Toledo, Ohio.—The Toledo, Presque Isle & Nilosean Beach Suburban Railway Company has been organized by Frank B. Losee, Capt. David Stroud, Henry T. Niles, Adam Burger and Horace Potter. The road will be ten miles in length and will extend from Toledo to Nilosean Beach.

Chicago, Ill.—The Economic Electric Engine Company has been incorporated, capital stock $100,000, to manufacture and sell electric motors, engines, etc.; incorporators, Charles A. Jackson, Uriah Copp and Robert Doyle.

Carbondale, Pa.—The Lackawanna Valley Rapid Transit Company has been organized. Among those interested in the enterprise are John W. Aitken, George Conagan, H. B. Jadwin, Edwin Corey and J. M. Nicol.

NEWS OF THE WEEK.

Chillicothe, O.—Judge Clifford has handed down a decision in the street railway case which is said to have been the most intricate and involved case ever tried at the Ross County bar. The case arose out of the sale of the old street railroad to George F. Woolston, a New York promoter, who was to change the route to an electric road and then transfer it to a new company, which was organized to take it as soon as it was completed. Woolston never completed his contract, his creditors rushing in and taking out liens and attachments on the road. Judge Warren P. Noble and others, of Tiffin, O., originally owned the road, and sold it to Woolston for $45,000. The General Electric Company assisted in making the change to the value of $80,000. Local contractors invested about $15,000 in it; and various foreign firms aided until the total indebtedness amounted to something like $128,000. These creditors all fought each other, and, under different methods of legal procedure, until the case was very much mixed up. Judge Douglass, in deciding the case, held that the Massachusetts Loan and Trust Company, of Boston, held valid mortgage on the road; this mortgage secured Noble, the General Electric Company and the Harrisburg Foundry & Machine Works, whose claims aggregate $80,000. Several local claims were allowed on companies' liens, but the major portion of the liens were disallowed, or rather placed in abeyance, for the large claims will leave nothing for those left in the rear. The case will be appealed.

New York, N. Y.—The Broadway & Seventh Avenue Railroad Company has applied to the Railroad Commissioners for permission to build two additional branches of cable road, further extending the traction syndicate's lines. The first section of the new road is to be run from Twenty-third street and Broadway, where the Broadway road passes, to Lexington avenue, a distance of a full block and a half. The second section is to run on Lexington avenue from the intersection of Twenty-third street to Thirty-sixth street. By this means, if the application is granted, the Broadway road will receive either at Thirty-sixth or at Twenty-third street a patronage from the east side, now controlled by the Third avenue line. When the various collateral cable lines are completed, it will be possible for a person landing at the Grand Central Station to reach the lower part of the city with one transfer, and for only one fare. The extension of the cable system is gradually consolidating the various surface car lines throughout town, and adding to the facilities of transit. Through the 135th street trolley line passengers on the west side elevated can reach any part of the annexed district for one fare, with but a single transfer. The two elevated systems, the Second and Third avenues on the east side and Sixth and Ninth avenues on the west side, are absolutely distinct, and they connect only at the Battery. The Broadway cable line managers hope to secure east side as well as west side patronage for their central line, and to that end are establishing the present system of transfers to tap the business of both sides.

Metropolitan L Road, Chicago.—Word has come on from the financial fountain-head of the Metropolitan Elevated in the East to push the completion of that line with the utmost possible vigor, and at no time since the organization of the company has there been such activity on the part of its local representatives. Every effort is being made for the completion of the road by September 1. The work that is to be done is mainly in connection with the bridge and the down-town terminal and providing the electric equipment. The bridge contract calls for the completion of the structure by August 15. One pier has been already nearly completed and the work has been done in such a remarkably short time that it no longer looks unreasonable to suppose that the work will be completed according to the terms of the contract. It is said that the manfacturers of electric equipment have so few orders ahead that they are prepared to do some rapid work in executing orders for equipment of this road, and it now looks as if West-Siders will be whirled down town at the rate of forty miles an hour by early fall. The first stock of the company to be issued will come out next week, and there is a good deal of curiosity what the market will be for it. The stock will not be listed on the Chicago Exchange, the management of the company believing that that will not be to its advantage. It is said that bids of 25 are now made for the stock, but there is really no quotable market yet.—*Chicago Tribune.*

Norristown, Pa.—The litigation between the Jenkintown Electric Railway Company and the Philadelphia, Cheltenham and Jenkintown Electric Railway Company, a contest as to the occupancy of a switch of the Cheltenham and Willow Grove turnpike, commonly known as the Old York road, has terminated by amicable arrangements among the parties, the first named company accepting $10,000 for its franchises so far as the portion of the turnpike in dispute is concerned. The Jenkintown company applied for a jury to assess damages and a jury was appointed and held two meetings. The company had a franchise from the Jenkintown Borough Council, under which it proposed to occupy that part of the turnpike in the borough. But the Philadelphia, Cheltenham and Jenkintown Company acquired sufficient stook in the turnpike company to control it, and matters were very much complicated until settled by agreement. The latter company is to pay to the borough for the franchise $50 this year and $25 additional annually until the sum reaches $175, which is to be the annual payment until 1920, when it is to be increased to $225.

Chicago, Ill.—The date for opening the Metropolitan Elevated road has been fixed for September 1 and bids have been asked for the construction of operating machinery on that basis. The circulars addressed to makers of electrical plants call for bids on generators with a capacity of 5,000 horse power. Three different plans for the installation have been prepared and as many sites are under consideration for the location of the machinery. W. E. Baker, formerly general manager of the intramural railway at Jackson Park, will superintend the installation of the motive power. Under the schedule contemplated through express trains will run at the rate of nearly forty miles an hour, making the run from Paulina street to the down-town terminal station in five minutes. The difference in time between express and way trains is illustrated by the fact that way trains will take ten minutes from Paulina street to the down-town station. Trains will be operated first on the main line from down town west to the park and the equipment of the northwestern branch will follow as rapidly as possible.

Kansas City, Mo.—By recent action of the board of directors of the Metropolitan cable system the Vine street Electric and the Elevated railroads have been formally put under one management. At a meeting of the board held in the general offices last week, S. B. Armour, George H. Nettleton, C. F. Morse, Wallace Pratt and Watson J. Ferry were elected directors of the Vine street line. C. F Morse, Wallace Pratt, George H Nettleton, S. B. Armour, W. J. Ferry, C. W. Blair, Robert Gillham, L. E. James and D. D. Hoag of Kansas City and Mr. Martin of Chicago were elected directors of the Elevated company. Although these two lines are now part of the Metropolitan system, legally there has been no consolidation. According to its custom, this road instead of consolidating has simply bought the stock of these companies. The corporate name of each will be retained, but the Metropolitan will control. It is understood that Robert Gillham will soon retire from the management of the L.

Cleveland, O.—A meeting of the stockholders of the Cuyahoga Suburban Railway Company was held at the office of Charles C. Thompson last week. Capt. John Mitchell, H. C. Brent, Charles C. Thompson, Leland Ingersoll and A. Burt Thompson were elected directors. Capt. John Mitchell was elected president and Charles C. Thompson secretary and treasurer. A 'bus line will be run by the new company until the railway is in operation. Contracts for building the road will be let during the next week and work on the road will be commenced as soon as possible. I. C. Brewer, of Memphis, Tenn., will have charge of the construction.

St. Louis, Mo.—An interesting suit has been brought against the Lindell Railway Company. The question involved is whether a person to whom a transfer slip has been issued must present it at the transfer point. The complainant, Nicholas Gates, sues for $300 damages. He says that in September, 1892, he was a passenger on one of the Lindell Railway Company's cars and took a transfer ticket to take him beyond Taylor and Finney avenues. No car being in sight, he walked some distance until a car overtook him, when he got on board. The conductor refused to take the transfer ticket because Gates had not boarded the car at the exact junction, and demanded another fare, which Gates refused to pay, and he was put off the car.

Chicago, Ill.—The Lake Street Elevated Railroad Company began the construction of its downtown loop last Thursday night. It will occupy the alleys between Lake, Randolph and South Water streets, and the alley running north between Wabash and Michigan avenues. The loop lies in the path of the proposed Northwestern Elevated Road and it is predicted that a fight between the two corporations will follow.

Johnson-Lundell System in New York.—It is said that negotiations are now under way, which, if successful, will result in equipping Twenty-third street, New York City, from river to river with the Johnson-Lundell underground electric railway system. This system was illustrated and described in the STREET RAILWAY GAZETTE of May 12, 1894.

Kalamazoo, Mich—At the annual meeting of the Citizens' Street Railway Company the following officers were elected: Theo. P. Bailey, president, Chicago; Geo. J. Kobusch, vice-president, St. Louis, Mo.; Jas. W. Johnson, treasurer, Chicago; E. E. Downs, general manager, Kalamazoo. Mr. Downs succeeds G. K. Wheeler, as general manager.

Cape May, N. J.—The injunction against the work on the Cape May Point branch of the trolley road has been dissolved, and a large force of men is now engaged in repairing the road, which was damaged by the storm of April last, and the connection will be completed in a few days.

Oakland, Cal.—The suit of the Pacific Cable Company against the Piedmont Cable Company to recover for the use of certain cable auxiliaries alleged to infringe on complainant's patents, has been decided in favor of the defendant

Milwaukee, Wis.—The employes of the Milwaukee Street Railway Company are taking steps to petition the legislature to pass a law compelling street railway companies to vestibule their cars during the winter months.

Chicago, Ill.—The Northwestern Elevated Railway Company has filed its first batch of condemnation suits. These actions cover property on the proposed line of the road from Congress street north.

Laconia, N. H.—The Laconia Car Works were destroyed by fire June 30. The loss was $75,000 and the insurance was $49,500. The plant will be rebuilt at once.

Mobile, Ala.—The old car stables of the City Railroad Company were destroyed by fire June 1. There were forty old cars stored in the building.

Philadelphia, Pa.—The Philadelphia Traction Company's line to Darby was opened last week.

PERSONAL.

R. C. Brown, electrical engineer of the West End Street Railroad, Boston, has accepted a similar position with the Montreal Street Railway Company.

E. J. Wessels, of New York, representing the Genett Air Brake Company, was in Chicago yesterday.

J. H. Gormley, superintendent of the Scranton Traction Company, has resigned his position.

W. Worth Bean, of St. Joseph, Mich., was in Chicago last Thursday.

C. C. Smith, of Milwaukee, was in Chicago this week.

TRADE NOTES.

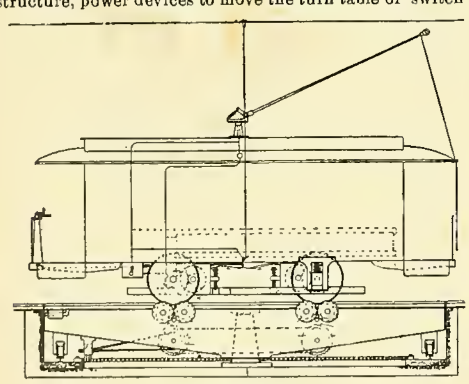
A Prosperous Business.—A little more than a year ago, Mr. J. H. Vail organized the Electrical & Mechanical Engineering & Trading Company. The company has in hand a variety of business, among which may be mentioned the following: Contract for car house, cars, motors, trucks and generators for Hoosick Railway Company, Hoosick Falls, N. Y.; contract for an electric light station and complete equipment at Rumsen Neck, N. J., for the Rumsen Improvement Company; contract for electric lighting in new addition to Buckingham Hotel, New York City; contract for underground conduit system, telephone and electrical conductors for J. C. Hoagland and Raymond Hoagland, Rumsen Neck, N. J.; consulting engineers for Trinidad Electric Light & Power Company, Port of Spain, Trinidad; contract for electric lighting system, underground conduits, pole line, etc., for Edward Kemp, Esq., Rumsen Neck, N. J.; supervising and consulting engineers for Poughkeepsie City and Wappingers Falls Electric Railway Company. This railway system will involve a 600 H. P. steam plant, compound condensing engines and direct driven generators; there will be some fine long distance work as one section of the road extends ten miles to the towns of Wappingers Falls and New Hamburg, operating cars in and between both towns. The plant will incorporate the use of Stirling boilers, compound condensing Ball & Wood engines, direct driven General Electric generators and G. E. 800 motors. Mr. Vail gives all the business of his company his personal attention, and aims to turn out none but the best of engineering and construction. The company has pleasant and commodious offices at 39 Cortlandt street, New York, and here may be found some of the most expert and experienced engineers engaged in the business.

RECORD OF STREET RAILWAY PATENTS.

Patents Issued May 29, 1894.

520,527. Electric Railway Turn Table. Rudolph M. Hunter, Philadelphia, Pa. Filed February 2, 1893.

The combination of a turn table or movable switching structure, power devices to move the turn table or switching structure about its pivot connection, an electric car adapted to be supported and moved by the turn table or switching structure and provided with an electric motor to propel it, power transmitting connections between the electric motor and power devices to move the turn table or switching structure whereby the electric motor may be employed to operate the turn table or switching structure, supporting wheels carried by the turn table or switching structure upon which the wheels of the car rest during the operation of the said turn table or switching structure, and means to raise and lower the said wheels for the purpose of supporting the car wheels independently of the rails. (See illustration).



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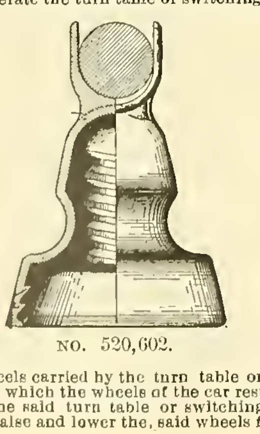


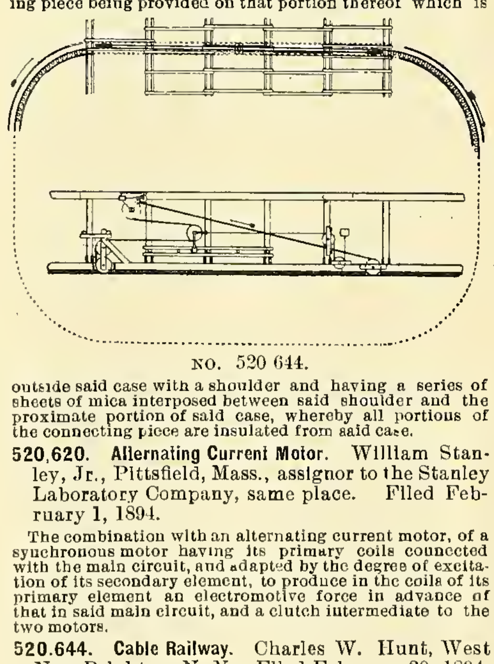
NO. 520,602.

520,602. Insulator. Henry H. Luscomb, Hartford, Conn. Filed March 19, 1894.

An insulator comprising a metallic case, and insulating material within said case, and said case having an inturned lip at the lower edge thereof in contact with and forming a protection for the lower edge of the insulating material. (See illustration).

520,606. Insulator. Louis McCarthy, Boston, Mass. Filed September 23, 1892.

An insulator comprising a case, a connecting piece within said case and insulating material to insulate it therefrom, a cap for said case, secured in place therein by bending the edges of the case over said cap, said connecting piece being provided on that portion thereof which is outside said case with a shoulder and having a series of sheets of mica interposed between said shoulder and the proximate portion of said case, whereby all portions of the connecting piece are insulated from said case.



NO. 520 644.

520,620. Alternating Current Motor. William Stanley, Jr., Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed February 1, 1894.

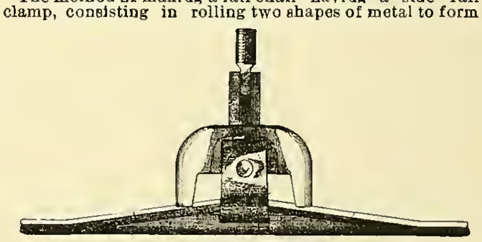
The combination with an alternating current motor, of a synchronous motor having its primary coils connected with the main circuit, and adapted by the degree of excitation of its secondary element, to produce in the coils of its primary element an electromotive force in advance of that in said main circuit, and a clutch intermediate to the two motors.

520,644. Cable Railway. Charles W. Hunt, West New Brighton, N. Y. Filed February 20, 1894.

The combination with the cable, the track for the cars and the driving mechanism for the cable, of sheaves or wheels around which the cable passes and which are located so that portions of the cable are parallel to each other along a straight or nearly straight portion of the track from the respective ends of which straight portion of the track, the cable descends and is acted upon by the driving drum whereby the cars can be disconnected from the cable at any part of the straight portion of the track, and then reconnected to the adjacent parallel portion of such cable to be carried around the circuit of the track. (See illustration).

520,654. Method of Making Chairs for Railroad Rails. Arthur J. Moxham, Johnstown, Pa. Filed December 5, 1890.

The method of making a rail chair having a side rail clamp, consisting in rolling two shapes of metal to form the two sides of the chair and welding the two parts together to form a rail seat.



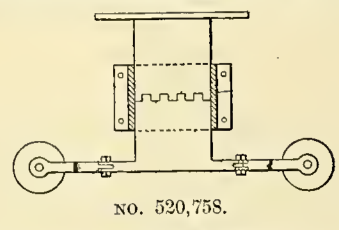
NO. 520,737.

520,737. Trolley Wire Support. Budd J. Jones, Sioux City, Iowa. Filed February 5, 1894.

In a trolley wire support a supporting piece of an approximately triangular form, adapted to fit a bend in the trolley wire, with its outer surface on a plane with the surface of the trolley wire, in combination with a bridge piece, stirrup strap, a straining bolt having lateral projections for engaging eyes formed in the free ends of the stirrup strap, and a clamping nut. (See illustration.)

520,739. Railroad Car Fender. James W. Madden, Brooklyn, N. Y. Filed February 3, 1894.

The combination with a car of one or more wings arranged to turn horizontally at the end or ends adapted to sweep aside any person or other object which may be struck, and one or more actuating springs having a force previously accumulated ready to effect such motion when required.



NO. 520,758.

520,758. Conduit Railway Trolley. William Lawrence, New York, N. Y. Filed August 17, 1892.

A contact plate formed in parts fitted one against the other, insulating material around said parts, a casing binding said parts together, and arms pivoted to one of said parts, said arms having contact wheels journaled therein (See illustration.)

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CHANGE OF PUBLICATION OFFICE.

This number of the STREET RAILWAY GAZETTE is issued from our new publicatian office at 1208 Havemeyer Building, New York City. This will hereafter be the principal business and publication office, and all communications intended for either the manager or editor should be sent to this address, although communications addressed to our Chicago office, which will be maintained as heretofore at 1432 Monadnock Block, will receive prompt attention. With increased facilities for obtaining the latest information regarding street railway affairs, the STREET RAILWAY GAZETTE will continue to furnish its readers with prompt and reliable news touching all branches of the street railway business in all parts of the country.

Metropolitan Traction Prize. The New York State Railroad Commission apparently does not regard more favorably the withdrawal of the prize offer by the Metropolitan Traction Company than do the inventors who competed for the $50,000 to be given to the discoverer of a satisfactory means of operating street cars in which overhead wires were not to be used. The Commissioners first refused to be judges, as the company which offered the prize had requested, on the ground that the law did not warrant them in acting in such a capacity. The legislature, after a long delay, granted them the authority to act as judges of award; but now that the prize has been withdrawn, they are left with plans and models from every State in the Union, and from many foreign countries, one coming from Persia and another from Cuba; but with no award to make. The Commissioners feel decidedly uncomfortable; and it is not surprising that, under these circumstances, they do not fancy the job of notifying all the confident inventors that there is no prize to be awarded after all. Inventors are an unlucky set proverbially, and in this case they have been even more than ordinarily unfortunate.

Conduit Electric Roads. On the following page will be found an interesting extract from the last annual report of the street railway company of Budapest that operates the electric conduit road of the Siemens-Halske type about which we have heard so much in the last few months. This report is of especial interest at this time, when one of the surface railway companies of New York City is reported as having recently decided to install a three-mile section of this system of conduit road on one of its crostown lines. The terms proposed by the railway company were not, however, satisfactory to the manufacturing company, and the plan of testing this system was abandoned in favor of one offered by an American company that was willing to agree to the railway company's terms. New York City is not by any means an ideal city in which to operate an underground system of any of the existing types, but the effort will undoubtedly result in the production of a thoroughly reliable and efficient system. Mr. Crimmins announces this week his intention to try such a system on one of the new lines in the upper part of the city for which his company has asked a franchise.

Instruct the Employes. Mr. Perry in his article this week takes up the management of street railway motors and points out a few of the causes of the troubles usually met with in their daily operation. This is a subject of the greatest importance, and Mr. Perry's exceedingly practical ideas will be found of great value if the trouble is taken to bring them to the attention of the men whose duty it is to care for the motor equipment. Mr. Perry's reference to the almost utter impossibility of a motorman following out the plan of wiring of his car suggests that it would be a good plan to have a "life size" drawing showing the arrangement of the motor connections placed in the car house or other convenient place, so that employes could spend as much time as they pleased discussing it and making themselves familiar with it. Such a knowledge of the car equipment could not fail to add to the value of an employe's services, and there is little doubt that the opportunity would be made use of by all intelligent motormen and those employed about the shop making repairs and doing similar work. Manufacturers are altogether too exclusive in conveying to the men who are to care for their motors the information needed for a clear and distinct understanding of their working parts and their method of operation.

Chicago Electric Elevated Road. The official announcement was made a few weeks ago that the Metropolitan Elevated Road, of Chicago, was to be operated by electricity. The executive committee which had this matter under consideration arrived at this decision only after an extended period of investigation, and it reached its conclusion in favor of electricity because the data which had been gathered indicated that the operating cost would be less with motors than with steam locomotives. The committee had every reason to be impressed with the necessity of making operating expenses as low as possible, for the two elevated railways in Chicago have as yet barely paid the cost of keeping them in operation, to say nothing of the interest on the bonds. The committee, therefore, was not so much interested in the initial cost as in the probable amount of the coal bill. When it was convinced that a very material saving could be effected by using cheap fuel in a power house instead of anthracite under locomotive boilers, few other arguments were necessary to determine the members in favor of electricity. The operation of the Intramural road at the Fair convinced them that electricity was a reliable agent and that it could be depended on to embrace the conditions encountered in elevated railroad practice. The company hopes to have the road in operation by Sept. 1, but it seems hardly likely that the work can be completed by that time. During the last week or two bids have been received from manufacturers for the electrical equipment. It is reported that four American companies and one English concern have submitted propositions. It is hard to see how the foreign firm can hope to compete with American manufacturers, for the latter have reduced their prices until the profit is almost all wiped out, and at the same time they are protected by a 40 per cent. duty. The contract will be awarded within a few days, and active work will then be begun on the plant. The installation will be the first permanent elevated electric road, and the progress of the work, and the solution of the various problems that will be encountered, will be watched with the utmost interest.

Electric Postal Cars. The announcement is made this week that the postmaster of Brooklyn has made a contract with the Atlantic Avenue Railroad Company, by which the electric cars are to be utilized for the transportation of mails. The arrangement appears to be only a beginning in the establishment of what might be made a most efficient system for the collection and distribution of mails. As we said last week, there is no reason why the excellent facilities of many of the more important street railway systems, established primarily for the transportation of passengers, should not be utilized for the transfer of the United States mails. No other method exists that can compare with the electric car in furnishing precisely the class of service demanded for extending the efficiency of the post-office department of the government in large and widely scattered cities. In cities like Brooklyn, where electric cars run in every direction, there ought to be no hesitation in utilizing the rapid transit facilities of these lines for the transportation of mails. It is a matter of surprise that the Broadway and Third avenue cable cars in New York City have not been made use of for this purpose. Both New York and Brooklyn have much to learn in this respect from such cities as St. Louis, where electric mail cars, used exclusively for this purpose, have been in regular service for some years, carrying packages of mail to the postmen in the suburbs, who thus lose no time in traveling to and from the central post-office, and bringing back on the return trip the outgoing mails that have been deposited in the accumulation boxes along the route by the carriers who collect from the regular mail boxes placed about the streets in the suburban districts. It is said that the Atlantic Avenue Railroad Company is also considering the proposition to put mail boxes in all of its cars for the use of passengers. This would certainly be a great convenience to the patrons of the road, but it is more than likely that it would lead to considerable annoyance from persons who were not passengers, but who would stop the car to deposit mail in its box. A traveling mail box, at the service of everyone, would of course be a great convenience, but if it should at the same time interfere with the rapid transportation of passengers it would not be tolerated. The attachment of a mail box to each car might make it rather difficult for striking employés to interfere with the operation of the cars, as the men would then be subject to the charge of interfering with the transportation of the United States mails. Should the Brooklyn road adopt this plan it will be interesting to watch the result.

NEW YORK CITY RAPID TRANSIT COMMISSION AND ITS PLANS.

John H. Inman has been elected to fill the vacancy on the Board of Rapid Transit Commissioners caused by the selection of Alexander E. Orr for president of the Chamber of Commerce. Mr. Inman's experience on the old commission ought to be very valuable in considering the plans proposed. In answer to the question whether the commissioners would have the rapid transit work ready to be voted on in October, Mr. Inman said a few days ago:

"If everything goes on as I hope it will there is no doubt about it. The old commission has been over all the preliminaries and obtained the necessary specifications and consents, and my plan is for the Board to meet next Tuesday and sit until Friday. If the plans of the old commission of 1891 are accepted we can get through the work by that time and simply have to wait."

ANNUAL REPORT OF THE BUDAPEST ELECTRIC RAILWAY SYSTEM.

So much consideration has been given recently to conduit electric railways that the following details regarding the operation during 1893 of the Budapest line, taken from the annual report, will be of interest. During the year the capital stock was increased from $1,446,000 to $1,928,000 by the issue of 10,000 new shares of a par value of $48.20 each. Certain lines were extended, and the motive power of the Central-Friedhof section was changed from steam to electricity, with overhead conductors. The generating plant in the central station and the rolling stock were increased to keep pace with the above extensions and the rapidly increasing business.

Comparative figures for the years 1892 and 1893 are shown in the following table :

	1892.	1893.
Car miles	1,433,540	1,593,530
Passengers carried	10,989,172	12,499,274
Receipts	$369,558	$443,090

The company has a central station building covering an area of 852.56 square metres, standing in grounds having an area of 2,230 square metres, and two car yards. One yard has an area of 9,094 square metres, of which 3,221.44 square metres are under cover; the area of the other yard is 10,660 square metres, with 1,668.17 square metres under cover.

The length of line is as follows :

1. Surface road with underground conductors : Length of street, 12,283.87 metres; total length of track, 25,459.64 metres.

2. Surface road with overhead conductors: Length of street, 5,240.12 metres ; total length of track, 10,132.49 metres.

3. Road with steam as motive power and Vignol rails : Length of street, 5,549 metres ; total length of track, 6,693.05 metres.

4. The Koebanya car yard, with Haarmann track and Vignol rails : Total length of track, 1,229.69 metres.

Altogether, the length of street is 23,072.99 metres (14.31 miles) ; length of track, 43,514.87 metres (26.98 miles).

The equipment of the central station consists of three compound condensing steam engines of 100 H. P. each, to which are connected three dynamos; four compound condensing engines of 200 H. P. each, directly connected with four dynamos: one motor for driving the ventilating fan of the cooling tower and the centrifugal pumps; one continuous current transformer, consisting of two dynamos, for lighting purposes; five Steinmueller water tube boilers of 98 square metres heating surface each; one Steinmueller water tube boiler of 212 square metres heating surface; four Worthington steam pumps, used as cold water and feed water pumps; two centrifugal pumps; two injectors: one cooling tower for thoroughly cooling the water from the condenser; one water filtering apparatus; one "washing machine," driven by electricity; one battery accumulator for lighting the central station and the car yards after the machines have shut down, and two traveling cranes in the power-house. The two car yards, where there are also repair shops, are provided with electric motors and the necessary tools, machines, accumulators, etc. In order to keep the track clean and in repair there are sweeping machines, snow plows, etc., which can be driven by horses or electric power. The rolling stock consists of 92 cars, of which 82 are motors cars, 10 being summer cars without motors. For the steam railway there are five locomotives, nine passenger cars, and three open freight cars.

The operating receipts and expenditures were as follows:

OPERATING RECEIPTS.

Passenger traffic	$443,(90
Various receipts	27.323
Total	$470,413

OPERATING EXPENSES.

General management	$29,280
Inspection and repair of track	27,3?0
Managing and commercial service	41,024
Operating and shop service	111,911
Sundry expenses	3,374
Total	$212,9:9

EXTRA EXPENSES.

Taxes, etc	$47,350
Charged off to depreciation	28,920
Stocks redeemed	8,098
Total expenditure	297,287
Balance	$173,126

The balance sheet for the year 1893 was as follows:

ASSETS.

Track system, central station and rolling stock	$1,643,622
New buildings and improvements	458,809
Bonds deposited	21,456
Extraordinary reserve:	
Real estate	96,992
Stocks	186,187
Bills receivable	207,905
Cash on hand	7,860
Material in stock	24,115
Total	$2,649,946

LIABILITIES.

Capital stock	$1,928,000
Extraordinary reserve	354,033
Traffic reserve fund	3,352
Tax reserve	1,338
Renewal reserve	53,448
Stock sinking fund	8,098
Bonds	7,690
Bills payable	105,842
Coupons not redeemed	442
Balance of 1892	14,578
Surplus of 1893	173,126
Total	$2,649,946

After making deductions from the surplus in accordance with the statutes, it was proposed to declare a dividend of 8 per cent., and to carry $12,315 forward to the new account.

It will be remembered that in the Budapest underground system the conduit is placed under one rail and consists of castings having flanges of 47 inches placed about 4 feet apart, the space between being a conduit of concrete. The oval-shaped conduit has a width of 11 inches, and a height of 13 inches. The slot consists of two beam rails having no inside lower flange; and these are fastened to the iron frames by wrought iron angle pieces. The width of the slot is $1\frac{5}{16}$ inches. The total depth of the foundation below the rail-top is $27\frac{1}{2}$ inches. The conductors, both positive and negative, are made of angle irons, secured by means of insulators fastened to the castings. They are sufficiently high above the floor of the conduit to be protected from the water which may collect. They are, furthermore, under the top of the oval, so that they cannot be touched from the outside. No earth return is used, as both leads are insulated. The water which runs into the conduits is collected at the lowest points and passes to the sewers.

The system is run with 300 volts pressure, and all the dynamos lead to common bus wires. The leads are made of lead-covered cables armored with iron bands and laid directly in the earth ; these lead to junction boxes from which others run along the road and are connected at intervals by means of short branch conduits to iron leads in the conduits. The first portion of the road—about one and a half miles—was opened July 30, 1889, and has therefore been in operation nearly five years.

PROPOSED CONSOLIDATION IN ST. LOUIS.

It is predicted that within a comparatively short time the street railroads of St. Louis will be consolidated. Efforts in this direction have been in progress for several years. The St. Louis *Globe-Democrat* states that though the gentlemen working toward the consolidation of the lines have not agreed upon the details of the plan, they were so near an agreement two years ago that were it not for the legal limit of capitalization in Missouri, which is $10,000,000, the roads would have been brought together.

The law is clear, and, acting under the best legal advice, the promoters of the St. Louis Traction Company have concentrated their attention now upon getting the statutes so amended as to bring the limit of capitalization up to $50,000,000, whereupon consolidation will immediately follow.

Already under the Illinois law, and acting by authority of an Illinois incorporation, the National Railway Company, of which D. G. Hamilton, of Chicago, is president, controls the Citizens', Cass Avenue, St. Louis, Union, Seventeenth Street and Northern Central Railways ; when the St. Louis Traction Company comes into business it will include these roads as well as the others, and will represent a capitalization of about $20,000,000, with a bonded debt of very nearly the same figure.

Mr. James Campbell, who was, from the first, one of the men most deeply interested in the consolidation, is quoted as saying: "Ever since 1882 I have been working to get the roads together, and the only obstacle now standing in the way is the letter of the statute which forbids a corporation to have more than $10,000,000 capital. This, I think, will be amended by the next Legislature, and there will be nothing in the way of the consolidation, if the companies choose to come together. A committee to appraise the values of the different companies was appointed some time since, and it has worked at the problem until a very fair solution has been found. Not alone are the capital stock, the bonded debt and the mileage elements to be considered, but the people carried, the excursion privileges and the probable future of each road. In order to bring about a solid agreement, of course the rights of each party must be carefully preserved, and full justice done. Of course there is still much difference of opinion, but it is upon minor points, and it will disappear as the advantages of consolidation become more and more apparent. The companies will save all the expense of separate management, an economy which I estimate will amount to five per cent. on $2,000,000 every year in salaries alone. The work will be better done under one central control, and each road will have the benefit of the whole effort and economy. The people will at once come into possession of a transfer system that will make any part of St. Louis accessible for five cents."

The following table shows the standing of the securities and the mileage of the St Louis roads:

Railway.	Capital Stock.	Market Value.	Bonds.	Mark't Value.	Miles of tr'k (single).
Cas. Ave	$2,500,000	80	$1,600,000	Par	30
Citizens	2,000,000	Par	2,000,000	105	21
Fourth & Arsenal	150,000	8 (50 is par.)	50,000	Par	6
Jefferson Ave	112,000	300	100,000	Par	5
Lindell Ry	2,500,000	85	3,000,000	Par	70
Missouri Ry	2,400,000	205	500,000	Par	28
People's Cable	300,000	Par	$1,000,000	80	10
St. Louis R. R	2,000,000	150	2,000,000	Par	20
St. Lo's & Suburb	2,500,000	11	2,300,000	85	18
Southern Ry	800,000 (pref.) 700,000 (com.)	80 20	500,000	Par	8
Union Depot Ry	3,000,000	125	3,000,000	105	67
Totals	$18,962,000	.....	$16,050,000	....	283

Jamaica, N. Y.—The village authorities have referred the question of granting a franchise to the Long Island Electric Railway Company to a committee for investigation, and final action will not be taken until the 28th of June.

CENTRAL POWER STATION AT NEWPORT, KY., AND ITS EQUIPMENT.

Nearly 60 miles of track are now operated under one management in the cities of Covington, Newport, Bellevue and Dayton in Ohio and Kentucky. These lines operate in two States, three counties, five cities and seven villages, and the combined system is known as the Cincinnati, Newport & Covington Railway.

The power for operating the system is generated at two stations. The old station, which formerly provided all the power for the system, stands on Second street, in Covington, near the end of the suspension bridge, but at present supplies the power for operating the sections across the bridges and on the Cincinnati side only. A new central station, shown in the figure, has recently been erected in Newport, beside the Licking River near Eleventh street, above the second bridge connecting Newport and Covington, the two cities being separated by the Licking River, which forms a junction with the Ohio at this point. According to the *Street Railway Journal* the new station is of brick, having a ground dimension 169½ × 70 feet, with a wing for the boiler room 70 × 50 feet. The roof of the station is of slate, and supported by steel trusses. The smokestack is of brick, circular, and 135 feet in height; the base is 9 feet in diameter, but tapers to 6 feet at the top.

The original design was for a double station with switchboards at either end of the building, and the first half has been equipped with this view, but it is the intention of the management to add to the equipment as necessary, placing the switchboard in a tower on the side so that one set of engineers can operate the entire station.

The boiler equipment, which is located in the wing in the rear of the engine room, consists of four Babcock & Wilcox boilers 250 H. P. each, and two Stirling boilers, each of the same capacity, and all are provided with Roney mechanical stokers. The auxiliary steam equipment consists of a Webster purifier and pumps of the Blake type. A hot-well, which was formerly in the engine-room, has been removed to a corner in the rear of the boiler-room. This was rendered necessary as the vapors in the hot-room destroyed the insulation on the trunk wires which pass under the floor in the basement. The feed and condensing waters are obtained from the river, from which the station is distant about 800 feet. The pumps for lifting the water are located on the river bank, and are housed in a small wooden building, provided with wheels and supported on an incline track laid on the sloping banks of the river. Steam is delivered to the pumps from the station by means of a 4-inch pipe, which is provided with a covering for most of the distance. The suction pipe is provided with a screen, and the whole arrangement of the station is such that the building can be moved up or down the incline by means of wire ropes and hoists to adjust it to the height of the water in the river, which has an extreme variation between low and high water of 40 feet. Two hoists are provided and also safety ropes, and the arrangement is such that the power of six men can operate it. The water and steam pipes are provided with junctions (the former of which are 10 inches in diameter), so that attachments can be made at different stations as conditions may require. The station has a pumping capacity of 2,000,000 gallons, and the feedwater is lifted into a tank near the boiler-room, having a capacity of 39,000 gallons, the entire lift above low water being 80 feet.

Pittsburgh and Kanawha coal is employed, which is delivered by carts from neighboring coal depots, being brought from the mines on barges, and costs delivered about $1.25 per ton. From 26 to 28 tons are consumed a day for fuel, the cost being about $.0119 per car-mile.

CENTRAL POWER STATION AT NEWPORT, KY.

The power equipment consists of four 500 H. P. vertical compound condensing engines of the marine type, which were manufactured by the Cleveland Shipbuilding Company. These exhaust into Brooklyn surface condensers placed between the engines and generators, the condensers being the standard in use on vessels in the United States Navy. The flywheels of the engines are 11 feet in diameter, and the governing mechanism is contained in the flywheel. The cylinders are 18 × 28 and 34 × 28 inches, and are run at 130 revolutions. The tops of the cylinders extend about 16 feet above the floor, and are provided with iron platforms and iron steps, so that all the operating parts are readily reached by the attendants. A belt 11 feet in diameter with a 50 inch face is used. It is placed between the frames, with the cranks on the outside of the main bearings at right angles to each other. The wearing surfaces of the crossheads and the main bearings are lined with anti-friction metal. The shaft is of mild steel forging 8½ inches diameter, in journals. The valve motion is very accurate, and the engine is under perfect control, notwithstanding the rapidly varying load. The high pressure valve is actuated by an eccentric connected to a flywheel governor; the low pressure valve is moved direct by an eccentric keyed to the main shaft. The throttle valve is six inches in diameter, and is operated by a hand wheel placed in a convenient position for operating from the floor. Around the engine at a convenient height is placed a platform of iron grating and iron pipe railing. The engines are belted direct to Westinghouse generators by means of 48-inch belts, the distance between shaft centers being about 50 feet.

The four generators are of the M. P. type, of 500 H. P. each. The belts are of three ply leather, and were manufactured by the Bradford Belt Manufacturing Company, of Cincinnati. The switchboard is of white marble and equipped with Westinghouse instruments. A current of 550 volts pressure is carried. An overhead 10-ton hand power crane, manufactured by the Phœnix Iron Works, of Cleveland, completes the principal station equipment.

In connection with the telephone equipment of the station, colored incandescent lights are provided which light up when a call is rung so as to attract the attention of the attendants in case the noise of the machinery should prevent them hearing the bell call. All the appointments of the station are very complete, and the details as to cleanliness and operation reflect creditably upon the engineer in charge.

The original equipment of the old station, referred to above, consisted of three high speed engines, two of them being of the Armington & Sims type, and of 125 H. P. each, and one of McIntosh & Seymour make of 150 H. P., and were arranged to belt direct to Short 80 K. W. generators. More recently, however, the equipment of the station has been increased by the installation of a 400 H. P. Corliss engine, manufactured by Lane & Bodley, of Cincinnati, and which drives, by means of belting and countershaft, the Short generators referred to above, the high speed engines being used only in case of emergency.

Still more recently an additional unit of power has been installed, consisting of a 500 H. P. vertical engine, of the same make as those described above for the central station, and which is belted direct to a 400 H. P. M. P. Westinghouse generator. This unit has a separate switchboard equipped with Westinghouse instruments, while the switchboard for the balance of the station is provided with instruments of the Short type. The boiler equipment of the station consists of four tubular boilers, of 100 H. P. each, which are equipped with Murphy smokeless furnaces. These furnaces, the superintendent states, operate very satisfactorily when the boilers are moderately fired, and the grates last from six to eight months;

but when it is necessary to force the fires, the grates require changing frequently.

The same is true of other auxiliary equipment, including the pumps; as long as they are not overtaxed everything works in a satisfactory manner, and this, said the superintendent, is the secret of success with all street railway appliances, as nearly all breakdowns come from overloading. The same quality of coal is supplied as described for the central station, and it requires 10 tons a day, of 19 hours each, at a cost of $12.50, to operate the 22 cars, the average number on the Cincinnati side of the river. Some of the grades are 8 per cent., as before noted, and the approach to the suspension bridge on the Cincinnati side is especially difficult, as it consists of a long curve on a 7½ per cent. grade. The approach to all the bridges is over a considerable grade, and, with one exception, on difficult curves.

A comparison is made in this station on the cost of operating with condensing and non-condensing engines. With the compound engines water for condensing purposes costs six cents per 1,000 gallons, or a total cost of $200 per month for water, and for feed water only about $50. This expense offsets the extra cost for oil which is consumed on the countershaft and extra bearings connected with the single cylinder engine, so that the cost of operating the engine with either system is about the same, there being a 50 per cent. saving in oil, ordinarily, with the direct connected apparatus.

AN ELECTRIC RAILWAY IN ST. PETERSBURG, RUSSIA.

G. Wilfred Pearce, of New York City, announces that he has been requested by the secretary of the Imperial Institute of Engineers of Russia to notify United States inventors that the tramway lines of St. Petersburg are to be equipped with the best street railway motors that can be obtained. Full particulars and specifications are obtainable from H. N. Mollwo, whose address is 72 English Quay, St. Petersburg, Russia.

EXTENSIONS OF THE METROPOLITAN TRACTION CO.'S LINES IN NEW YORK CITY.

The Metropolitan Traction Company made two applications this week to the New York board of alderman for permission to extend its tracks and to build new lines in the upper districts of the city. It is stated that a conduit electric system will be used if possible, but if this should fail to be satisfactory the cable will be introduced. The contemplated extensions require about eight miles of new track. The aldermen appointed Sept. 6 and Sept. 13 for the public hearings on the two applications.

John D. Crimmins said of these applications:

"These applications provide for two important extensions. The first is from Columbus avenue and 109th street, through 109th street east one short block to Manhattan avenue, so as to avoid the use of Cathedral Parkway; thence north through Manhattan avenue to connect with the cross-town line in 116th street, and continuing north through Manhattan and St. Nicholas avenues, crossing the river to Kingsbridge station.

"The chief part of this route, all, in fact, north of 116th street, is technically a new route instead of an extension. Consequently, under the law, the franchise will have to be sold at public auction. The Third Avenue Company has made an application for the same route, so it will simply resolve itself into a question as to which connection the residents prefer and which of the two companies is willing to pay the larger amount of percentage to the city for the franchise.

"The other application is for an extension of our Amsterdam avenue line, one block west from Amsterdam or Tenth avenue in 125th street to the Boulevard, and thence through the Boulevard north to the junction with the other line at 167th street and Kingsbridge road. If these applications are granted, and we obtain the franchises, work will begin at once. We hope to be able to use the underground electric system of motive power, but in the event of experiments in that direction proving unsuccessful, we shall construct our conduits in such a way that a cable system on the same principle as that now in use in Broadway can be substituted."

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Twenty-third Article.)

THE MANAGEMENT OF STREET RAILWAY MOTORS.

At the outset of this chapter the author might as well confess his inability to teach a novice, either by letter press or pen, how to actually manage an electric street car in its various moods and whims, if so they may be called. If he can impress upon his readers at the outset that motors do not have whims at all, and that the seeming irregularities of their behavior are all due to definite causes which are in most cases within the control of the motorman, he will have made a good start. No one, from book reading alone, can expect to step full-fledged a motorman upon his car. There is much, after all is told, that must be learned by actual experience. For instance, the *sound* of his motors often tells him much, and not only indicates either that everything is all right and permits him to continue on with confidence, or that something is wrong, and moreover frequently indicates just *what* is wrong, or so nearly so that the experienced motorman need not look far to find the trouble, whereas the novice might spend an hour or two fruitlessly hunting for the fault. And this was the moral intended to be taught by the little anecdote at the beginning of this brochure.

We believe, however, that if one thoroughly understands the construction of this apparatus and the principles upon which it operates, the instructions which follow will well supplement a growing experience and enable the conscientious operator to avoid many difficulties and to correct them, when they do occur, the more readily. It was with the object of *leading up* to the management of the motor rather than of teaching it, that this work has been undertaken. It only remains for us to give a little kindly advice which it is hoped the reader will by this time have been prepared to understand. The remaining pages will, therefore, partake more of the nature of those medical works intended for family use than of the nature of a technical medical treatise.

The first thing to keep in mind is to keep your motor dry, for if it get wet the whole structure is liable to give way—burn out. The second word of advice is to keep it clean, for thereby most of its ills will be avoided. Water and dirt are the two greatest enemies of the electric motor. The third is, study the wiring of your car so that you have clearly mapped out in your mind the various connections and their functions. This will enable you to test out a fault which could not easily be detected by the eye, and to locate it at any rate within a given circuit. In giving this last advice to the motorman, the author is not unmindful of the difficulty, nay, even the impossibility, of the motorman's being able to trace out the wiring of his car unassisted. To do this he must have the full co-operation of those in authority, and here we have a word of advice to give to those in charge of the rolling stock.

If a motorman or other employee of yours having in the performance of his duty to do with your motors wishes any information in regard to the same which it is in your power to supply—supply it fully and freely. In fact it is your duty, if you would have good service, to educate your employee to the highest degree possible in his duties. Do not be content to let him do things with your machinery simply because you tell him to, thereby making of him a machine which is even more likely to get out of order than the inanimate machinery he has to handle; but after telling him what to do and what not to do, try to explain to him the reasons therefor, and the penalty—not to him, but to the machinery in his charge—of disobedience. Encourage him to ask proper questions—and all questions in regard to his motors are proper ones—and help him to become an intelligent man; for by so doing alone can you get the best service, the most for your money.

The next advice to the motorman is that he study the "habit" of his motors. Let him keep his ears open to every sound until any variation from the same would awaken him even if he were asleep, for the sounds given out by the motor are as surely an indication of its condition as is the pulse of a human being of his state of health. A variation from the normal sound is often the first indication the operator may have of trouble with his machines. If heeded at once, disaster may be entirely averted where it would otherwise almost surely follow.

If the ear detects anything unusual the car should be stopped at once and a careful examination made to detect if possible the cause. If it cannot be located at once it may be well to cut out first one motor and then the other, running the car carefully for a short distance with each separately, if the grades are such as to make this safe. In this way the trouble may be located by sound in the motor in which it exists, and thus its specific nature and exact location be more easily traced.

The most common diseases of electric motors of any kind, street car motors included, their symptoms and remedies are the following:

First of all comes

SPARKING AT THE COMMUTATOR.

A properly constructed motor in normal working condition should not spark at all, or at least not noticeably. Sparking may, therefore, be regarded more as a symptom of a disease than as a disease. The sparking of the commutator is often the first indication that the operator has that everything is not as it should be. When sparking is observed, therefore, an investigation should be made at once to determine its cause and to rectify it on the spot, if possible, or, in case it is not possible to do this, to run the car into the shop for repairs. Sparking should be stopped for its own sake, however, for if allowed to continue it will corrode the commutator blocks, and in this way increase itself until the commutator is so far gone as to require renewal.

Crocker and Wheeler, in their most excellent little work on "The Practical Management of Dynamos and Motors," assign fourteen different causes for sparking, not all of which, however, need concern us here. The following, however, are those which especially concern the motorman:

First Cause.—Armature carrying too much current. This means that the motor is being overworked. The motorman need not be alarmed if his motor sparks some on ascending a heavy grade, for that is rather to be expected, especially if the load be at the same time heavy. The remedy for this, of course, is to save your motor as much as possible by gaining momentum before reaching a grade, and then maintaining a uniform slow speed until the grade is passed. A motor that sparks on ascending a grade should never be stopped on the grade, if it can by any possibility be avoided, as on starting again the work it will be called upon to do will be many times that which it ought to do, and disastrous results may follow.

But the sparking from overload may not always be due to the excessive *useful* work the motor is performing. It may be due to the striking of the armature against the pole pieces, to the binding of the armature shaft in its bearings, to a bad short circuit or to the grounding of the motor on the frame. Any of these latter causes, if active, are likely to cause sparking when the motor is not doing much apparent work, and this fact will help to distinguish which of the two classes of troubles causes the overloading. The general indication that the sparking is due to overload is the overheating of the whole armature. If this overload is due to frictional causes, they may be detected by examination first of the bearings, which will be unusually hot if the trouble lies there, and second by an examination of the armature. If friction is indicated there, the trouble is extremely serious, as in overwound armatures (viz., those on which the coils are wound on the surface as distinguished from the ironclad armatures in which the coils are placed in slots on the surface, and therefore beneath the surface), continued friction is sure to wear off the insulation and cause a burn-out of the armature. In this case the motorman should exercise his mechanical ingenuity, and so centre his armature that it will not strike the fields at all.

Second Cause.—Brushes not set at the neutral point. We have seen that there are two positions in every evolution of a coil in which it generates no electromotive force. In a two-pole machine these two positions are diametrically opposite each other, and in a four-pole machine they are 90° from each other. These points are called the neutral points. If the brushes bear at exactly these points there should be no sparking, but if they bear at any other points on the commutator the brushes will pass off from bars that have an electromotive force which is greater the further the brushes are removed from the neutral points, and it is this electromotive force that causes the sparking. We have seen that as the current supplied to the motor changes, so do the positions of these neutral points in some machines, so that it is necessary in such to move the brushes back and forth as the load varies. It is this change of the positions of the neutral points that causes the sparking due to overload, just described. But the ampere turns on street railway motors on the armatures and fields are so disposed, the one predominating over the other, to such an extent that the load may vary within wide limits without perceptible change of the neutral points. The brushes are, therefore, usually fixed once for all at the proper places, so that the sparking, if due to the brushes, is probably due to one or more of the following causes rather than to wrong position:

(a) Commutator rough, eccentric or has one or more high bars or what are termed *flats*. To detect these, the commutator should be examined while at rest for roughness and also for eccentricity. This latter can be detected better, however, by watching the motor carefully when slowly in motion. If the brushes alternately rise and fall, the commutator is not centered properly on the axle. When running fast, the whole armature may *chatter*. High bars or flats—the latter being flat surfaces on the commutator—are best detected while the motor is running, by resting the finger-nail against the commutator. Any irregularity of surface will thus be readily detected. These are all difficulties with which the motorman would better not fool, for fear of increasing the trouble. His duty will have been done if he cuts out this motor and proceeds to the car barns at once with the other motor.

(b) Brushes make poor contact with the commutator. Close examination will show that the brushes touch only at one corner or only in front or behind, or there is dirt on the surface of contact. The remedy for this trouble readily suggests itself. Clean the commutator and replace the brushes, being careful that they have ample bearing on the commutator. Occasionally the fault lies in the brush itself—it may be extremely hard or have extremely hard spots in it which wear away less readily than the remainder of the carbon. The remedy for this is to throw away such brushes and replace them by new ones.

STREET RAILWAY MAIL SERVICE FOR BROOKLYN.

The use of electric cars on city and suburban street railway lines for other than passenger service is gradually extending. The most rapid extension is in the transportation and distribution of mails. It is announced this week that the Atlantic Avenue Railroad Company, of Brooklyn, has made a contract with Postmaster Sullivan for carrying the mails from the main office to the Union station at Fifth avenue and Thirty-sixth street. From this point the mail will be transferred to a special closed trolley car, painted white, and marked "U. S. Mail," for distribution along the line of the road from the station to Coney Island. The company is also considering the proposition of putting mail boxes in all the trolley cars for the convenience of the passengers.

REPORT ON ELECTROLYSIS IN NEWBURGH, N. Y.

John D. Van Buren and Everett Garrison, engineers, recently presented a report on electrolysis to the Newburgh (N. Y.) water board. Their conclusions were as follows:

There is no system employing rail conduction in such railways which can be considered entirely safe as regards corrosion of adjacent pipes, but that the electrolytic action may be greatly reduced and perhaps kept within comparatively safe limits by such good connection as is recommended by Mr. Farnham.

That there is only one sure remedy for this trouble, which is the complete insulation of the trolley circuit from earth, as is done in the double trolley and in the conduit plans.

We believe that the interest of the cities and of the road companies themselves will compel the adoption of such a system in the near future.

We have now pointed out as clearly as we are able the dangers to our water pipes from a poorly constructed trolley road, and submitted the opinion of an expert of the highest standing as to what should be the standard of such a road using rail conduction, and have stated the points of difference between this standard and the plan adopted for the Newburgh road.

We have thus fulfilled the duty imposed upon us by the resolutions adopted by your board as far as we are able and can do nothing further in this matter.

The duty of determining what action should be taken to protect the interest of the city devolves upon your honorable body and the common council.

BROWNELL REVERSIBLE CAR SEATS.

The accompanying illustration shows the Brownell reversible car seat, as used on a part of the Brownell car equipment on the Cincinnati, Newport & Covington Railway. These cars have a seating capacity for 32 people. The seats are readily reversed by taking hold of the round cross bar, which forms the upper part of the back sup-

Brownell Reversible Seats.

port, and throwing it over to the opposite side—a very ingenious arrangement. By means of the folding seat 7 inches of room is gained over the old style, and the device accomplishes for street cars what the folding opera chair has done in theatres and public halls. In a car with seven seats, 49 inches in length can be saved, yet the passengers have the same accommodation that they have now in a stationary seat car. Another great advantage claimed for this over the ordinary seat, is the convenience of cleaning out the cars. All the seats can be folded up and the car can be swept out almost as easily as if there were no seats at all.

RAPID TRANSIT IN ATLANTA, GA.

Joel Hunt, president of the Atlanta Consolidated Street Railway Company, recently published a statement as a reply to the censure of a coroner's jury in an accident case. Criticism was made by the jury of the plan of operating cars without conductors, a plan which, Mr. Hunt says, is to be found at the ends of long lines through sparsely settled suburban districts. This is a method which has necessarily been adopted on the score of economy. The following appears in the statement in reference to the transportation service and to accidents:

The cars of the Atlanta Consolidated Street Railway Company are running throughout the city in almost every direction, and make a daily distance of about 4,300 miles, which is about once and a half across the continent, from New York to San Francisco, this travel, within a month's time aggregating 130,000 miles, or more than five times around the world. We are carrying daily now about 20,000 passengers, this within one month's time aggregating about 600,000. The distance of one haul is, in many cases, over five miles, and the charge for this haul is only five cents. Without a practical demonstration such an amount of accommodation at this rate would not be deemed possible, and yet it is being done, though at a great risk to the investments in the road. In the absence of street railways the expense to the public on making this distance of travel would be at least five times what it is now, resulting in a cost to passengers of over $1,000,000 per annum more than is now being paid to the street railway company. From statistics accidents would be fully ten times what they are now, due to the more unreliable transportation by horse power and reckless driving. It is hardly possible, indeed it is not possible, to transport so many people throughout the city daily and avoid accidents altogether.

During the past four years the lines with which I have been connected in the city have hauled over 24,000,000 people, have had accidents resulting in the death of six children, and on five of the cars causing the accidents there were conductors, this car yesterday being the first one meeting with such an accident without a conductor. In four cases all of the proof was to the effect that these small children were wandering around on the streets at will; that they were on the sidewalks when the car was approaching and suddenly darted across the tracks, rendering an accident unavoidable.

ARMATURE LIFT AND TRUCK.

The accompanying illustrations show two pieces of very useful carhouse apparatus, manufactured

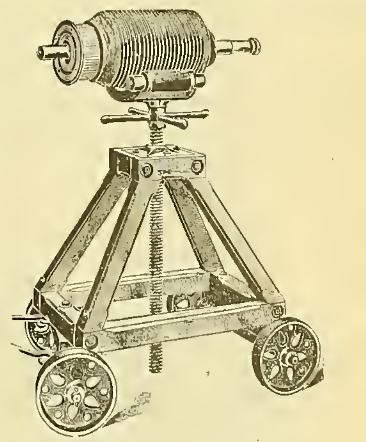


Fig. 1—Armature Lift

by the Dorner & Dutton Manufacturing Company, of Cleveland, Ohio. Fig. 1 shows an armature lift by means of which any style of armature can be quickly raised or lowered to any desired height. Being mounted on wheels it can readily be moved to any position in the pit, a track being unnecessary. The saddle is made of wooden rollers to avoid any possible injury to the armatures. Fig. 2

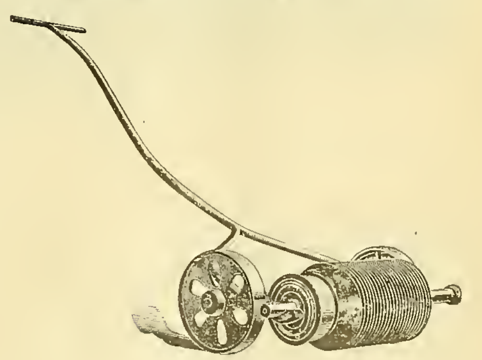


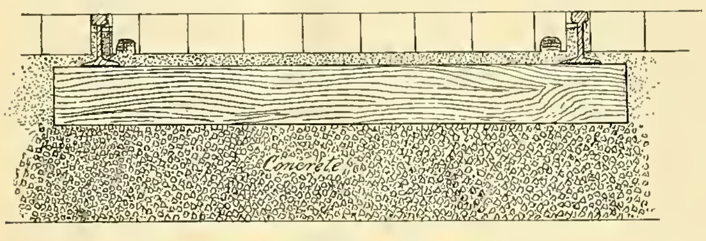
Fig 2—Armature Truck.

shows an armature truck that forms a complement to the lift. It takes the armature from the lift, (with only a boy to operate it,) and carries it to any part of the shop or carhouse with the least possible danger of injury.

Electricity for the Bridge.—It is reported that the Brooklyn Bridge Trustees have been in conference with the General Electric Company, with reference to the substitution of electric power for the cable in operating the bridge cars.

T-RAIL TRACK CONSTRUCTION AT TERRE HAUTE, IND.

At Terre Haute, Ind , the street railway tracks are laid throughout with T-rails, and the method of roadbed construction employed is extremely interesting, owing to the popular interest felt at the present time in T rail construction. The weight of the rail used is 60 pounds in the suburbs and 72 pounds in the center of the city. The form is the Shanghai, rolled by the Illinois Steel Company. The accompanying illustration, for which we are indebted to the *Street Railway Journal*, shows a section of track. As will be seen, the rails are mounted directly on ties 5 × 7 inches × 7 feet, and these are of white and burr oak. The paving is carried up flush with the outside of the rail, and on the inside a special brick block, molded to suit the purpose, is employed. The space between the rails and the blocks on each side is filled with grouting, and the ties rest on a bed of concrete 10 inches in depth. The space between the brick blocks within the tracks is laid for part of the distance along the road with brick, for another section with asphalt, and on a third division with gravel. All the crossings were supplied by Elliott, of East St. Louis, and the Paige Iron Works, of Chicago.



TRACK WORK AT TERRE HAUTE, IND.

The rails are double bonded at the joints, and are connected to a supplementary iron and tinned copper wire. Seven-sixteenths of an inch iron bonds are used where the streets are unpaved, and No. 0000 copper bonds are employed in the paevd streets.

The North Jersey Street Railway Company has been incorporated with $5,000,000 capital to operate 250 miles of electric street and road railways in northern New Jersey. The main office is to be located at Newark. While the papers do not indicate the proposed route to be occupied by the company's street railways, it has been learned that electricity will be the motive power, and the first line to be run will be from Bloomfield to Caldwell, that connections are to be made with Morristown and other places.

STREET RAILWAY EARNINGS.

The earnings of the Brooklyn Traction Company continue to make a remarkably good showing, especially gross, which increased $3,270.31 to $80,466.86 for the month of May. It is impossible to show the changes in the other items which go to make up a statement, as no data for last year is attainable. Operating expenses for last month were, however, $50,880.47, thus leaving net earnings from operation of $29,586.39. There was also received from other sources of income $1,488.40, making a total net revenue for the month of $31,074 79. The statement of the Columbus Street Railway Company for the same month is also favorable. Gross earnings aggregated $49,367.36, an increase over the same month last year of $1,820.57. Operating expenses were $23,055.81, a decrease of $5,898.39, so that the net earnings were $26,311.55 last month, an increase over May, 1893, of $7,718.96.—*Philadelphia Stockholder.*

PECKHAM'S AUTOMATIC LIFE AND WHEEL GUARD.

An automatic life and wheel guard, combining simplicity, lightness and strength, was recently placed on the market by the Peckham Motor Truck & Wheel Company, and is shown in the accompanying illustrations.

FIG. 1—CAR EQUIPPED WITH PECKHAM'S FENDER.

The guard is constructed of 1-inch wrought pipe, and carries a wire screen 5 feet 8 inches long and 30 inches wide. It is attached to the guard plank by two cast iron brackets, in which are pockets for two spiral springs, one of which allows an upward movement in case of striking an immovable object. The rear extension is bolted to the truss bar of the truck, and is provided with three holes, so that it is easily adjustable, and can be carried at any distance above the track. It is inclined at a slight forward angle, so that in striking any movable object the springs allow the screen to drop to the track.

Fig. 1 shows the fender as applied to one of the cars of the Consolidated Traction Company of New Jersey, and Fig. 2 is a side elevation of the fender.

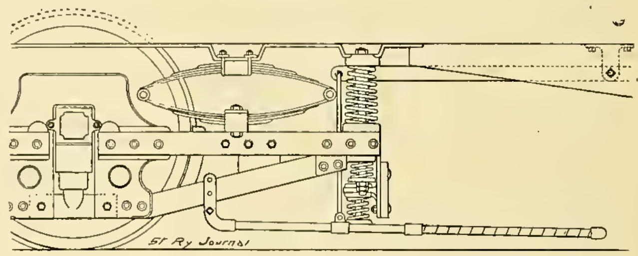


FIG. 2—SIDE ELEVATION OF PECKHAM'S FENDER.

STEAM AND ELECTRIC RAILWAYS.*

BY THOMAS L. GREENE.

The development of electric railways into what may be called suburban systems is having certain results not at first foreseen. The comparative cheapness of electric propulsion cannot be denied. The statistics of surface roads tabulated by the Massachusetts Board of Railroad Commissioners shows an increase in net earnings of several cents per car mile in electric over horse railways. Such a saving, multiplied into the large number of car miles run over the tracks of an electric road in a city or country having a fair population, gives results which amply justify the adoption of the electric methods of propulsion, either in the laying out of a new road or by the substitution of electricity for horse power. The figures of the Massachusetts Board show that the capitalization of street railways has increased in greater proportions than their net earnings, and it is against this over-capitalization of electric roads that the Massachusetts Board raises its note of warning. The spread of electric roads into rural districts is evidence enough of the success of that method of power under reasonable conditions of population and capitalization.

One result of the joining of near-by villages and towns by electric roads is that the steam railways, which have for years carried the local travelers who journeyed from one station to another, have felt the competition, in some cases seriously. For a ride of but a few miles it is clear that a surface road has a number of important advantages. If the speed be reasonably rapid—and electricity allows of that—the traveler will have to spend very little if any additional time on the journey, and any slight excess of time required is more than made up by the privilege of beginning his journey at any hour which may suit his convenience. Perhaps the electric cars pass his door, while the steam railway station is some distance away. So, too, at his destination, the electric car will land him at whichever portion of the city or village he may wish to go. Possibly in cities this advantage may save him an extra fare which he might have to pay some street road from the railway station. An instance of the effect of this competition is seen in the service between St. Paul and Minneapolis, Minn. The distance between these two cities is about ten miles. The travel between them has been accommodated by local trains run at convenient hours throughout the day by the two principal steam railways. The completion of the electric street railroad system between the two cities, however, was followed by such a complete falling off in the travel upon the steam railways that they practically abandoned their local service. In Connecticut, where the steam lines running through populous districts were threatened by the competition of electric roads, there has been a long legislative wrangle over the equities involved.

The situation is such that the steam railways must expect to lose a certain portion of their station-to-station travel. Rapid transit in the streets and along the highways has become so important from a public point of view that it is not easy to see how the steam roads can retain their old number of short distance travelers; nevertheless, the competition is unjust. The steam railway has spent large sums of money for its roadbed, equipment and plant, and, as the owner of real estate in the town or county, usually pays a

* From the *Independent*, New York.

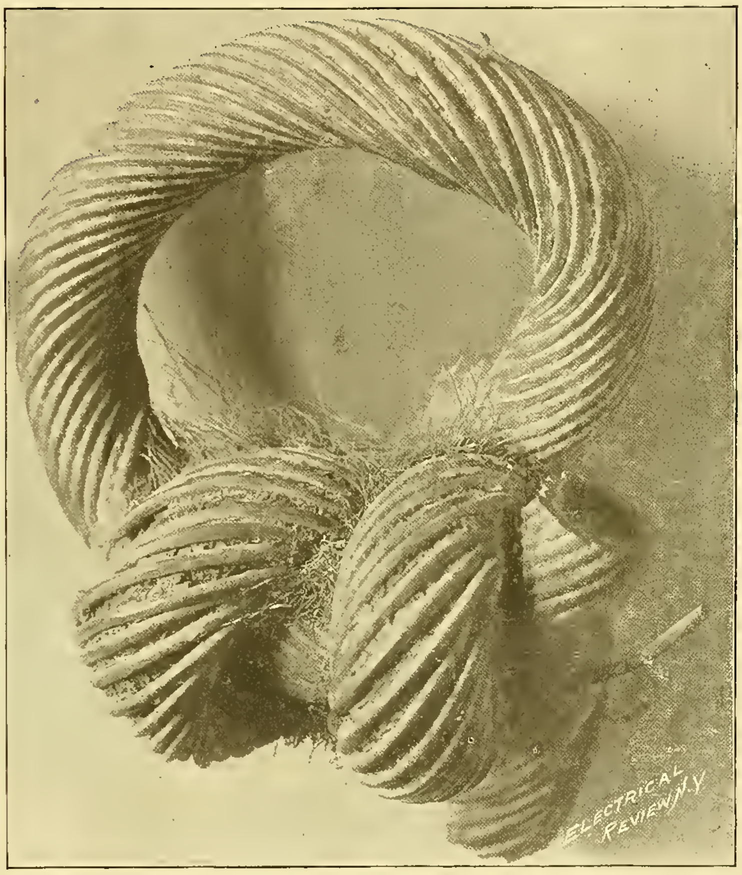
large proportion of the public taxes. On the contrary the electric road usually pays nothing for its right of way, because the privilege of laying its tracks on the public streets or on the public wagon roads without charge is commonly granted to it; and in these privileges it has a material advantage over the steam road, which, indeed, is often indirectly taxed to support its rival through street or road repairs, or something of the sort.

In another way, also, the electric road has the steam road at a disadvantage. The laws relating to the control of horse cars on the public streets and roads were based upon the assumption that the horse car was an ordinary street vehicle in another shape, as indeed it was. No more precautions were necessary to be taken by the horse car company than by the owners of private wagons: but rapid transit has changed these conditions, while the slow law has not caught up with them. The fast-moving electric car introduces an element of much greater d nger, not only to the pedestrians and trucks upon city streets, but to all who have occasion to drive upon or across the public highway. As yet the electric roads have not been compelled to take any precautions such as experience has shown to be necessary on steam roads, and which the law makes obligatory upon the latter. The electric railways are not obliged to put up any signal apparatus or to protect the public in any way against the new danger—such, for example, as fencing off its tracks, a thing the steam road must do, often at large expense. This is particularly true in cases where the electric crosses the steam railway tracks. By one means or another permits have been secured, where the electric systems are being extended, to cross the steam railway tracks at grade. Strangely enough the public mind has not yet *awakened* to the extreme danger of this new style of crossing. Not only is the possibility of the ordinary collision present, but it has happened that a failure of the motive power at just this point has at times left the electric car and its passengers open to great peril. Commenting on the increase of such crossings in Massachusetts in two years from 26 to 100, the Railroad Commissioners of that State in their last annual report say: "Of all the perils which attend travel on the railroads of this Commonwealth there is not one which, in the apprehension of the Board, is so serious, both in i s character and extent, as that here pointed out." Safety both for electric and steam passengers demands the enactment of laws in every State requiring that no electric road shall cross a steam railway at grade, unless the most approved signals and derailing switches are set up.

But while the competition of electric roads between villages is felt by the steam railways which have heretofore carried all the travel, that statement does not exhaust the subject. Even in regard to this same competition it must be remarked that frequent and rapid transit "creates" travel, as the railroad men say, and that more people journey from vill ge to village under those circumstances than would take the steam trains if the latter were the only means of inter-village conveyance. More than that, it is highly probable that the effect of the extension of electric roads outside of cities will in the long run benefit the steam railways and facilitate their business. Not every electric road competes by running alongside a steam railway. A great many of them are built to connect distant villages, which have no steam communication, directly with some railroad station. In all such cases, the value of the electric roads as feeders of the steam railway is rightly considered great. The demand for electric connections is sure to be heard from all the interior towns and villages of local importance. The social effect of these subordinate lines connecting the main road of some great steam railway with the county seat or some flourishing village community is certain to be important. Farmers are among our most intelligent and upright citizens; yet the isolation of their profession often leads to distorted thinking unless the man is guided by the careful study of books or by intercourse with his fellow-man. For rubbing down the angles of our character or opinion nothing is better than contact with one another. It is possible that the expansion of the new system of street and road transportation, when once extended into the rural districts generally throughout the country, will have important effects upon our political-economic problems as well as upon the revenues of the steam railways, which must continue to be the only method of travel for longer distances. Anything which stimulates and benefits the trade and commerce of a town or section or State, ultimately benefits also the steam carriers. It is so with canals; it is so with the great lakes and rivers; it will be so with the Nicaragua Canal when completed; and such will prove to be true with the extension of electric railways upon our common roads.

It is within the range of possibilities that electricity may prove itself capable of benefit to the steam railways in another way also. The steam railways are now being solicited by the Department of Agriculture to give their aid to a movement for the improvement of the common roads throughout the country. This claim upon our great railroad systems for help in road improvements has good sense in it. Anything which would reduce the expense to the farmer and thus give him larger earnings from the sale of his products will help the steam railroads also which are dependent upon farming for a large part of their traffic. The cost of drayage of farm products from the fields to the railway station over bad wagon roads forms a very serious item in the expenses of the farmer. Good wagon roads would reduce that expense; hence, the movement for the improvement of common roads has a basis in good business sense. It is possible that in time this cheapening of the cost of drayage from the farm to the station may be further reduced by the application of electricity; possibly through the medium of these very same electric roads. Cheap tracks could now be put down upon any highway, which, by means of electric propulsion, could haul produce from the farm to the railroad station; the drawback is that the neighboring farms do not furnish traffic enough to support such a railway from products alone. We often hear, however, of electric roads which are chartered and allowed to carry both passengers and freight; and it is within the range of possibilities that some means will yet be devised which will furnish to the farmers a cheaper transportation of their loads of hay and grain to the steam-railway station than even good wagon roads and broad-tired vehicles can furnish.

It is possible, too, that through this d velopment some practical means of furnishing power to the farms may be devised. The saving of labor on farms, of which we have heard a good deal lately, has been accomplished solely by the invention of machinery through which one man is enabled to do the work of many men by substituting horse for human power. The horse draws the mowing machine, the rake, the plow, and in this way has saved much human labor; but we have not yet succeeded in conducting farming operations with any other power than the horse except for threshing. It may be that in this direction our next great agricultural improvement will come. If we can furnish mechanical power for the various operations of farming, when and where it is wanted, and in such a shape that it can be of practical use, we will have taken a long step forward. It is possible that this step may be taken in some way through electricity, and perhaps we may attain it through the introduction of the electric power along the country roads where the electric railway has been introduced. Every important step of this sort is to be encouraged by the steam railways. The present condition of agriculture is the great hindrance to remunerative rates and good traffic on the part of our great carrying systems. Anything which will cheapen the cost of production of our food staples will be of great advantage to the steam railways as well as to the people at large; so while the temporary disadvantages of the competition of electric roads with steam railways are in plain sight, observers of the situation are inclined to believe that the electric railway in the rural districts is capable in the future of benefits to the steam railways which the latter could receive, so far as we can now see, in no other way.



KNOT IN AN OKONITE CABLE.

CURIOUS KNOT IN AN OKONITE CABLE.

The accompanying illustration shows a knot cut out of an Okonite submarine cable which was laid about five years ago from the government pier at Fortress Monroe, Va., across Hampton Roads to

Willoughby Spit. The cable belongs to the Southern Bell Telephone and Telegraph Company. Just at this place in Hampton Roads the water is very deep and very swift. During the winter an ice jam formed and forced the ships lying in the Roads to drag their anchors. A ship's anchor caught the cable and broke it. When it was hauled up for repairs this knot and several others were found. Until the break occurred the cable had worked perfectly and, in fact, examinations and tests made on this knot show the conductors and insulation to be in perfect order and the resistance as high as ever, although the iron armoring is badly strained.

RUSSELL & CO.'S DIRECT COUPLED ENGINE AND G. E. DYNAMOS.

The direct coupled dynamos and engine recently installed in the station of the Edison Electric Light Company at Grand Rapids, Mich., possess some features of interest and deserve special notice. The outfit consists of one four-valve compound condensing engine, 15 × 24 × 24, rated at 300 to 400 H. P., built by Russell & Co., of Massillon, O., and two 100 K. W. generators made by the General Electric Company.

The bed of the engine and the fields of the dynamos rest upon a common iron base. The main shaft of the engine carrying the two armatures in addition to the flywheel is supported in two pillow blocks mounted on detachable iron stands, so that the armatures may be removed without lifting the shaft out of place.

A test conducted by Frank A. Simonds, M. E., to determine the engine's economy in verification of guarantees gave the following results:

RUNNING NON-CONDENSING.

Duration of trial	6 hours
Average steam pressure	139.5 lbs.
" revolutions per minute	162
" I. H. P. developed	307.71
Water per I. H. P.	18.45

RUNNING CONDENSING.

Duration of trial	6 hours
Average steam pressure	130 lbs.
" vacuum	25.75 lbs.
" revolutions	162
" I. H. P.	327.75
Water per I. H. P.	15.59

The Fort Wayne Electric Corporation has contracted with the receivers to continue the business at Fort Wayne, and the contract has been sanctioned by the court. Assets of the old company will pay all debts and leave a considerable surplus. The New York office of the Fort Wayne Electric Corporation has been removed to 115 Broadway.

COMPLETING THE CONNECTING LINK BETWEEN BROCKTON AND BOSTON.

On Saturday of last week the new six-mile extension of the Quincy & Boston electric street railway was opened for regular service, and cars are now run over the line from East Weymouth to Quincy at half-hour intervals. Appropriate celebration of the event was made by the citizens of the two towns, who held a "wedding reception" in honor of the union of the two places. East Weymouth is one of five villages bearing the name of Weymouth and together constituting the largest township in Massachusetts. All these villages will soon be joined by an electric railway system. The line just completed forms almost the last link in the system of electric railways that will connect Brockton and Boston, making it possible to take an electric car ride nearly 60 miles in a single direction.

METROPOLITAN ELEVATED ELECTRIC EQUIPMENT, CHICAGO.

The Metropolitan West Side Elevated Railroad, Company of Chicago, last week received bids for the electrical equipment of its road. The bidders for the generators are the General Electric Company, Westinghouse Electric & Manufacturing Company, Siemens & Halske Electric Company of America, and the Walker Manufacturing Company. It is reported that Elwell & Parker, of London, have put in a bid, but as there is a tariff of 45 per cent. on dynamo-electric machinery it is not likely that the English firm can compete. The specifications call for 2,000 and 1,000 H. P. machines, which will probably be directly coupled to the engines. The larger generators will be operated at 75 revolutions per minute, and the smaller ones at 100 revolutions. The ultimate capacity of the power-house will be about 8,000 H. P., but as every effort is being made to have the road in operation by September 1st, the bidders are asked to make estimates on 6,000 H. P.—two 2,000 H. P. machines and two of 1,000 H. P. each—as well. One hundred and ten motors of 125 H. P. each will be required at first to equip 55 motor cars. It is likely that each motor car will ultimately be equipped with 500 H. P. in motors, but at the start two 125 H. P. motors will be used for each car. The bids will be opened in a few days, and the successful competitor will be required to build the machinery with all possible speed.

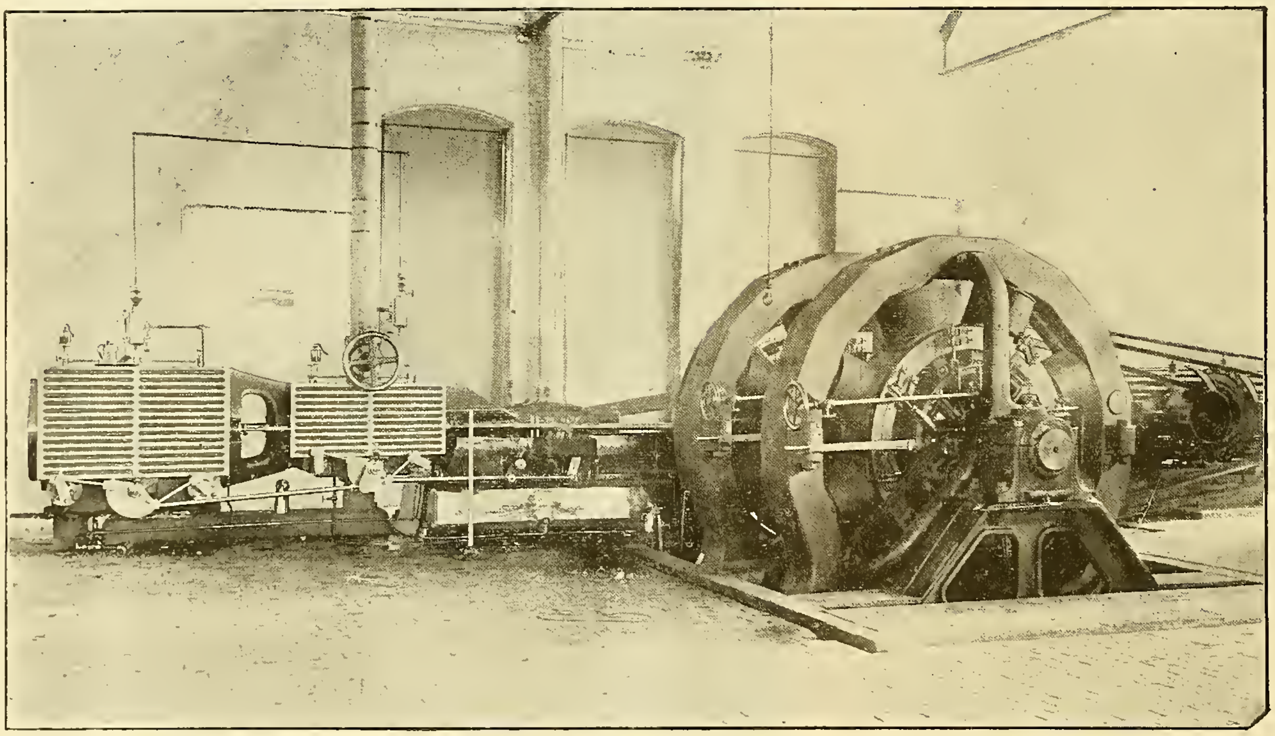
MECHANICAL DRAFT.*

BY WILLIAM R. RONEY.

The largest and most successful applications of mechanically induced draft have been made in connection with feed-water heaters designed to utilize the waste heat of the flue gases, and known as fuel economizers. This form of feed-water heaters has been manufactured in England for over 50 years and in this country for three or four years. They have, however, been imported for many years, as their value as a fuel-saving device is well established. Their successful operation is, however, so dependent upon good draft that no well-informed engineer would think of installing an economizer without making provision for much better draft than the boilers would require without it.

On account of the reducing effect on the draft caused by lowering the temperature of the gases and retarding their flow by the mechanical interference of the pipes, it cannot be considered good engineering to attach an economizer to a chimney less than 200 feet in height. In fact, the best working economizers in connection with chimneys are those where the chimney is considerably over 200 feet high.

The objections to be urged against high chimneys, as compared with mechanical exhaust draft when used with economizers, are: (1) Excessive cost, both on account of the height required and on account of foundations; which must of necessity be very substantial, and which may involve expensive piling and filling. (2) The space required for foundations, which may be very valuable, especially in large cities, or may be required for other purposes and which can with difficulty be spared. A chimney 250 feet high will require foundations not less than 30 feet square, and in some cases much more. (3) A certain minimum temperature of flue gases is required to produce an effective draft and to operate the boilers economically, and this fact limits the amount of economizer heating surface which can be used, and consequently the fuel saving obtained by use of the economizer. The same fact operates unfavorably at small capacities, which are often unavoidable, when the chimney must be built large enough for future increase of the boiler plant. (4) A chimney once built limits the maximum capacity of the boiler plant, and also is liable to be affected by atmospheric changes which may seri-



DIRECT COUPLED PLANT—RUSSELL & CO.'S ENGINE AND GENERAL ELECTRIC COMPANY'S DYNAMOS.

*Abstract of a paper presented at the Montreal meeting of the American Society of Mechanical Engineers.

ously impair its efficiency. These objections to the tall chimneys, which are so essential to the use of economizers, do not hold with mechanical draft.

The first cost of a properly designed mechanical draft plant is very much less than that of a suitable chimney of equal capacity, often averaging 75 to 80 per cent. less, according to the size of chimney and character of foundations required. The fans and short stack require very little foundations, even less than that of an ordinary boiler setting. The space usually required for extensive chimney foundations can be utilized for economizers, and by elevating the economizers and fans upon beams and columns, the space underneath them can be used for pumps, condensers, etc. The space thus saved is often of great value, especially where land is expensive.

Natural draft requires that the gases in the chimney be above a certain minimum temperature in order to secure a proper supply of oxygen in the furnace and a good combustion of the fuel, whereas with mechanical exhaust draft the amount of draft obtainable is entirely independent of the temperature of the flue gases, and when used in combination with a properly proportioned economizer it is possible to lower their temperature to a point where the draft of even a very tall chimney would be practically destroyed.

Mechanical draft possesses great advantages over natural draft in its flexibility and adaptability to both large and small capacities, and in its ability to meet sudden and excessive demands for steam, either by an extra turn of the throttle valve, or by an automatic regulator controlling the steam supply to the fan engine according to the boiler pressure. It is unaffected by atmospheric changes, furnishing the desired amount of draft irrespective of conditions of wind or weather. Operating independently of the amount of heat in the stack, it is possible to obtain a higher temperature of feed water in the economizer and a lower temperature of escaping gases than could possibly be obtained with a chimney, and at the same time provide sufficient draft to maintain rapid and economical combustion of the fuel. There are undoubtedly many boiler plants equipped with economizers and chimneys, where the draft is so greatly reduced by the economizer, that it is an open question whether the saving in fuel by thus heating the feedwater is not more than balanced by the loss due to imperfect combustion in the furnace; and whether it would not result in a greater saving in coal to cut out the economizer and get better combustion, and a higher initial temperature due to better draft. Unquestionably the "black eye" which fuel economizers have sometimes received has been often due to bad engineering, and to placing them where the chimney draft was none too good already; the result being that they not only failed to show the economy that the purchaser expected, but so impeded the draft that the efficiency and capacity of the boilers were greatly impaired. It was quite natural, under such circumstances, that the economizer should be neglected and allowed to foul up by the accumulation of sediment within the pipes, and of soot without, until it became a source of loss instead of economy. A chapter on the use and abuse of fuel economizers could easily be written, but—" that is another story."

A mechanical draft plant properly designed, with duplicate fans and engines of suitable construction, so arranged that one is always in relay, can be made so reliable that the boilers cannot be shut down by any ordinary accident. With the fans properly designed and proportioned to the work, the power required to operate them is so small as to practically have no effect on the economy obtained. The mistaken idea that prevails somewhat, even among intelligent engineers, regarding the amount of power required for mechanical exhaust draft, is probably caused by the well-known large amount of power required to drive the high-speed pressure blowers and fans used for forced draft. Mechanical draft handles a large amount of heated gases with slow speed exhaust fans at a low pressure, and with a small expenditure of power. To illustrate, the writer recently designed a mechanical draft and economizer plant for 6,000 H. P. of water-tube boilers, providing duplicate large slow running fans of special design, each driven by an independent engine, and each having a capacity, estimated in pounds of coal burned per hour, sufficient to develop 25 per cent. in excess of rating, or 7,500 H. P. The power required to drive one fan to do this work was 0.6 per cent. of the boiler horse-power developed. Or, estimated in coal per horse-power per hour, and at $3 per ton, the fuel cost of operating the plant one year was two per cent. of the estimated cost of the chimney originally planned for the plant. In other words, it would not pay to build the chimney so long as money was worth more than 2% per annum.

In a typical boiler-house the economizer is elevated upon columns and beams to provide for utilizing the space under the economizer for feed pumps, condenser, etc. The exhaust fans, of which there are two placed side by side, are equipped with direct-connected engines, only one engine showing in the illustration, the other being on the farther side. These fans and engines are of special design, with protected bearings, self oiling and water-jacketed, to withstand the heat when the economizer is cut out for cleaning or for repairs, and the hot gases pass directly to the fans. They are so proportioned to their work as to handle a maximum amount of gases with a minimum expenditure of power.

The arrangement of the economizer pipes and blow-off connections are worth noticing, in that they provide a means of blowing out the sediment which may accumulate in the pipes, and at the same time a complete circulation is maintained in the economizer. Many extensive plants are now in operation, or in process of construction, in various parts of the country equipped with economizers and mechanical draft similarly arranged

Probably the largest plant of the kind yet built is that of the Philadelphia Traction Company. Two large power-houses are in process of erection and partly in operation for this company; one of 7,500 H. P., and one of 6,000 H. P. In the Thirteenth and Mt. Vernon street power-house there are 20 Babcock & Wilcox boilers of 375 H. P. each, arranged in two parallel rows of ten boilers on opposite sides of the boiler-room. The other station of 6,000 H. P. is arranged similarly, except as to the number of boilers. The gases from each row of boilers are conveyed by flues at the back to the center of the boiler-house, drawn through the economizers and discharged into stacks by four large slow-running exhaust fans of special design. These fans are arranged in pairs, and are of such a capacity that two of them will handle the gases for the entire plant, thus leaving two in reserve. The fans are driven by duplicate engines and counter-shafts, so arranged that either engine will drive any one or more fans, as desired. The stacks extend but a few feet above the roof and are lined with brick to preserve them from the corroding action of the gases. The feed-water is pumped through exhaust steam heaters to the economizers, and thence to the boilers. At the Thirty-third and Market street station of the same company the fans are driven by engines belted directly, one small engine to each fan. The economizers occupy the space originally planned for two tall chimneys, one for each side of the boiler-house. These chimneys were to have been 200 feet high with a flue 11 feet in diameter. Two of the fans are capable of producing a draft equal to that of the two brick chimneys originally planned. The power required to drive one of these fans, as the plant is now being operated, is exceedingly small, being less than 10 H. P. for each 2,000 H. P. produced, or less than 0.½ per cent. of the power developed by the boilers.

Green Bay, Wis.—The electric cars were started for the first time last Saturday night.

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

NO TROUBLE WITH EMPLOYEES.—Repeated rumors about the development of friction once more between the Lynn & Boston Railroad Company and its employes, which have appeared in certain newspapers recently, are denied by the officers of the company. Mr Foster, general manager of the company, is emphatic in his assurance that the agreement recently signed by the company and the men is being lived up to by all parties, and that there is no reason whatever for the rumors.

MORTGAGE FORECLOSED.—The bondholders have foreclosed on the Union Street Railway at Dover, N. H., and Mr. George A. Macumber, of Augusta, Me., has been appointed receiver and has entered upon his duties.

R. T. WHITE'S ELEVATED SYSTEM.—R. T. White, a Boston inventor and mechanical engineer, who is well known throughout the country by his many inventions of street railway appliances, is trying to induce the legislature to adopt his system of elevated railway. Mr. White has succeeded in getting his petition to construct a road included in the orders of the House of Representatives, so that it will now get a hearing and his system will be carefully examined. Mr. White has a number of substantial backers who would find all the capital necessary for constructing the road.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

A RESTRICTED MARKET.—The market for street railway securities has dwindled away perceptibly of recent days; the bond field has been especially restricted. By reason of the large amounts of money seeking investment in other than steam railway mortgages, street railroad bonds have been put up to figures when the net returns on capital invested are on a lower basis than has ruled for years. In consequence investors are beginning to fight shy of placing further amounts of capital in these securities, albeit that they generally furnish unexceptional advantages as to security. It cannot be said, though, that the dullness of business has militated against prices. Quotations hold with a firmness quite at variance with Wall Street's generally accepted rules as to supply and demand, and their steadiness only goes to prove the assertion made in these columns all along that money placed in street railway stocks and bonds is, when good judgment and care are exercised in the selection of the security, about as safe an investment as the financial bargain-counter counts among its manifold wares.

COMPETITION FOR NEW LINES.—What most local street railway men are at present most interested in is the now open fight between the Third avenue people and the big Metropolitan Traction Company for the acquisition of a franchise to build and operate cable roads from 116th street northerly through Manhattan and St. Nicholas avenues, Kingsbridge and Broadway to the city limits. As intimated in these columns last week the Metropolitan Railway Company (so the traction roads are known here) has made application to the board of aldermen for exactly the same franchise that the Third avenue Railroad Company asked for a year ago, the application still pending before the Board of Aldermen. The Third Avenue people are in high dudgeon over the way their application has been held back till the Metropolitan Traction was ready to step in with a similar request. The Third Avenue claims to have secured the necessary property owners' consent to the proposed extension of system, and it has made arrangements to secure at an instant all the money necessary to build the lines contemplated. The officers are prepared to make a mighty resistance to the encroaching demands of their rich and powerful rival. No action is to be taken till the fall, a public hearing having been fixed for Sept. 13 next, but the fight is on, and promises decided interest. The stock of Third Avenue has gone off a point or two in consequence of this vicious rivalry, but dealers do not fancy any decided slump is at hand. The most interesting fact in connection with the Metropolitan Traction Company's application, which now operates 71.68 miles of street railroads in this city, is its implied announcement that an underground electric system will be used to operate the asked-for extension. It is stated that the company has already arranged with the General Electric for underground electric fittings wherewith to equip 3½ miles of railroad. It is practically sure that, if the system is a pronounced success, it will be used on the new Lexington and Ninth avenue lines, now nearing completion, and it is even hinted that the underground electric motive power will be substituted for the cable on the Broadway line.

NEW CONNECTIONS FOR THE MADISON AVE. LINE.—People dealing in street railway shares are paying a deal of attention to the rumors of consolidation, extension and traffic alliances afloat. Several of them have materialized, so that it is well to consider the value of such reports when estimating stock market values. The Madison avenue car line, finding its business cut into by the quicker service and transfer advantages offered by the Third avenue cable road, has been looking around for some time for new connections, and it has just succeeded in arranging a transfer system at Union Square with the Fourteenth street cars running west to Christopher and West Fourteenth street ferries. There the Forty-second and Boulevard line is arranging to build a crosstown line on the west side to connect with the Madison avenue's line, running from the East River through Eighty-sixth street through Central Park to Eighth avenue. These and other alliances are all the result of the competition instituted by the building and inauguration of the many new lines and systems, and they are likely to lead to new speculative activity in the stock market.

RICHMOND COLLAPSE.—Eastern investors are much interested in the collapse just announced of the Richmond Railway & Electric Company, in that the bonds of this company were placed in this city two years ago by the banking house of John H. Davis & Co. It seems that the company never carried out its contract with the bondholders of the Richmond & Manchester Railway Company, whereby it secured control of the Manchester road, and, in consequence of a default in the payment of interest on the bonds of the Richmond & Manchester Railway Company, guaranteed principal and interest by the Richmond Railway and Electric Company, Judge Simonton, of the United States circuit court, has entered an order appointing Mr. Arthur M. Seddon temporary receiver of both companies, with authority to take full charge of their properties. The Richmond Railway and Electric Company is a consolidation of three street railway and three electric light and power companies of Richmond, and when its is ue of $2,000,000 first mortgage 5 per cent. gold bonds was offered for sale in this city, the promoters made the cheering announcement that the net earnings were 50 per cent. in excess of the annual interest charges. The bonds were offered for sale at 95 and interest; some of the bonds are now offered at 80, but the best bid obtainable for months been around 76—a rather low price for a 5 per cent. bond that has always paid its interest charges. The trouble with the bond itself, aside from its present unhappiness, is the way it was placed. John H. Davis & Co. sold them to their own private customers: the bonds thus never received proper prominence; so that it is now practically impossible to find a market for them.

LONG ISLAND TRACTION continues weak. Mr. Flynn says he will push his suit to break the lease of the Brooklyn City road to a finish, and it seems that this time he means it, as he has everything to gain and nothing to lose by the suit. In the meantime earnings continue good. It is pointed out that on last Sunday the traffic on all the trolley lines of the Traction Company aggregated 460,000 passengers, the biggest day's business since the organization of the company.

NORTH SHORE TRACTION reports net earnings for April of $35,441, an increase of $13,415 over the record of April, 1893, yet the stock does not move up. The brokers say the thing is overdone. There is too much of the stuff, and it will be a long, long time before the traffic will be sufficiently large to make the stock of any value by insuring dividends.

Financial Notes.

West Chicago Bonds.—The Illinois Trust & Savings Bank, of Chicago, has purchased from the West Chicago Street Railroad Company the $1,220,000 tunnel bonds which that company has held in its treasury for some time. The price which the bank paid for the bonds was about 99. These bonds were issued in 1889, and the whole issue is $1,500,000. Before the completion of the tunnel the market for bonds was not favorable. The company supposed that it sold the entire issue soon after the date of the mortgage, but most of them came back into the treasury. They were then used as collateral security for loans. Some of those loans were called during the financial disturbances of last summer, and the company then issued new stock and with the proceeds took up the loans and turned the bonds into the treasury. The bonds are issued by a distinct corporation. The street railroad company leases the tunnel at a rental which it agrees shall never fall below an amount sufficient to pay the interest on the bonds and provide a sinking fund for their retirement. The money which the company now realizes for the bonds will be used in the main to pay for electrical construction.

Detroit Electric.—The Boston *News Bureau* says, in regard to the affairs of the Detroit Electrical Works: "Stockholders are notified that a meeting will be held in Detroit June 23 to consider a letter from Mr. Hugh McMillan, dated June 1, in which he states that the parties to whom he had sold the property through foreclosure April 6 have made default; that it has never been Mr. McMillan's intention to profit personally by the enforcement of the mortgage; and that he always intended to dispose of the equity in the interest of the stockholders, and now, as collections and sales have reduced the amount of his claim, he is willing to accept security upon the property for the balance, if the stockholders wish to attempt a reorganization. Mr. McMillan further declares: 'Whatever is done by me in that direction must be upon the understanding that it is voluntary. I am unwilling that the benefits shall be shared by creditors who are prosecuting suits against the electrical works or myself personally.' "

Chicago Tunnel Bonds Sold.—The Illinois Trust and Savings Bank, of Chicago, has bought the $1,200,000 tunnel 5s of the West Chicago Traction Company, paying about 99 for them. The negotiations leading up to the deal have been going on for some time. The bank has under consideration a proposition from English interests to take the entire block of bonds at a considerable profit over the price paid for them. The deal with the West Chicago Company is, however, contingent on the opinion of Judge Wilson, of Chicago, in regard to the bonds being a first lien upon the property. The proceeds will be used by the West Chicago Company to extend its electrical equipment.

Westinghouse.—A director of the Westinghouse Electric & Manufacturing Company says: "The May shipments of the company were in the vicinity of $500,000, or something above the recent average. The outlook for the immediate future is very fair. The regular meeting of the directors will be held on June 27, when the regular dividend on the preferred stock will be declared. Whether or not a dividend will then be declared on the common it is now impossible to say. The matter has received no consideration whatever at the hands of the directors, and I do not care to express any opinion concerning the probable action."

Increased Earnings.—The earnings of the New England Street Railway Company for the first nine days in June were as follows:

	1894.	1893	Inc.
New Haven	$5,585	$5,098	$488
Plymouth	703	650	52
Total	$6,288	$5,747	$541

Street Railway & Illuminating Properties.—The trustees of the Street Railway & Illuminating Properties have further set aside $50,000 to buy in their preferred shares. Proposals for the sale of same will be received by the trustees until noon of June 19.

Sale of the Rome (Ga.) Railway.—The property and effects of the Rome Street Railway Co., of Rome, Ga., will be sold at auction July 5th.

NEW INCORPORATIONS.

Nashville, Tenn.—A charter of the Nashville Traction Company was secured last week. This is the new name under which the Overland Railroad will be reorganized. The Nashville Traction Company, of which F. W. Hunter is president and Thomas Taylor secretary and treasurer, will purchase the Overland Railroad from Rudolph M. Hunter, who bought it at a recent sale. The new company will immediately proceed to improve the property. The old rails are to be replaced with 60-pound steel rails, some of which are already at the depot. The grades along the route in the country are to be cut down, and new feed wires are to be put up, so that greater speed may be attained in the operation of cars. Five extra open cars have been purchased, and the schedule of the road will be changed so as to run cars to the park every ten minutes. The buildings at the park will be remodeled and the grounds generally improved. The new company has arranged to have concerts every evening and concerts at the park every Sunday.

Pine Bluff, Ark.—The Citizens' Street Railway Company has been reorganized. The new board of directors is composed of John O'Connell, H. P. Bradford, John M. Taylor, T. S. James and Arthur Murray. The following officers were then elected: President, John M. Taylor; vice-president, T. S. James; secretary, Arthur Murray; treasurer, John O'Connell; general manager, H. P. Bradford. General Manager Bradford assumed his duties on June 15. Richard Dorms has been appointed superintendent. The company is making important improvements in the system.

Cortland, N. Y.—The Cortland & Homer Traction Company has been incorporated with a capital stock of $300,000. Those interested in the road are: C. D. Simpson, P. S. Page, H. E. Hand, H. Bergholtz, H. C. Sanderson and I. L. Post, of Scranton; D. F. Van Vleet, E. H. Bostwick, F. P. Fuller, J. A. Maxwell and W. J. Davis, of Ithaca; H. L. Bronson and E. A. Fish, of Cortland. The company is incorporated to construct an electric railway twelve miles in length from Cortland to Homer, and to extend to McGrawville, all in Cortland County.

Philadelphia, Pa.—The Roxborough, Chestnut Hill & Norristown Traction Company has been organized with a capital stock of $5,000. The object of the company is stated to be the construction and operation of motors and cables or other machinery for supplying motive power to passenger railways. The promoters are Wm. H. Heulings, Jr., Jno. T. Dunlap, Henry C. Esling, Philadelphia, Pa.

Gunnison, Colo.—The Willow Creek Railway Company has been incorporated with a capital stock of $100,000. The company will build a railway in Gunnison County. The promoters are S. G. Gill, M. A. Gill, W. J. Fine, H. M. Fine, John Latimer, Gunnison, Colo.

Danby, N. Y.—The Tompkins & Tioga Traction Company has been formed to operate an electric railway from Ithaca, through Danby, South Danby, Spencer and Candor, to Owego. The company is organized to carry mail and freight as well as passengers.

Terre Haute, Ind.—The Terre Haute Electric Railway Company has been incorporated; capital stock, $500,000. The promoters are Paris P. Thomas, John C. McNutt, M. F. Burke, Russell B. Harrison, Thos. Moore, Jr., Thos. A. H. Hay.

Peoria, Ill.—The Mark D. Batchelder Company has been incorporated by Mark D Batchelder, Mary A. Batchelder, George H. Burwell and Minnie E. Calvin. The capital stock is $10,000. The company is engaged in street car advertising.

Tampa, Fla.—R. W. Easley and W. H. Kendrick have organized the Palm Beach Railroad Company with a capital of $25,000, and intend building an electric trolley line from Ybor City to Palm Beach.

Bradford, Pa.—The Bradford Electric Street Railway Company has been incorporated with a capital stock of $100,000. The promoters are W. R. Weaver, C. P. Collins, L. E. Hamsher.

Rockledge, Fla.—The Rockledge Railway & Improvement Company has been incorporated, with a capital stock of $10,000.

NEWS OF THE WEEK.

Toledo, O.—The county commissioners have granted a franchise for the construction of the electric road to Detroit through Lucas Canal. The franchise specifies that the motive power shall be electricity and is not to be changed without the permission of the county commissioners. It was also specified that the rate of fare for persons over 10 years of age would be 1½ cent per mile, and for those under 10 years of age 1 cent per mile. The road is to be completed within 18 months. Those asking for the franchise are Joseph H. Ainsworth, J. Ellery Eaton, W. G. Gardiner, Jacob N. Bick and J. A. Dawson. The line will be from Toledo, through Washington township, Bedford, Vienna, La Salle, Monroe City, Frenchtown, Ashtown, Berlin, Flat Rock, Dearborn, to Detroit. It is expected to make the time between Detroit about as fast as the steam railroads. The franchise for the entire line has now been secured.

Lancaster, Pa.—The jury in the suit of Frank C. Musser, a young drover, of this city, against the Lancaster City Street Railway, to recover $25,000 damages for the loss of his right arm, last week brought in a verdict giving the plaintiff $18,000. The case is likely to be carried to the Supreme Court by the company. Musser lost his arm on July 4, 1892, while walking along the Philadelphia turnpike, a broken section of a steel cable, used in drawing the cars up Pott's Hill, striking him and cutting off the arm near the shoulder. The verdict is the largest ever rendered in Lancaster County for personal injuries, and it is one of the largest ever rendered anywhere against an electric railway company for injuries of this character.

Chicago, Ill.—The Lake Street Elevated Railroad Company has secured an injunction restraining the Northwestern Elevated Railroad Company from interfering with the former's construction work on its downtown loop. The Lake street company asked for the injunction on the ground that it had the first ordinance for a northside L road, mapped out its line and commenced work on it. The bill says the Northwestern "has located its line of road maliciously and willfully for the purpose of depriving the Lake Street L Company of its just gains and profits to be made by its north branch line of the road."

Woodbury, N. Y.—Several attempts have recently been made to wreck the trolley cars on the Camden, Gloucester & Woodbury Electric Railroad by placing obstructions on the tracks. The work of the would-be train wreckers, however, has thus far been unsuccessful, as the motormen have in every instance detected the obstructions before any damage was done. All the attempts to wreck the cars have been made at Shivers' line, on the outskirts of Woodbury, where there is a sharp curve in the road. Heavy pieces of iron have been found wedged between the tracks.

Pittsburgh, Pa.—The contracts for building the extension of the West End Electric Railway from Temperanceville to Carnegie will be made in a few days and the branch will be in operation before the end of six months. It will be about 6 miles long, and will pass through Elliott borough, Obeyville, Crafton, Idlewood and Lee's Bottom. The cost of a trip one way will be 15 cents as against 30 cents at present by railroad, and the round trip will cost 25 cents, as against 55 cents by railroad.

Chicago, Ill.—There is considerable talk of an electric railroad on Kedzie avenue from Blue Island north to Norwood Park, with branches in various directions, one including a line by which the heart of the city will be reached. The work is being done under the name of the Central Construction Company and considerable frontage has been secured. Dr. A. G. Goodman is president of the company.

Brooklyn, N. Y.—At a recent meeting of the Executive Committee of the Board of Directors of the Brooklyn Traction Company, which owns the Atlantic avenue system, the offices of secretary and treasurer, which had been held up to that date by William J. Richardson, a son of the founder of the road, were separated. Mr. Richardson was chosen secretary and Benjamin Frick was elected treasurer.

Pottstown, Pa.—The Ringing Rocks Electric Railway is having constructed at the Philadelphia Bridge Works, Pottstown, an iron tower or observatory 100 feet high, to be erected at the park at Ringing Hill. It will have an elevator and a platform on the top, and one 20 feet below the top. This tower is to be completed by July 4. It will afford a splendid view of the Schuylkill Valley.

Milwaukee, Wis.—The Russell avenue line of the street railway system will shortly be extended to St. Francis and Cudahy and probably to South Milwaukee. Right of way has already been obtained as far as Cudahy and it will be an easy matter to extend it to South Milwaukee. The only condition which is to be met is the raising of a satisfactory bonus by South Wilwaukee.

Alpena, Mich.—The city council has granted a 30 year franchise for operating the electric railway in Alpena to Andrew L. Comstock, W. P. Williams and John A. Drake. It is understood they have completed negotiations for the purchase of the electric light and water-works plant. They will operate the railway and consolidated plant by water power from Thunder Bay River.

Chicago, Ill.—The Cicero & Proviso Railway Company last week presented a petition to the Board of Trustees of the village of Harlem, asking for permission to construct and operate a single track street railway on Harlem avenue, between the north line of the village of Harlem and the center line of West Madison street.

Opelika, Ala.—It is stated that arrangements have been completed for the construction of the proposed electric railway from this place to Auburn, a distance of seven miles. The officers of the company are: President, M. E. Gray, Columbus, Ga.; vice-president and general manager, J. L. Cowan; secretary, C. I. Doughtry.

Fond du Lac, Wis.—In a card addressed to the public W. G. de Celle, president of the Fond du Lac Light, Power & Railway Company, announces that the street railway service will be discontinued July 1, as it has not been profitable. The arc and incandescent business will be continued as heretofore.

A Curious Accident.—While Frances Werner, aged 14, was passing under the Brooklyn Elevated Railroad structure last Sunday, some live coals from an engine fell on her dress and ignited it. Before the flames were extinguished she was so severely burned that she died soon after her removal to the hospital.

Kansas City, Mo.—On June 4 the Kansas City Elevated Railway Company served notice on the Kansas City Cable Railway Company that the arrangement by which it accepted transfer tickets would be discontinued. The latter company began injunction proceedings to prevent the discontinuance.

Electrical Units.—The bill of Representative Charles W. Stone, of Pennsylvania, which passed the House last week, gives national recognition to the units of electrical measurement adopted by the Electrical Congress. The units are the ohm, ampere, volt, coulomb, farad, joule, watt and henry.

Baltimore, Md.—Three weeks ago an ordinance was adopted prescribing that all street cars must come to a full stop before passing fire engine and hook-and-ladder houses. For violating the ordinance eleven motormen of the City & Suburban Company were fined $1.70 each last week.

Luehrig Gas Motor.—United States Consul-General Frank H. Mason writes from Frankfort-on-the-Main that an English syndicate has purchased the American rights on the Luehrig gas motor car and will at once introduce it in the United States on a practical scale.

Chicago, Ill.—The Appellate Court has handed down a decision reversing the judgment of the lower court in which a verdict of $14,200 for personal injuries was given to Mary Fitzgibbons in her suit against the North Chicago Street Railroad Company.

Philadelphia, Pa.—Attorney-General Olney has instructed United States Attorney Ingham, of Philadelphia, to start at once condemnation proceedings to acquire land on the Gettysburg battlefield owned by the Gettysburg Electric Railway Company.

Harrisburg (Pa.) Franchise Purchased.—The Cumberland Valley Traction Company has purchased the franchise of the Harrisburg & Mechanicsburg Electric Railway Company, and will construct the line which will connect Harrisburg with Carlisle.

Middletown, O.—The commissioners of Butler County have granted a fifty-year franchise to the Hamilton, Le Sourdsville & Middletown Electric Railway Company for a road from this city to Hamilton.

Racine, Wis.—The Belle City Street Railway Company has been awarded the contract for city lighting for a term of five years. It will receive $78 for all-night lights and $58 for one o'clock lights.

Danville, Va.—The council of Danville has passed an ordinance imposing a fine of not less than 50 cents nor more than $2 upon boys jumping on and off cars of the Danville Street Car Company.

Indianapolis, Ind.—The case of the city of Indianapolis against the Citizens' Street Railroad Company has been set for June 19. The company will be represented by ex-President Harrison.

Muskegon, Mich.—The Street Railway Company recently awarded prizes of $15, $10 and $5 to the three conductors who sold the largest number of tickets during April and May.

Cambridge, O.—A project is under consideration to build four miles of electric railway in Cambridge and to construct a branch to Byesville, six miles south of the city.

Philadelphia, Pa.—The Select Council has rejected the application of the Diamond Street Passenger Railway Company for a franchise on Diamond street.

Urbana, O.—An electric railway from St. Paris to Mechanicsburg by way of Urbana is projected. Mr. R. S. Stearnes, of Cincinnati, is interested in the enterprise.

Hartford, Conn.—The Hartford Street Railway Company has awarded the contract for setting 2,000 iron poles to Edward Balfe, of Hartford.

St. Augustine, Fla.—Holmes & Jackson are reported as interested in a movement to securing right of way for a proposed electric railway.

Kansas City, Mo.—The Kansas City Cable Railway Company has decided to expend $30,000 in improving the old Kansas City cable lines.

Indianola, Ia.—B. F. Clayton, A. A. McGarry and E. W. Hartman are interested in the project to build an electric railway to Des Moines.

Centerburg, O.—Right of way has been granted to Harry B. Vansickle for an electric railway to Delaware, according to reports.

Rockford, Ill.—It is announced that about four miles of the Rock River Electric Railway will be constructed this season.

PERSONAL.

Mr. Alex. H. Lewis, well known to street railway and electrical men, has become associated with the Abendroth and Root Manufacturing Company, of New York, and will look after the interests of that company from the western agency in Cincinnati. His headquarters there will be in the Neave Building.

George W. Adams has resigned his position as superintendent of the Watertown (N. Y.) Street Railway Company, and Henry W. Hammond, of Carthage, formerly division superintendent of the Rome, Watertown & Ogdensburg Railroad, has been appointed to fill the vacancy.

C. S. Rusling, formerly manager of the railway department of central district of the General Electric Company, is now New York State agent for the Liability department of the Travelers Insurance Company, of Hartford, Conn., with headquarters at Buffalo, N. Y.

S. H. Brakel has been appointed manager of the mechanical and electrical department of the Muskegon (Mich.) Street Railway. Mr. Brakel has been manager of the Telephone Exchange in Bloomington, Ill., for nine years.

M. A. Hanna, president of the Cleveland City Railway Company, was elected last week vice-president for Ohio of the American Protective Tariff League, succeeding the late Hon Geo. H. Ely, of Cleveland.

J. A. Humphries, superintendent of the Rivermont Street Railway Company, of Lynchburg, Va., resigned his position last week, and the directors appointed Walter Legrand to fill the vacancy.

George W. Jacobs, Jr., has resigned the presidency of the South Mountain Electric Railway Company of Boonsboro, Md., and George J. Shafer has been elected to fill the vacancy.

Walter J. Gillham has been appointed superintendent of the Kansas City Elevated Railway Company.

W. J. Cooke, of the McGuire Manufacturing Company, of Chicago, was in New York City this week.

TRADE NOTES.

The United States Headlight Company, of Utica New York, has purchased of M. M. Buck & Co., the Dayton Manufacturing Company, Kelly Lamp Company, Steam Gauge & Lantern Company, J. A. Williams & Co., and the Adams & Westlake Company, the machinery, tools, patterns, etc., constituting their headlight business, together with 32 letters-patent and a number of applications for patents covering all of the standard devices for illuminated numbers and signals in headlights and other desirable improvements therein. It is the intention of the United States Headlight Company to unite with the patents and facilities thus acquired, the result of over 40 years experience in manufacturing headlights, for the purpose of embodying in them the latest improved devices which will add to the design, convenience and durability: furnishing headlights for all purposes superior to any heretofore supplied, at the lowest possible price consistent with first class material and workmanship. Selling agents for this company will be conveniently located in the best distributing points of the country, who will carry in stock a full line of standard headlights and parts thereof, for the purpose of filling all orders promptly.

Insulating paper is rapidly taking the place of cloth and shellac as an insulating material for use in manufacturing and repairing armatures, field coils and electrical work generally. The Beardsley Manufacturing Company, 234 Lake street, Chicago, makes a specialty of this, and claims to make the highest grade and most perfect paper in use. The company reports that its trade is rapidly extending to every section of the country.

The McGuire Manufacturing Company, of Chicago, has purchased the controlling interest in the Columbian street car heater. This heater attracted considerable attention at the Milwaukee Convention last October. It is a base burner that can be easily placed on the car seat without cutting or fitting, and it is claimed requires but a pound of coal per hour to heat a 21-foot car.

The Chicago Electric Truck Company, of Chicago, is about to erect a plant near Chicago for manufacturing its trucks. When completed it will give excellent facilities for handling a large trade and filling orders on short notice. The "Chicago" trucks are proving very popular in service on account of their easy riding qualities.

The McLean Armature Works, 197 South Canal street, Chicago, reports business as unusually good, particularly in the armature winding and repairing department. This company makes a specialty of street railway repair work, and has again enlarged its shop-room and facilities to meet its constantly growing business.

The Complete Electric Construction Conmpany, of New York, has closed the contract to build the Lockhaven street railway at Lockhaven, Pa., and furnish the entire equipment, including power station.

The Clonbrock Steam Boiler Works has closed a contract for Climax boilers of 4,000 H. P. capacity with the Edison Electric Illuminating Company, first district, Pearl street, Brooklyn, N. Y.

RECORD OF STREET RAILWAY PATENTS.

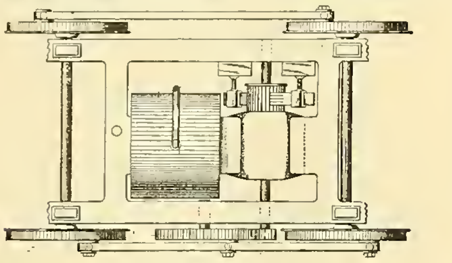
U. S. Patents Issued June 5, 1894.

520,772. Fuse-Box; Axel Ekström, Lynn, Mass. Assignor to the General Electric Company, of New York. Filed Nov. 29, 1892. The combination with a box of line terminal supports arranged at each side thereof, leaving a wedge-shaped space between them, and a wedge-shaped fuse supporting block carrying contacts and adapted to slide in between said supports and fill the space between them, being guided by its edges to a proper position to cause said contacts to engage with the line terminals.

520,776. Lightning-Arrester; John W. Gibboney, Lynn, Assignor to the General Electric Company, Boston, Mass Filed Feb. 6, 1893. The combination with an electric generator, and a work circuit supplied therefrom, of a constantly maintained short circuit of high resistance, and a spark gap lightning arrester, both connected across the main line conductor and to ground.

520,777. Snow-plow; William Grunow, Jr., Mount, Vernon, N. Y., Assignor to Zalmon Goodsell, Bridgeport Conn. Filed Feb. 15, 1894. A snow-plow for street and other railways, consisting of a metal body suspended from carriages traveling upon guides at the front of the car and adapted to be directed to either side of the track, and means for raising the point of the plow to clear obstructions.

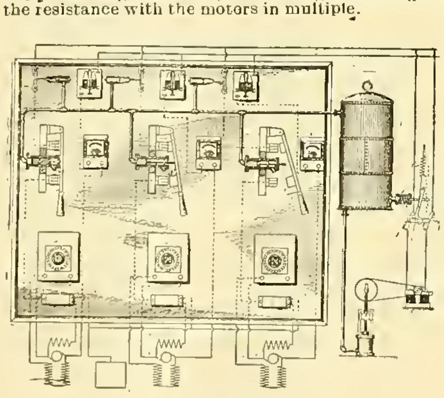
520,780. Electric-Motor Truck; John C. Henry, Westfield, N. J. Filed Aug. 27, 1892. A motor truck comprising two axles, a motor mounted between them, a pinion on the motor shaft, and a large spur gear meshing with said pinion and connected with the car wheels, said pinion and gear being in line with the wheels,



No. 520,780.

whereby the lower edge of the gear can be brought down near the ground without danger of striking obstructions. (See illustration.)

520,784. Electric-Motor Controller; William J. Hopkins and Theodore Stebbins, Boston, Mass., Assignors to the Thomson-Houston Electric Company, of Connecticut. Filed Sept. 19, 1891. This is a controlling apparatus for electric motors, comprising a fixed contact connected to one side of the circuit, a rheostat in circuit with the motor terminals, a transfer switch for changing the motors from series to multiple connection, and a common operating device for cutting down the resistance, throwing the transfer switch and simultaneously inserting resistance, and then again cutting down the resistance with the motors in multiple.



No. 520,809.

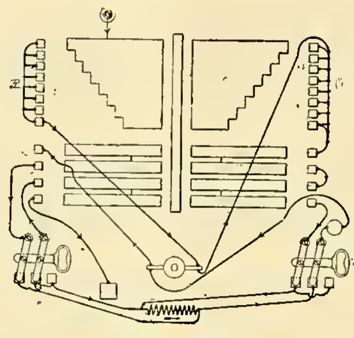
520,787. Electric Locomotive; Walter H. Knight, Lynn, Assignor to the General Electric Company, Boston, Mass. Filed Jan. 18, 1891 This comprises the combination with a vehicle having four axles, of a motor for driving each of the axles, a controller for the motors for connecting the same either in series or parallel and at some points shunting part of the motors, mechanical devices connecting the axles in pairs, one pair of axles being driven by motors one of which is shunted by the controller simultaneously with shunting the corresponding motor of the other pair of axles.

520,789. Voltmeter; Edward R. Knowles, Middletown, Conn., Assignor to the Schuyler Electric Company, of Connecticut. Filed Dec. 5, 1893. This is the combination with a permanent magnet of a spool of non-magnetic material lying transverse to the poles thereof, and containing a socket, and a shell removably fitted into said socket and having journal bearings for an armature spindle.

520,809. Means for Preventing Arcing in Electric Power Stations; Elihu Thomson, Swampscott, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Sept. 1, 1890. The combination with a reservoir and an insulating field distributing system leading to the various circuit-breaking apparatus of an electric power installation, and designed to prevent arcing thereat by delivering a jet of air or like fluid across the arcing space, of a compressor forcing air into the reservoir and a pressure valve connected with the reservoir and controlling the compressor. (See illustration.)

520,811. Electric Meter; Elihu Thomson, Swampscott, Mass. Filed Feb. 21, 1891. In an electric meter, a series coil, an armature, a resistance in series with the armature, and a shunt coil arranged to furnish an initial or starting field sufficient to balance the friction of the moving parts, such coil being in series with a resistance.

520,818. Wire-Stripper; John J. Bettinger, Hamilton, Ohio, Assignor to Charles L. Cornell, same place. Filed Jan. 16, 1891. This is a wire stripper composed of a pair of handles joined by a spring bow and armed with blades projecting inwardly at right angles to the handles and adapted to overlap in shear like contact and provided in the ends of the blades with triangular notches having their sides straight and formed with knife edges.



No. 520,822.

520,822. System of Circuit Control for Electric Machines; Charles E. Davis, Chicago, Ill., Assignor to John H. Leslie, same place. Filed Oct. 16, 1893. The method of variably retarding or checking the motion of motors normally coupled to the feed circuit in pairs, together with a variable resistance for the operation of such motors; consisting in breaking the supply circuit, connecting the motors in series on a local circuit including said variable resistance, and then causing said resistance to be regulated to suit the requirements regulating or varying said retardation. (See illustration).

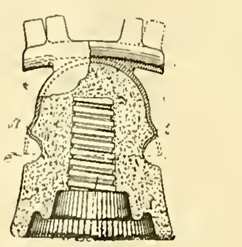
520,852. Electric Switch Box; Edward R. Knowles, Middletown, Conn., Assignor to the Schuyler Electric Company, of Connecticut. Filed Dec. 5, 1893. This is a switch box, comprising a pair of contact arms connected by an insulating link, a block pivotally mounted on the under side of the box cover and having a fork to engage with said link, springs having one end secured to the cover and the other end attached to an eye sliding in a slot in said block, and a handle on the outside of the cover, adapted to operate said block through a lost motion device.

520,855. Feed-Wire Insulator; Charles A Lieb, New York, N.Y., Assignor to the General Electric Company, Boston, Mass. Filed April 12, 1894. This is a cap and cone insulator consisting of a body of insulating material provided with a recessed portion and a shoulder above such portion, a metal cap therefor having a part engaging with the shoulder, and a sleeve having a curved bottom adapted to contain the feed wire. (See illustration.)

520,857. Fender for Railway Cars; John E. McBride, New York, N. Y. Filed Feb. 24, 1894. The combination with a car, of a fender mounted thereon and connected thereto by a bar or bars pivoted at one end to the fender and universally-jointed to the car at the other end, whereby the fender may have vertically and laterally swinging movements with relation to the car.

520,860. Railway-Rail Chair; Henry O'Shea, Johnstown, Pa., Assignor, by mesne assignments, to the Johnson Company, of Pennsylvania. Filed April 24, 1893. A rail chair for railroad rails, comprising two side members, the upper portions of which engage the rail, while the lower edges are provided with feet for a bearing on the tie; an interposed chock upon which the rail rests, and which has lower flanges bearing on the tie, the edges of which flanges engaging the bases of the side members act as a distance piece between said side members, and means, passing beneath the rail, for securing the two side members against the rail and against the chock, whereby the chair may be attached to a rail without cutting or similarly preparing said rail.

520,893. Heat Regulator; James F. McElroy, Albany, N.Y., Assignor to the Consolidated Car Heating Company, Wheeling, W. Va. Filed Dec. 1, 1893. In a heat regulator, a seat provided along its front with two openings, one near the floor and the other near the top thereof, a heater placed beneath said seat, a shutter adapted to close said upper opening, each end of said shutter provided with a means for adjusting the end of the shutter independently, so that the flow of the heated air of one end of a car or other apartment may be controlled without affecting the flow of air to the other end of the same.



No. 520,855.

520,937. Trolley-Wire Support; Louis McCarthy, Boston, Mass. Filed March 3, 1894. A trolley-wire support comprising a supporting-arm, an insulator, and jointed connectors extending upwardly in opposite directions from the said insulator and suspending it below the points of attachment of the said connectors to the said arm, leaving the insulator unconstrained by its supporting devices and free to respond to the vibrations of the trolley-wire. (See illustration.)

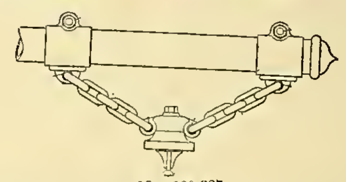
520,938. Closed Conduit for Electric Railways; Paul Plodeck, Sr., Cleveland, Ohio. Filed Feb. 21, 1894. In a conduit for underground electric railways, the combination with a conduit provided with lids for covering the opening in the roadway, of a hanger attached to car-truck, an arm attached to the hanger, an arched bar attached to arm adapted to lift the lids as described, of trolley levers attached to said bar, and arm and trolley wheels adapted to run on the conductors.

520,940. Dynamo-Electric Machinery; Coleman Sellers, Philadelphia, Pa. Filed Oct. 27, 1893. In a dynamo electric machine having a vertical shaft, a cylindrical frame having internal projections and concentric bearings to receive the spider frames within which the shaft is supported, and provided with a ring or flange, or segments of rings or flanges, so situated as to form a ledge upon which the ends of the lower spider frame may rest when removing or replacing the same.

520,963. Ammeter; Edward R. Knowles, Middletown, Conn., Assignor to the Schuyler Electric Company, of Connecticut. Filed Dec. 9, 1892. An ammeter having its helix composed of a continuous strip of metal curved around a center, the inner edge of said strip having two opposite portions eccentric to said center.

520,971. Electric Railway Overhead Switch, Miller A. Smith, Brooklyn, and William Clabaugh, New York, Assignors to the New York Electrical Works, New York, N. Y. Filed Feb. 21, 1894. The combination in a switch, crossover, etc., of a main portion, contact ribs integral therewith, one or more of said contact ribs being provided at the outer end with a key clamp and at the inner end with a clamp formed by a screw-threaded split boss into which enters a projection from the switch, crossover, etc., and a screw nut for said boss.

520,973. Trolley; Edgar M. Tousley, Jamestown, N. Y. Filed Jan. 9, 1894. The wheel having a chamber containing a liquid lubricant and provided with means for insuring the inward flow of the liquid, a bushing

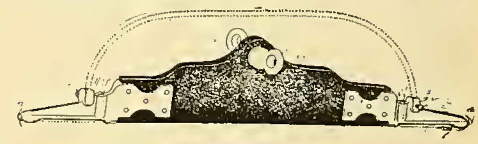


No. 520,937.

containing a semi-plastic lubricant, and an interposed porous body feeding the liquid to the semi-plastic lubricant between the bearing surfaces.

520,975. Converter System for Electric Railways; George Westinghouse, Jr., and Charles F. Scott Pittsburg, Pa. Filed July 31, 1893. In an electric railway, a working conductor, an alternating current generator and main line fed therefrom, and a converter for the working conductor, the primary of which is fed by said main line and the secondary of which is connected to said working conductor; in combination with means for resisting flow of current in series with the primary of said converter and means actuated by the increase of current due to closing the secondary circuit through the car motors for short-circuiting said current resisting means.

521,010. Conduit Electric-Railway System; James B. Brand, Milwaukee, Wis. Filed March 19, 1894. An underground conduit for electric conductors, comprising a closed tube or pipe, a conductor extending longitudinally therethrough, but insulated therefrom, a plurality of contact devices movably engaged within bearings in the side wall of said tube or pipe and adapt-



No. 521,124.

ed for electrical contact with said conductor, means for normally holding said contact devices out of contact with said conductor, and a service rail comprising a plurality of sections flexibly engaged with and insulated from each other at the joint and pivotally connected at the joint with said contact devices.

521,014. Railway Switch; Harry B. Büttel, Newark, N. J. Filed Sept. 19, 1893. An improved switch-operating apparatus, consisting of a vertically movable rod mounted in suitable bearings, secured to the car, and adapted to engage with and open the switch tongue; a lever fulcrumed on the platform of the car within reach of the driver or motorman, and means connecting with said lever and said rod, whereby the latter is operated.

521,034. Car Brake; John Mayer, Amsterdam, N. Y. Filed Feb. 6, 1894. In a car brake, the combination with a car, of a series of contact blocks hung from the car over the track rails, each block having an upright limb and two divergent arms, the lower faces of which are convex, the blocks being pivoted near the junctions of their arms and limbs, and a device on the car adapted for manipulation at each end of said car, and arrange to rock the blocks in either direction.

521,124. Section-Insulator; Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Filed Jan. 25, 1894. A section insulator for an electric trolley system, comprising an insulating block or strip of fiber, hard rubber, or the like, with end slanting fingers or arms with divided ends engaging said block or strip and each having a channel in the lower edge thereof and a socket, said channel of each finger or arm merging with a vertical opening, tightening means connected with each socket, a bridge wire adapted to be detachably connected with the sockets of said fingers or arms and staples or hooks connected with said block or strip for the reception of guys adapted to support the device. (See illustration.)

STREET RAILWAY GAZETTE

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CONTENTS.

Accurate Motor Testing. Elsewhere in this issue we publish a second article by W. Nelson Smith dealing with the inaccuracy of the methods employed in calculating the results of electric railway motor tests. The points to which Mr. Smith calls attention are worthy of careful consideration. In a former article Mr. Smith directed attention to the errors that have often crept into calculations of this kind, and in this contribution he gives specific examples of the way in which the two methods of calculation affect the results. It will be seen that in the cases cited the tests were competitive and the decision as to which was the most efficient motor depended entirely upon the way in which the results were calculated. The error which Mr. Smith points out is certainly a very simple one and all too common in ordinary tests made with the ammeter and voltmeter as the only measuring instruments. As we have before said in these columns, the commercial testing of electric railways has never received the careful attention that has been given to other branches of engineering of much less consequence. Many tests have been made and results published for the purposes of advertising some particular motor, but too often these have been not only unreliable and inaccurate, but incomplete and misleading. We hope to see greater care and more accuracy on the part of both engineers and manufacturers.

Information for Motormen. A communication from an experienced and intelligent motorman, presented elsewhere in this issue, criticises the policy of manufacturers in withholding information regarding their motors from the men who are to operate them on the road. The matter is one which companies may well consider carefully, especially in view of one statement that the writer of the communication asserts. He insists that many motors are condemned by street railway companies not because of any inherent defects, but because the men in charge of them do not understand them and fail to handle them intelligently. It is a grave mistake to put men in charge of electrical apparatus without giving them any sort of an idea of the principles on which it is constructed and operated. An intelligent class of men is required to operate electric cars, men of a better ability than were needed to drive a slow-going pair of horses. One of the first steps in securing employes of this class is to insist that the men shall have at least a general sort of a comprehension of the apparatus which they are to operate. When men versed in the fundamental principles which underlie the operation of electric motors are secured, cars will be run with more satisfaction to the management and to the public, accidents will be fewer, repair bills will be smaller and the number of cars stalled on the roads because of some trifling trouble which the motorman should be able to remedy will be greatly decreased. The writer of the communication expresses in somewhat complimentry terms his appreciation of the series of articles by Mr. Nelson W. Perry, which we are publishing. We are thoroughly convinced that the manager of an electric railway cannot make a better move than to bring these articles to the attention of his motormen. In no other publication with which we are acquainted is the information designed for motormen so comprehensively and intelligently presented.

Operation of the Intramural. The figures given elsewhere in our columns regarding the cost of operation of the Intramural railway are of great interest as indicating to a certain extent what may be expected of electricity as a competitor of steam for the hauling of such trains as are used for elevated railroad service. The figures so far given out for publication are somewhat meager and incomplete, so much so in fact that it is almost impossible to make comparisons with the cost on other systems, if indeed such comparisons are not made practically valueless by the peculiar character of the service that the Intramural road was called upon to furnish. As it was built entirely within the Exposition grounds, it was not possible to have any very great length of straight track. The structure and power-house were temporary in character, and the whole system was a new and untried one, with no former experiments available to direct the management in its methods of construction and operation. The results are therefore not such as might be expected from the operation of such a road as the Alley Elevated in Chicago or the Manhattan in New York, although in a general way it is possible to judge from these figures about what might be expected in such cases as those mentioned. An interesting comparison is shown between the speed curves of the Intramural trains and those of a steam propelled train on an elevated structure. The comparison exhibits the superiority of the electric motor in getting a train rapidly under headway after leaving a station and thus increasing the average speed of the train between stations. Of course this was to be expected, but the curves we have shown, both taken from actual service, are good evidence of the extent of this advantage. In cable railway practice the rapid acceleration of the loaded train is so great as to frequently produce annoyance and discomfort to standing passengers and may, if a number of trains are accelerating rapidly at the same time, result in a broken cable. Here the maximum speed is reached in very short distance, while, as is shown by the curve, the steam locomotive doing elevated or suburban railroad work does not reach its maximum until about the time steam is shut off, and the brakes are applied to slow down for the next station, thus materially reducing the average speed, and so the number of trains that may be run on a given headway. As shown by the results of the Intramural service the acceleration of an electrically propelled train is much more nearly equal to that of the cable than of the steam locomotive. The figures show that the cost of transporting the passengers was less than that of transporting those who travel on the Manhattan system in New York, but it seems to us absurd to make any comparison between two systems so widely different in their length, capacity and character of traffic.

Blockades on Street Railways. Nothing so exasperates the man in charge of the motive power of a street car, be he motorman, gripman or driver, as the delay caused by an obstinate teamster who refuses to leave the tracks and turns a deaf ear to the sound of the gong and to the appeals of trainmen. There are ordinances in force in most cities making it an offense to do this sort of thing, but unfortunately the measures are as dead as the "Blue Laws," and teamsters continue to block cars day after day and are never called to an account for their flagrant violations of municipal regulations. The evil, however, is not quite so pronounced as once it was, for since the introduction of rapid transit on surface lines stubborn and defiant teamsters have learned by bitter experience that in collisions between their wagons and cars propelled by mechanical power they and their vehicles are likely to be the worse sufferers. The practice, however, is still indulged in to a shameful extent in most large cities by the contemptuous proprietors of coal wagons and other heavy vehicles; and that no effort is made to secure the enforcement of the ordinance prohibiting the nuisance simply shows how long-suffering are the street railway companies and their passengers. But too much patience and forbearance may be exercised by companies in cases of this kind and too little regard be paid to the passengers, all of whom are annoyed if they are delayed. Certainly the interests of patrons would be consulted if strenuous efforts were made to secure the arrest of a few of these exasperating drivers. If several of them were fined for obstructing cars the news would soon be printed abroad in any city and the nuisance would soon be abated in that community. Another cause of annoyance somewhat allied to that already referred to, in that it causes in the same way a vast deal of inconvenience to the public, is the blockading of street car lines by parades and funeral processions. That the transportation facilities of an entire city should be rendered useless for any considerable time for such a reason is an outrage on the public, but it is happening continually. Chicago suffered almost daily from this cause during the World's Fair; and in Milwaukee, last week, not a car stirred for over an hour, because a funeral procession was taking place. It is not to be wondered at that the press of Milwaukee is demanding the repeal of the ordinance which makes such public inconvenience possible. With street railway companies and their passengers the matter of time is one of paramount importance, while time is of relatively small importance to those engaged in procession. The remedy seems obvious. Before granting a permit for any procession or parade, local authorities should invariably insist that the line of march should be so planned that the least possible interference with street car lines would be caused. It should then be thoroughly understood that the blockades on lines which were to be crossed should be allowed to continue only for a few moments. At intervals the line should be opened and the delayed cars should be permitted to proceed. Such a plan would not involve more than a moment's loss of time to the paraders who could easily close up the break in the line. Mail wagons have the privilege of breaking through lines, and some such scheme for preventing delays should be in force for the benefit of the traveling public. Such an arrangement would not interfere materially with parades, and it would not be considered by sensible people disrespectful in the case of a funeral. In each case the rights of the public would be preserved and parades and the processions would be prevented from becoming unmitigated nuisances.

MOTORMAN'S KNOWLEDGE OF HIS MOTOR.

To the Editor of the STREET RAILWAY GAZETTE:

In an editorial in your issue of June 16th last, referring to Mr. Perry's articles, you speak of the fact that the manufacturers are too exclusive in giving information regarding their motors to the motormen who are to handle them. From practical experience with motors of different makes I can substantiate every word you say in this respect. Although I carry the best of letters of recommendation as a motorman in high speed work I have not known fully until recently just why my car started slowly and gained speed as the cylinder was pushed around to the seventh or tenth notch as the case may be. I have taken new motors out of the house, and when I asked the experts from the factory for pointers they would either reply with a long harangue that amounted to nothing or they would remark that there was nothing to be told. The only thing to do was to blunder along as well as possible. They would never let you see a blue print. If some simple little thing happened, however, and you were pulled into the house, they would want to know why under the sun you didn't fix up the trouble and go ahead. Then they would raise a great cry about your ignorance when they ran across the superintendent. Who is to blame?

More motors have been condemned in the last few years because they have been ignorantly handled than because of their inherent imperfections. It is my candid opinion that if the manufacturers would issue circulars giving genuine information instead of so much that is puffery and mere trash the result would be decidedly beneficial. If I could not replace the series of articles written by Mr. Perry I would not dispose of mine for a hundred dollars. I think every motorman should secure these articles and study them until he is thoroughly acquainted with them. I would not be afraid to venture the assertion that not one in twenty-five, or even one in fifty, motormen understands his motor as a marine engineer understands his engine. MOTORMAN.

CHICAGO, June 19, 1894.

GETTYSBURG RAILWAY LITIGATION.

The Gettysburg Electric Railway Company began suit in the United States Circuit Court in Philadelphia this week to enjoin the officials of the United States from instituting condemnation proceedings to acquire property belonging to the complainant on the Gettysburg battlefield. The condemnation proceedings which were instituted on behalf of the government a few weeks ago were dismissed by the court at that time, because Congress had not explicitly delegated to the government the authority to acquire property. A joint resolution was then passed by Congress conferring the authority to start the condemnation proceedings and suit was commenced about two weeks ago.

The suit which the company has begun in its opposition to the condemnation proceeding is entitled the Gettysburg Electric Railway Company against the Hon. Daniel S. Lamont, Secretary of War; Hon. Richard Olney, Attorney-General, and Ellery P. Ingham, United States Attorney. In the bill which has been filed the constitutionality of the act on which the proceedings are based is called in question.

TROLLEY CAR WRECKED AT A STEAM RAILROAD CROSSING.

A serious accident occurred at Paterson, N. J., on Monday of this week, in which a trolley car was demolished and eight persons more or less seriously injured by collision with a fast express on the Susquehanna Railroad. The gateman, whose duty it was to guard the crossing, was leisurely talking politics with a neighbor fully 50 feet from the crossing, while the car conductor, seeing the gates up and the gateman so unconcerned, thought the way was clear and signaled the car to go ahead without looking for an approaching train.

ORGANIZATION OF NEW YORK'S RAPID TRANSIT COMMISSION.

At this week's meeting of the Rapid Transit Commission all the members were present. Wm. B. Parsons, the designer of the underground system agreed on by the former commission, was chosen chief engineer. Lewis L. Delafield was appointed secretary at a salary of $2,500. Permanent rooms have been secured on the ninth floor of the Home Insurance Building, at 260 Broadway, where the next meeting will be held June 28.

BROOKLYN TROLLEY CAR SPEEDS.

George W. Plympton recently submitted the following report to Mayor Schieren in regard to the speed of trolley cars:

"The complaints of several citizens in regard to the unlawful speed of trolley cars, referred by yourself to the Subway Commission, have been considered and examined with the results given below.

"The first complaint was made by residents of Eighteenth street and Seventh avenue, and specified the section of the Seventh avenue trolley line between Seventeenth and Twentieth streets as a locality where the speed was dangerously high. Measurements made June 2, between 10:15 and 10:45 A. M., gave for the block between Eighteenth street and Nineteenth street the following results:

Car No. 415	16 miles per hour
Car No. 423	15½ miles per hour
Car No. 139	12¼ miles per hour
Car No. 142	12 miles per hour

"Fourteen cars passed during the time of the observations. Ten of them did not exceed the required limits of velocity.

"Another complaint referred to the speed on De Kalb avenue between Nostrand and Marcy avenues. Measurements made on this section gave results as follows:

Car No. 237	15 miles per hour
Car No. 221	15¼ miles per hour
Car No. 213	15 miles per hour
Car No. 216	13 miles per hour

"Five other cars passed at a proper rate of speed during the time of observation, which was between 2:45 and 3:15 P. M., June 3.

"It should be said in regard to both sets of observations that the velocity here reported was continued only within the limits of the block, but it was dangerously high for a short distance.

"A third complaint relates to the noise occasioned by the crossing of the trolley lines of Nostrand avenue and Park avenue. There is no question here of too high speed, only of imperfect construction at the intersection. Such a crossing is necessarily noisy, but in this case the disturbance might be alleviated by the adoption of a better method of construction."

ELEVATED vs. SURFACE LINES IN CHICAGO.

A director of the West Chicago Street Railway Company, in speaking of its affairs, says a good deal of talk is going the rounds of speculative circles to the effect that the company has not been earning its dividend. Continuing, he said:

"That is true of every street railroad in Chicago, not only this year, but for the first four or five months of every year. From January 1 to about May 1 we do not expect to earn our dividend, and would consider ourselves remarkably lucky if we did do so. Street railway companies' profits are made during the summer and fall months, when people are attracted to the parks and other points of interest about the city. Every pleasant Sunday from this time on will mean an increase of at least $7,000 in our receipts. The elevated railroads are not going to make such serious inroads on the business of the West Side surface lines as some people seem to imagine. In the first place the elevated roads will have to depend largely on the long-haul traffic, and they are welcome to that. There is no money in carrying a passenger more than three and one half miles for 5 cents, as any railroad official will testify. It is the short distance business that pays, and with our electrical lines once in operation I do not think that much of this will go to the elevated roads. Another fact that is overlooked is that wherever electricity has been substituted for horse power the short-haul traffic of the line has increased all the way from 25 to 60 per cent. Chicago needs elevated roads, but it is mainly because they afford rapid transit to and from the suburbs, and not because they are of any especial convenience to persons traveling distances of less than two miles. The consequence is that these roads, here as elsewhere, must to a very large extent develop their own traffic by building up the territory through which they pass."

DISCUSSION ON ELECTROLYSIS IN A GAS ASSOCIATION.

At the meeting of the Pacific Coast Gas Association, at Sacramento last month, John Kempt, of Salt Lake City, read a paper on "Foes to Our Gas Mains and Service Pipes." He referred to the fact that, in his city, gas pipes had been very seriously corroded by currents leaking from the street railway circuits, and he remarked that "unless some better and more certain way of protecting our mains and service pipes is used, or the street car companies are made to take care of all their current, we will soon be out of the gas business in a number of our cities."

In the discussion that followed, C. W. Quilty, of the San Jose (Cal.) Light and Power Company, said: "San Jose had the pioneer electric roads in this State, and, as far as we have been able to ascertain from practical experience with two electric roads, the greatest danger is where the current returns to the generating station. The damage on the Alameda has been very severe on the water company. Our gas mains have been affected very little because they are quite close to the water mains, and the latter are a better conductor. Some gentleman suggested that, if we would assist the electricity back from our pipes to the generator, and have plugs in the mains with metallic connection, it would facilitate the return of the electricity and prevent a great deal of this trouble. The water company in San Jose has had to replace its water mains in front of the power-house two or three times, and the results indicate that the corrosion is due to our foe, electrolysis."

John A. Britton, of the Oakland (Cal.) Gas Light and Heat Company, said: "We have probably more miles of electric railway in Oakland than in any other city of its size in the United States. We are gridironed with electric roads. Our experience is that the main trouble has always been at or near the power-house. I do not think a single instance has ever been cited of damage to cast iron pipes by the electric current beyond 100 yards either side of the power-house. Probably the difficulty is greater in Salt Lake City by reason of the flowing water through the streets, and its seepage through the ground. The ground is naturally very damp in all directions surrounding the gas pipes, and the water and the damp earth which surrounds it help the current in its endeavor to get back to its source. We have tapped probably 30 places in Oakland, within a distance of 20 feet from the rails of the electric company, and so far found no damage whatever. The only evidence of the electric current using pipes for return that we have seen, was in the town of Berkeley, at a distance of about 300 feet from the electric road, where our man dug down to tap the pipe, and the electric current knocked him out of the hole. Our pipes cross the electric road about a block farther away, and my theory was that the wires rested upon our pipe, and the pipe had carried the leakage. There was a soldered joint in the bond wire. We have an opposition water company in our city, and their pipes are sometimes within two inches of ours and sometimes right over it. I think they are going to be our preservation, if any trouble of this kind comes. In such an event I think the trouble will come to the water pipe, before it reaches the gas pipe. I think, too, the electric current is a 'Bogie man,' and I think the telephone companies having underground conduits are raising most of this trouble, and endeavoring to make the gas companies parties to it, and I do not think there is anything to be feared, except where the pipes are immediately adjacent to the power-house. Fortunately we have no pipes at or near the power-houses in Oakland. We have had no difficulty so far with this question, with the exception that I speak of. I think no gas man will say that he has had any real difficulty, unless it should be a case like I mentioned in Berkeley, where the bond wire, or the return wire, comes in very close contact with the rails, the earth being worn away and the copper wire resting upon it. But I think also we should demand that the electric railway companies, in laying their rails, should have the return wires and bond wires of the rails kept within proper conditions, and I think that municipal legislation to that effect could be had. The construction of electric roads should be subject to the inspection of an electric inspector."

Edward C. Jones, of the San Francisco Gas Light Company, said: "I once had a friend who, upon trying to light the gas, found that water spurted out to the ceiling. He found that one of his mains had been undermined and broken by a broken water pipe on a hill some distance away, filling an entire gas district with water. Thus the friendly water mains spoken of by Mr. Britton may become a boomerang."

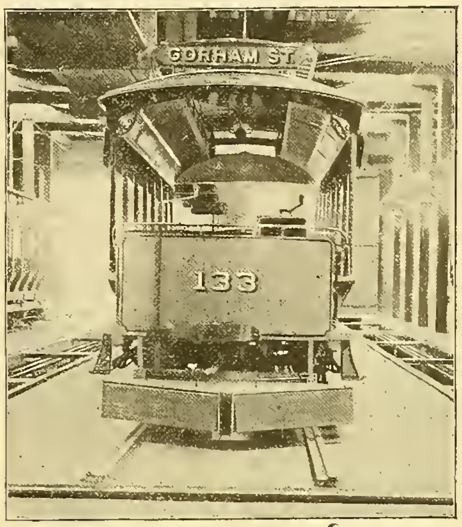
D. Decker, of the Fresno (Cal.) Gas and Electric Light Company, said: "As I feel somewhat more at home on the subject of electricity than I do on the subject of gas, I would like to offer some suggestions. Electricity follows the lines of least resistance. No matter how you insulate the rails from the earth, there is considerable resistance in them, owing to the fact that they are made of iron, and also the fact that the rail is laid on the ground. Consequently the loss of current from the rail would be proportional to the difference between the resistance of the rail and the resistance of the ground. The object of electricity is to find its way back by the easiest route, and it will diffuse itself all around, in different directions. The water pipe having the greatest area, it will take that route back. All the current that reaches out for its conductivity, that reaches the water and gas pipes, must eventually leave them. It simply follows them on the way back to the generator, using them for that purpose. When it reaches a point that it is possible to leave them it will do so. If it oxidizes it will eat out the pipes. I am surprised that electricians have not come forward and suggested the remedy. The electric current has no bad effect while it is properly conducted. It will not be long, in my opinion, before somebody will suggest a remedy, after the gas and water companies discuss the trouble sufficiently. You will see the day when they will force all electric street car lines to make proper connections through water and gas mains.

BARNES' AUTOMATIC LIFE GUARD.

The accompanying cut illustrates an automatic life guard invented by Thomas Barnes, of Lowell, Mass. The device is in the form or shape of an isosceles triangle attached to the end of the car; in the center is an ordinary buffer that is padded and covered with leather. This buffer is set on or rests against a spiral spring in such a manner that any object striking against it is turned in a lateral direction either to one side or the other. The buffer forms the apex of the triangular life guard; and the blow a person receives from it, although the car may be going at a high speed, is, owing to the spring and pad, comparatively light. When the person or object struck is pushed to one side the momentum of the car brings the object so struck against one side or the other of the triangular guard. The instant there is a pressure against either side it releases a catch and powerful springs push the sides out straight and parallel with, but outside of, the rails and wheels, thus brushing any object that is over four inches in height to one side and out of the way of the wheels. The sides of the guards are also padded and have a double front. The outer and padded front of the side guard also rests on spiral springs which give way sufficient to lessen the blow if the one in front of the car is struck by one of the sides in place of being struck by the buffer. It is claimed that it will be impossible for any one to be mangled by the wheels of an electric car equipped with the Barnes life guard. The advantages of this life guard are its simplicity of construction and the ease with which it may be applied to the car. One guard will suffice for each car, as it may be reversed at the end of the route to the other end of the car in a minute's time and thus save expense. Being automatic in its action it requires no care on the part of the motorman.

BRILL VESTIBULED OPEN CARS.

The accompanying illustration shows one of the new style of vestibuled open cars built by the J. G. Brill Company, of Philadelphia, for the Hartford Street Railway Company, of Hartford, Conn. Other cars of the same type have been built for the



Barnes' Automatic Life Guard.

Central Railway and Electric Company, of New Britain, Conn.; the Lehigh Traction Company, of Hazleton, Pa., and for the Easton Traction Company, of Easton, Pa

These cars have seats arranged lengthwise of the car on each side of the motorman's position. There are two seats at each end accommodating three passengers each. Their total seating capacity provides for 47 persons. The inside finish is known as the Palace No. 2, with decorated veneer ceilings, spring roller curtains and a handsome vestibule, as shown. The motorman's box contains sufficient room for all the brake mechanism, sand-boxes, track scrapers if desired, and controlling apparatus. The partition extends to the height of the motorman's waist. The cars have full length monitor deck roof, bronze metal trimmings, and are handsomely finished throughout. In the Hartford

United States statute prohibiting the importing of alien labor.

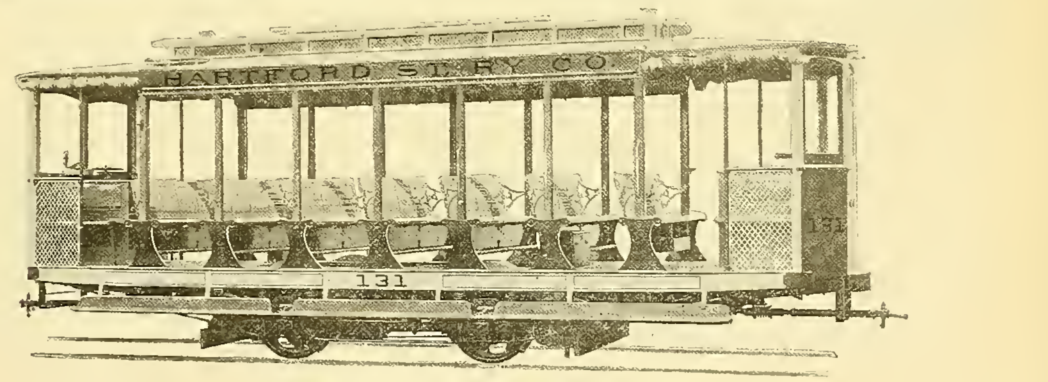
"In times like these when there is not work enough for all, I am not prepared to say that the Common Council may not lawfully make it a condition of a grant to a street railway to use one of the public streets and carry on a business of a public nature, that the company shall give citizens preference in its service, notwithstanding the fact that there is no statutory law governing the matter."

OPERATING EXPENSE OF THE INTRAMURAL ELEVATED ELECTRIC RAILWAY.

The figures given below, for which we are indebted to the *Street Railway Review*, are the first that have been published regarding the actual cost of operating the Intramural electric railway at the World's Fair. Since they were obtained from W. E. Baker, who was general manager of the Intramural, and who is now consulting engineer for the Metropolitan Elevated, Chicago, since that company has decided to adopt electricity as the motive power, the figures may be regarded as authentic. During its six months of operation the road carried 5,803,895 passengers. The price of tickets was ten cents each.

Most of our readers are acquainted with the general plan of construction and equipment of the road. It will be remembered that the line consisted of a wooden elevated structure of a sufficiently strong character, but temporary enough to be wrecked at the end of the period without too great waste. The columns were of wood, carrying wooden stringers and girders, surmounted by double tracks. The total length was three and a quarter miles of double track, looping at either end. The power house was a temporary structure also, but was well built and amply sufficient for far greater output than was found necessary at any time during the exposition, with the exception of one occasion. Twelve trains during September and October was the maximum number in use, with less during the first of the exposition period.

The road, of necessity, abounded in curves, varying from 200 feet to 90 feet in radius, the total number being 22. Stations were 1,590 feet apart. To each motor car were attached four General Electric motors weighing 3,800 pounds each, including gears. The weight of the motor car was 44,600 pounds; weight of trail car, 27,000 pounds; and as one motor and three trailers were run in each train the total weight of the train was 62½ tons. The horse power of each motor was 133. The highest speed run was 32 miles an hour;



BRILL'S OPEN VESTIBULED CAR.

cars, one of which is shown herewith, the height was restricted because of the necessity for operating under a bridge with 11 feet clearance, so that it was necessary to cut down materially on the shoulder-posts to come within the restrictions of height.

EMPLOYMENT OF LOCAL LABOR.

In a recent opinion submitted to the Board of Councilmen of Buffalo, Corporation Counsel Laughlin referred as follows to the employment of local labor by the street railway company:

"The State law giving citizens preference over aliens on public works and municipal contract work does not apply to steam or street railway companies. The only law limiting the right of such companies to employ whom they see fit is the

average speed, 10 miles. Actual operation required 42 H. P. per train, or a total of 500 H. P. for 12 trains. On Chicago day 125,476 passengers were handled on 14 trains, with a mileage of 1,000, or 125 passengers per train-mile.

The total earnings, expenses and net earnings per train-mile of the system for the term may be seen in the following table. May is eliminated, as the Fair had hardly opened and the system was just being tested:

	Earnings.	Expenses.	Net.
June	$2.82	$0.81	$2 01
July	2.44	.70	1.74
August	3.08	.63	2.45
September	4 40	.67	3.73
October	5.12	.71	4.41

The cost per passenger for the whole term, including the month of May, was $0.021.

The average power for August and September was 31.4 K. W. per train = 42.0 H. P. For the month of August the following is an exhibit of cost of the various departments of service :

Power-House.—Fuel, $1,379.17 (oil burned); labor, $1,348.18 (30 per cent. of which was Exposition labor, which, strictly speaking, should not be counted); lubricants and waste, $134.14; train-miles run, 32,058; ton-miles (empty trains), 2,042,094; passengers carried, 1,000,672. Operation of power-house per ton-mile: fuel, 0.00067 cent; other expenses, 0.00072 cent; total, 0.00139 cent; total kilowatt-hours developed in August, measured by wattmeter, 133,049.

OPERATING EXPENSES.

	Total.	Per train-mile.
General expenses	$4,763.89	$0.1486
Transportation expense	12,716.78	0.3966
Maintenance way and buildings	1,209.38	0.0377
Maintenance equipment	1,393.15	0.0434
Total	$20,083.20	$0.6263

The cost of operating per train-mile then was $0.626, and the cost of fuel was $0.043. The exhibit in the accompanying table is self-explanatory. It gives the operating expenses and the cost of motive power for each month of the term :

A comparison with Manhattan Elevated traffic shows as follows :

In 1887 the Manhattan carried 158,963,232 passengers, at a cost of $4,498,462, or $.028 per passenger.

In 1889 the Manhattan carried 179,497,433 passengers, at a cost of $4,858,703, or $.027 per passenger.

In 1890 the Manhattan carried 185,833,632 passengers, at a cost of $4,854,202, or $.026 per passenger.

In 1891 the Manhattan carried 196,714,199 passengers, at a cost of $4,975,141, or $.025 per passenger.

In 1893 the Intramural carried 5,803,895 passengers, at a cost of $121,848, or $.021 per passenger.

If the rate per passenger on the Manhattan, in 1891, had been 2.1 cents instead of 2.5 cents, the saving resulting would have been $786,856 to the Manhattan system.

The diagrams, Figs. 1 and 2, are specimens of those showing the operation of Intramural trains. These show plainly that one of the most important features of electric train service is the rapidity with which the motors accelerate the load and reach, very quickly after starting, the maximum speed. In striking contrast with this is the speed curve, Fig. 3, showing the rate of acceleration of an elevated train drawn by a steam locomotive. This curve was taken by a Boyer speed recorder from an actual train in regular service, and is reproduced from the STREET RAILWAY GAZETTE of May 5, 1894. The requirements in the two cases are not very different as the distance between stops is about the same and the maxium speed to which the motor must accelerate the load is nearly the same in the two cases.

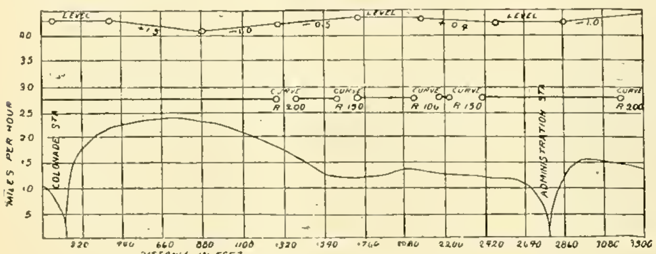


FIG. 1—INTRAMURAL SPEED CURVE.

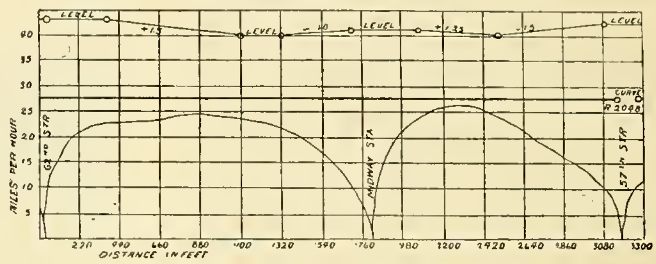


FIG. 2—INTRAMURAL SPEED CURVE

GENERAL EXPENSES.

	May.	June.	July.	Aug.	Sept.	Oct.	Ave.
Payrolls	$7,150.95	$14,673.52	$19,259.00	$19,904.80	$14,466.71	$14,771.26	$14,204.87
Cost, per train-mile, all items	1.69	. 1	.70	.63	.67	.71	.87
Oil, per train-mile (gallons)	8.99	2.88	3.44	2.49	3.56	4.36	4.28
Cost of fuel, per train-mile (cents)	15.54	4 97	5.95	4.30	6.15	7.54	7.408
Operation of power-house, per train mile (cents).	15.46	5.61	6.15	4.21	4.08	4.20	6 618
Wages motormen, per train-mile (cents)	8.42	6.74	6.38	6 09	6.09	6.53	6.708
Oil, per passenger	.38	.10	.14	.08	.08	.08	.172
Passengers, per train-mile	23.75	28.31	24 46	30.97	44.29	51.32	33.85

MOTIVE POWER EXPENSE (CENTS).

	Repairs, Equipment.	Fuel.	Lubrication car.	Power-house wages.	Motormen's wages.	Lubrication, power-house.	Repairs.	Total.	No. motors
June	3.26	4.97	0.47	5.61	6 74	0.28	.06	21.39	8
July	3.13	5.95	0.32	6.15	6.38	0.79	0.29	23.01	12
August	3.04	4.30	0.40	4.21	6.09	0.38	0.42	18.84	12
September	5 09	6.15	0.23	4 08	6.09	0.77	0.28	22.70	13
October	6.12	7.54	0.42	4.20	6.53	0.70	0.57	26.08	11

The men employed on the payroll during the term for operating the system were as follows: Train service, 110: power-house, 51; repair shops, 132; station service, 151; general offices, 23. This number was large in a few departments, resulting from a new system, but the handling of 5,000,000 in six months, with a train service of 110 men, deserves attention.

The repair shops employed 133 men because a large part of this work was really construction. Men competent to do the work were difficult to obtain, and the changes made in this department were more numerous than in any other. On August 15 the total number employed, including timekeepers, inspectors, etc., was 25. The total repairs for the period were $5,916.35, of which electrical equipment counted $4,047.28: electric power plant, $38.91.

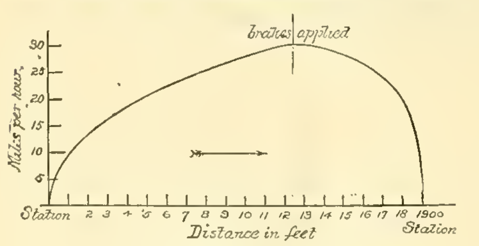


Fig. 3—Steam-Train Speed Curve

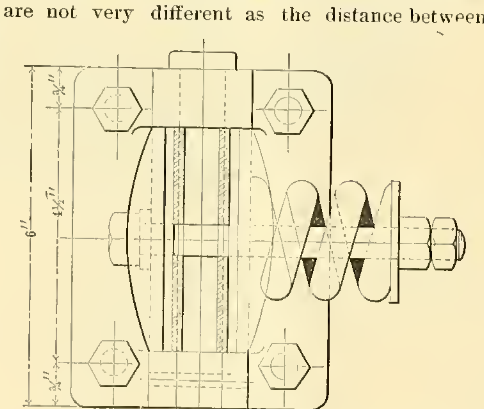


Fig 2—Plan View of Gibbs' Spring Dampener.

Lorain, O.—The capital stock of the Lorain Street Railway Company has been increased from $40,000 to $100,000.

THE GIBBS SPRING CONTROLLER.

The accompanying diagrams represent the arrangement of a device invented by Mr. Geo. Gibbs, mechanical engineer of the Chicago, Milwaukee & St. Paul Railroad, which is intended to so control the motion of a spiral spring as to give it the smoothness of action of an elliptic spring. The difference of action in these two classes of springs is due mainly to the friction between the plates of the elliptic spring which gives it the easy action so desirable on street cars. Mr. Gibbs' device is intended to supply to spiral springs the required amount of friction at a small additional cost.

Figs. 1 and 2 show in detail the construction of the "vibration dampener," as it is called, as designed by Mr. Gibbs for street car service. To the under side of the car frame is fastened a casting. Lengthwise through this casting is a heavy pin over which is folded a sheet of iron or steel. Another sheet is hung from a casting on the truck, but instead of bearing directly upon the pin it bears upon a casting through which the pin passes, this casting being so much larger than the pin that the folded

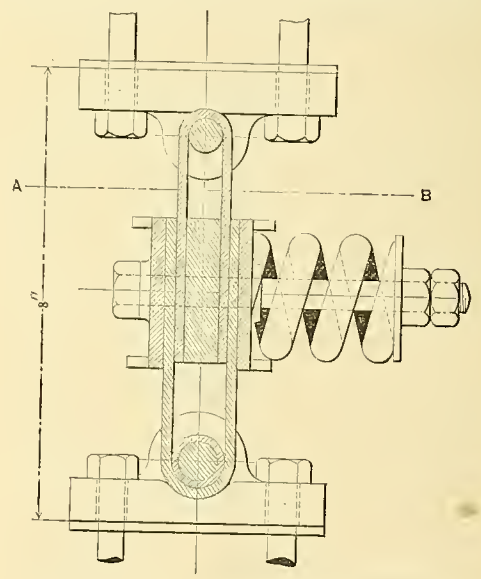


Fig. 1—Side View of Gibbs' Spring Dampener.

sheets from below will lie flat against those from above. The casting over which the lower sheet is folded projects upward to a point somewhat past the center, its thickness being equal to the diameter of the pin above. Through these plates and the casting passes a bolt provided with small springs and washers, so that a considerable pressure can be exerted between the plates. This arrangement permits the pressure between the plates and the consequent friction to be so adjusted as to produce the desired result. One of these dampeners is placed at each corner of the truck.

The Drexel Railway Supply Company, of Chicago and New York, is introducing this device.

Memphis Road Sold.—The Raleigh Springs Railroad Company's property at Memphis, Tenn., was sold at aution to J. T. Fargason on June 14th for $101,000. The property consists of the railway system and the Raleigh Inn. The road was constructed about two years ago by a company of which Mr. Duke, of Durham, N. C., was the chief spirit. The hotel was erected by the company at Raleigh Springs. When the hard times continued the company found it necessary to ask for the appointment of receivers.

THE NEW ROBINSON AJAX FOUR-WHEEL TRUCK.

All, or substantially all, the trucks heretofore introduced for use under four-wheeled electric cars have been constructed on the same general principle, the differences consisting merely in details of construction. The aim in the design of these trucks is to lessen the end teetering motion of the car by introducing springs between the car body and extensions of the truck frame projecting outwardly some distance beyond the axle boxes, the descending end of the car body compressing the springs from the top only. Some of these trucks have materially diminished the teetering of the car.

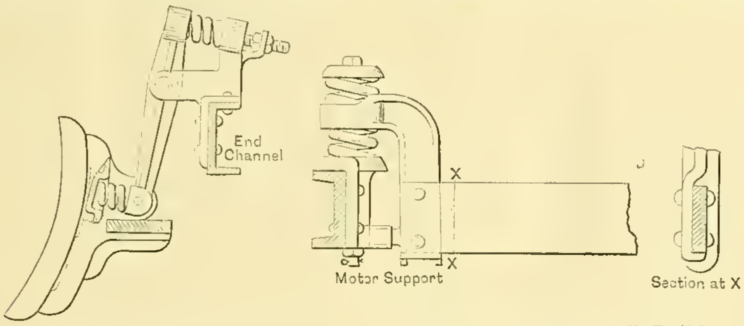
The new Robinson Ajax four-wheel truck which is illustrated herewith will prove of especial interest to our readers from its direct bearing on the solution of this important problem. It is the invention of Mr. William Robinson, inventor of the well known Robinson radial truck and general manager of the Robinson Electric Truck and Supply Company, of Boston, Mass.

The novel features of the Ajax truck will be best understood by referring to the illustration, Fig. 1, in which the saddle casting *A* forms, at *f*, a fulcrum for the bent lever *B*, one end of which is connected to the car sill, as shown at *g*, while the other end of said lever supports the springs *C*, upon which the car body rests. The lever *F* at the opposite end of the truck is arranged in the same manner as the lever *B* just described, and it will be observed that both levers are located wholly beyond the journal boxes outwardly.

The operation will be understood by assuming that the end *D* of the car body descends, as in teetering. This depresses the outer end *g* of the lever *B*, raises the inner end *h* of the same, and compresses the springs *C* from the bottom, thus resisting the downward tendency of the end *D* of the car. Now, if the end *D* of the car descends, in teetering, the opposite end *E*, of course, must ascend, raising the outer end *m* of the lever *F*, lowering the inner end *n* of the same, thus removing support from the springs *G* and compressing the cushion spring *H*; all of which resists the rising tendency of the end *E* of the car. It is evident then that as the ends of the car cannot rise or descend independently of each other, teetering if practically prevented.

The removal of support from the bottom of the springs *C* and *G* as the ends of the car attempt to rise in teetering, is claimed to be in itself sufficient to prevent the raising of the ends of the car, since the rebound is thus taken out of these springs and they have no fulcrum from which to exert an upward pressure on the rising end of the car body. In this connection it will be observed also that the action of the lever cushion spring *H* is peculiar. This spring is supported by a spring seat in the saddle casting and exerts an upward pressure on the inner end of the levers. Now, when the outer end of the lever *F*, for instance, is raised by the rising end *E* of the car body, the inner end of the lever *F* compresses the spring *H*, which thus directly and positively resists the rising tendency of the end *E* ot the car body. At the same time this pressure on the spring *H* exerts a positive pressure to push the truck frame downwardly.

Additional springs, supported on the truck frame between the boxes, as shown, are used, and a portion of the weight of the car body is carried on these. The number of springs and their arrangement, it is said, make the riding extremely easy. It will be seen furthermore that there are springs located between the axle boxes and the truck frame. Many advantages are claimed for these springs in taking up shocks, preventing strain on the truck frame and tending to ease of riding.



FIGS. 2 AND 3—BRAKE AND MOTOR SUSPENSION OF AJAX TRUCK.

The Ajax truck is provided with lever brake hangers, adjustable brake release springs of a novel character, and anti-rattlers, all of which are found to work satisfactorily.

The lower side members of the frame are composed of steel channels hot riveted to the lower part of the saddles. The upper side members of the frame are composed of steel tension chords, a construction giving, it is claimed, the greatest possible strength with lightness and simplicity. The ends of the truck are composed of specially heavy and strong channels securely hot riveted to castings similarly riveted to the sides and tops of the saddles. The whole design and construction shows careful work, the result of many years of expert experience, and the aim has been to place every ounce of metal where it will do the best service, and so to construct a truck of the simplest, lightest and most durable type, and, above all, of the best possible mechanical arrangement and construction to meet an extremely unmechanical requirement.

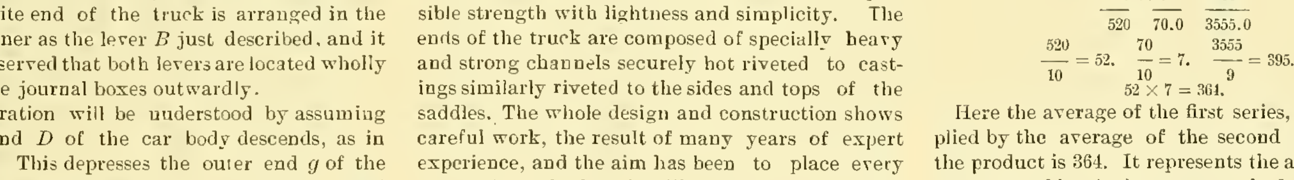


FIG. 1—THE NEW ROBINSON AJAX FOUR-WHEEL TRUCK.

The Ajax truck is put on the market by the Robinson Electric Truck and Supply Company, of Boston, Mass.

Philadelphia, Pa.—A charter was granted last week to the Philadelphia & Trenton Street Railway Company. The capital stock is $160,000. The road will run from Morrisville, Bucks County, over the Calhoun street bridge to Fallsington, thence to Hulmeville, Eddington, Cornwells, Andalusia, Barries, Torresdale, Pennypack, Holmesburg, Tacony, Wissinoming, Frankford and Philadelphia. The distance is 25 miles. The president of the road is L. Calvin Maus, Philadelphia, and the directors J. Uhle Bethell, Lansdowne; Theodore F. Hansen, Philadelphia; Joseph H. Reall, Bloomfield, N. J.; J. Henry Harrah, Trenton, N. J.

ELECTRIC RAILWAY MOTOR TESTS.

BY W. NELSON SMITH.

In a former article on this subject, published in No 13 of the current volume of the STREET RAILWAY GAZETTE (March 31, 1894), the writer undertook to point out the incorrectness of the methods commonly employed in the computation of results of motor tests, both as to matter and manner. The present article is a sequel to the former, and it is intended to practically illustrate the principles there enunciated, by a direct comparison of results both partial and final, when computed by the correct and incorrect methods.

Reference was made in that article to the inaccuracy of the usual method of obtaining the average horse power, which is as follows: Add up the volt readings (all in significant figures) and the ampere readings (largely composed of zeros) separately, and divide both totals by the same number, which is the total number of readings, giving presumably the average volts and amperes for the entire time of the trip; the product of these two averages is then taken as the average watts, and the horse power computed from it. On the other hand, the correct way is to multiply each volt reading by its corresponding ampere reading, add these products (watts) together and divide their sum by the number of "active" observations, the result being the average watts actually consumed.

The following two series of numbers, comprising ten in each, are set down to be averaged and multiplied together by the two methods alluded to, as an arithmetical illustration of them. They are abstract numbers, and do not necessarily represent volts and amperes as such, but correspond to them in a general way, simply to show the principle:

$$\begin{array}{rcrcr} 50 & \times & 8 & = & 400 \\ 55 & \times & 7.5 & = & 412.5 \\ 50 & \times & 7.5 & = & 375 \\ 60 & \times & 8 & = & 480 \\ 65 & \times & 0 & = & 0 \\ 60 & \times & 8 & = & 480 \\ 55 & \times & 8.5 & = & 467.5 \\ 45 & \times & 8 & = & 360 \\ 40 & \times & 7.5 & = & 300 \\ 40 & \times & 7 & = & 280 \\ \hline 520 & & 70.0 & & 3555.0 \end{array}$$

$$\frac{520}{10} = 52. \quad \frac{70}{10} = 7. \quad \frac{3555}{9} = 395.$$

$$52 \times 7 = 364.$$

Here the average of the first series, 52, is multiplied by the average of the second series, 7, and the product is 364. It represents the average watts as computed by the incorrect method. But if each corresponding pair of numbers in the two series be multiplied together and the products added, and their sum divided by the number of *significant* products, which is 9, there is obtained a number which represents the average of the products that have a value. If these products be now considered as watts, this average represents the average watts; that is, the average for the time when there are any watts actually in existence. In the numbers used to illustrate, this correct average is represented by 395, quite different from that obtained by the former method. Watts measure the rate of working; when the watts equal zero for any reading, there is no rate—hence they should be averaged for the period when they really exist. This is what constitutes the correct method. First get the watts, then average them; and average them only for the time during which they are being consumed.

In this discussion the word "active" is applied for brevity's sake, to those readings of time, pressure and current, and their resulting quantities and averages, which are made when the current is greater than zero. The "idle" readings are those taken when no current is flowing. The word "total," as used below, is applied to the observations as a whole, and to averages computed from the entire time interval and total number of readings, in contrast to their "active" readings, which only cover that portion of the test during which current is actually flowing.

Below are given, in parallel columns, the mean results of seven different tests, each computed in the two ways just outlined; the "active" and "total" methods are shown side by side, making evident the differences as they appear in the successive steps of each test. In column No. 1 are set down the total time intervals covered by each test, in minutes: in No. 2, the time covered by the active readings, allowing 15 seconds to each observation (except in Test E, where it is 30 seconds). The third column shows the total number of observations, and the fourth the number of active observations. No. 5 gives the percentage that the active readings form of the total number. No. 6 gives the mean voltage, averaged by the total method, *i. e.* by dividing the sum of all the volt readings by the total number of readings. This is in reality the average *line* pressure. The average of the active volts is given in No. 7, this being the mean *working* pressure at the motor when taking current. No. 8 shows the mean amperes, averaged by the total method, over the entire time of the test, while in No. 9 the active average current is given. The difference is clearly due to the fact that the same total sum of the ampère readings is divided in No. 8, by a greater number of readings than it is in No. 9, making the mean total much less than the mean active or working current. Column No. 10 shows the mean horse power as ordinarily calculated by the total method—multiplying together the means obtained in No. 6 and No. 8—to obtain mean watts. The active horse powers set down in No. 11 are calculated by the active method from the very same data, only that the watts consumed were first computed for each pair of readings separately, and then averaged by the active method. The differences between No. 10 and No. 11 are very noticeable.

The total work done, as derived from the average horse power and the time, is shown in No. 12 and No. 13. In No. 12 the result is obtained by multiplying the mean total horse power of No. 10 by the total time reduced to hours as given in No. 1. In No. 13, however, the mean active horse power of No. 11 is multiplied by the active time in hours of No. 2, giving an accurate result, because the *working* observations, and no others, are concerned in it.

Tests A and B were made by the writer in St. Louis in 1891. A is from a 25-foot car having a Robinson radial truck, equipped with two 15 H. P. "S. R. G." motors of Thomson-Houston make. B is from a standard 16-foot car with two 15 H. P. "F 30" motors of the same system, and pulling a trailer. Both these tests were made under practically the same conditions, as to time of day, travel-weather, etc.

Tests C and D were made on a little road in Moline, Ill., in the winter of 1890, by the writer and Mr. B. Willard, C being from a 16 foot car equipped with Sprague apparatus, and D from one with the Westinghouse system, both on the same day and under the same conditions. This road has a 6 per cent. grade 2,000 feet long. Test E was worked out from data published by Professor Short of Cleveland, in a paper read before the Chicago Electric Club, early in the year 1892. The car was provided with two gearless motors of the earliest type, and was in regular service pulling a trailer, on a particularly hot summer day. Tests F and G were made in Indianapolis by Mr. Willard, on the same road and under similar conditions, F being from a standard car equipped with two "F 30" Thomson-Houston motors. G was made on a similar car having two Short double reduction motors.

Six out of seven of these tests were practically competitive—A with B, C with D, and F with G. They will, therefore, serve to illustrate the importance of care and discrimination in arriving at conclusions that may be decisive commercially. It will now be shown how differences in the computation may effect both partial and final results.

In test A the average total horse power is 16.12; in B it is 15.68. So far, B is ahead. But by making *work done* the basis of comparison, A has 22.44 total horse power hours, B has 23.2, turning the tables in A's favor. A averaged the more total current, but made up for it by increase of speed on shortening the time of the trip. So much for the total method.

The active mean horse power of A is 30.28, of B 24.65; here B is ahead again. And in energy expended A is credited with 24.6 H. P. hours by the correct method, B with 23. So B shows the greater final economy after all. It will be noticed in the case of A that the active horse power hours are greater than the total, while in all the others they are less. This may perhaps be accounted for by the fact that the active readings formed but 51.7 per cent. of the total, which increased the mean active current to a greater extent than in any of the others; that is, the current readings averaged so high that the observed watts and consequent horse power and horse power hours were higher than usual. In general it will be found, in the computing of motor tests, that the variations in current affect the results far more than do the corresponding fluctuations in pressure.

In tests C and D the differences are plain, though not so marked. The mean total horse power of C is 10.98 and of D 11.14. If calculated on this commonly accepted basis, this means a victory for the Sprague system. But if their relative economy be based on horse power hours, as it should be, D with 3.66 H. P. hours shows better economy for the same trip than C, which has 4.21, turning the tables in favor of the Westinghouse car. This is by the total method. Working by the accurate active method these differences are changed somewhat, but the relative status of the two tests is not reversed. The average active horse power of C is 14.88, and of D 15.16. The active horse power hours of C are 4.03, and of D 3.61, showing that the Westinghouse car did its work with less expenditure of energy than the Sprague. It will be noted that in both these tests the active readings were about the same per cent. of the total. Tests F and G show matters up in very much the same light. Test E comes out with still less difference between the horse power hours, as calculated by the two methods, though the differences in the other elements do not vary greatly from the preceding. Indeed, it may be said that the differences between the final results, in horse power hours, are very slight in each of the tests. But this apparent coincidence of final results is no excuse for inaccurate determination of the elements that go to make them up, namely, time, mean pressure, mean current and mean horse power. It will be noticed that the mean current and horse power in particular differ markedly all the way through, and it is just as necessary to determine these elements accurately as it is to carry the results to completion, even if it does take a little more time. Moreover, the elements, as determined by the active method, are the real working elements with which the motor has to deal.

These results are presented for what they are worth; and if they demonstrate the desirability of arriving at commercial conclusions in a scientific manner, as is done in various other branches of expert engineering, the writer will consider his object accomplished.

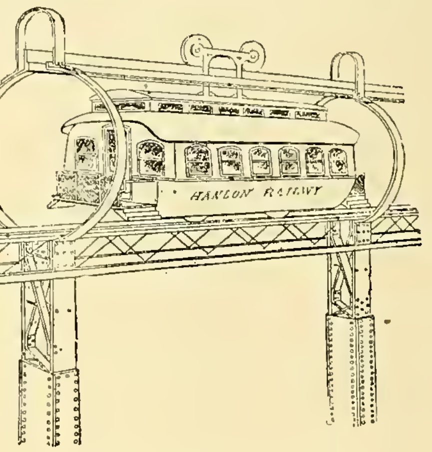
TABLE OF TESTS.

Test.	1. Total running time, minutes.	2. Active running time, minutes.	3. Number of readings, total.	4. Number of readings, active.	5. Active per cent. of total.	6. Mean volts, total.	7. Mean volts, active.	8. Mean amperes, total.	9. Mean amperes, active.	10. Mean H. P., total.	11. Mean H. P., active.	12. Mean H. P. hours, total.	13. Mean H. P. hours, active.
A	83.5	18.75	331	175	51.7	137.75	431.9	27.6	52.79	16.12	30.28	22.44	21.6
B	88.75	56	358	227	63	135.37	431.52	26.87	42.38	15.68	24.65	23.2	23
C	23	16.25	93	65	69.9	173.32	156	17.31	21.77	10.98	14.88	4.21	4.03
D	19.75	14	80	56	70	177.15	160.91	17.4	21.86	11.14	15.16	3.66	3.61
E	76.5	61	153	122	79.7	121.12	120.26	21.68	30.95	13.91	17.18	17.75	17.61
F	30	21.75	121	99	82.5	156.75	152.37	19.80	23.77	12.12	11.58	6.06	6.011
G	31.5	26.5	126	106	84.13	117.19	115.77	20.14	23.94	12.08	11.0	6.21	6.18

NOTE.—In tests A, B, C, D the total time interval is taken to begin with the first reading and to close with the last, giving one more reading than would be called for by multiplying the number of minutes by 4. In test E readings are taken at 30-second intervals.

HANLON'S ELEVATED RAILWAY SYSTEM.

Joseph P. A. Hanlon, of Boston, who some years ago patented a system of overhead travel, has just come forward with his idea of an elevated railway



Hanlon's Elevated Railway System.

and car. There is a single post railway with two continuous rail lines one above the other, and extending horizontally above and below the cars, which move between them. The upper rail line can be employed to sustain three-fourths of the weight of the car or cars, and the lower rail to support one fourth of the weight, or the lower rail can be employed to sustain three-fourths of the weight and the upper rail one-fourth, or, if desired, the weight of the cars can be equalized between the upper and the lower rails.

Any of the three ways of dividing the weight of the cars between the upper and the lower rails will, it is claimed, prevent lateral oscillation or any undue divergence of the cars from their proper path of travel.

The motive power may be either steam or electricity. The latter, the inventor thinks, would be the more economical. There is an arrangement of wheels just below the top travelers which are so disposed as to impinge against the guard rails when the train is rounding a curve. In switching no part of the superstructure is moved, and the same may be said of the crossing of trains at right angles. It is said that the syndicate backing the inventor proposes applying for a charter to construct, equip and operate the system in Boston and adjacent cities. The general arrangement of the structure is shown in the accompanying figure.

Painesville, O.—The Painesville, Fairport & Richmond Street Railway Company has increased its capital stock from $50,000 to $150,000.

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(*Twenty-fourth Article.*)

Sometimes a good brush has worn unevenly through grit on the commutator, and only needs dressing down to give good service. This is best done by drawing a strip of sandpaper back and forth between them and the commutator while the brushes are pressed down. This will dress their bearing surfaces to fit the commutator properly.

Third Cause.—Short-circuited coil in armature. This may be caused by a little carbon dust or other conducting material getting in between two of the commutator bars or between the connections leading to the bars. Perhaps the best indication of a short-circuited coil is the increase of heat in that particular coil or coils on the armature. If in feeling around the surface of the armature one or more coils appear much hotter than the rest, a short circuited coil is to be suspected, and a careful examination of the commutator and its connections should be made to discover the cause, and if found it should, of course, be removed. If the cause be removed early in the trouble it may have done no harm, but a short circuit is very likely to cause a burn-out of the armature. If the trouble is in the commutator or its connections its remedy, if taken in time, is exceedingly simple, but the short circuit may be in the armature itself, and if so cannot be corrected by the motorman. If he have reason to suspect that it exists in the armature, his only recourse is to cut that motor out and proceed to the stables with the other motor. The short-circuited coils will there have to be replaced by new ones.

The same effect may be produced exactly by a "ground" on the armature, which together with the intentional ground forms a short circuit. The indication, aside from the unduly heated coil, is very bad sparking occurring at intervals.

Fourth Cause.—Broken circuit in armature. This is usually indicated by violent flashes like the preceding, but unaccompanied by the heating of the coil, the flashing as before occurring at intervals when the commutator segment belonging to the broken coil passes under the brushes. The flashing in this case will be very much worse than in the preceding case even when the motor is running slowly. Examination should be made to see that the flash is not due to a high bar or dirt, or other insulating material on one of the bars. If not due to either of these, the break is most likely to be found in the connections between the armature coils and the commutator bars. If it be due to a broken commutator connection, a temporary remedy is found in connecting the disconnected bar with its neighbors by driving in between the bars a piece of copper wire so as to short circuit the broken coil. If the break be in the coil itself, rewinding is probably necessary and the motor should be cut out of circuit at once.

Fifth Cause.—Chatter of brushes. The commutator sometimes becomes sticky when carbon brushes are used, causing friction which throws the brushes into rapid vibration. When this is the case it is readily detected by the tingling or jarring sensation produced on the hand when lightly placed on the brushes. At the first opportunity the commutator should be cleaned with a rag or waste and oiled slightly. This will stop the trouble at once.

Sixth Cause.—Flashing all around the commutator. This may be due either to particles of carbon between the bars or to broken coils, or both, and the remedy is that recommended before for such troubles. If, after cleaning the commutator and no breaks are found, the flashing continues, the motor should be disconnected and the car run into the shops for overhauling.

MOTOR STOPS OR FAILS TO START.

First Cause.—Great overload.

Second Cause.—Very excessive friction due to shaft, bearings or other parts being jammed or armature touching pole pieces. In either of these cases the armature would most certainly burn up were it not for the fuses which are intended to melt and break the circuit before sufficient heat can be generated in the armature coils to do damage. A careful examination should be made to see what the trouble is, and it should be rectified if possible at once.

Third Cause.—Circuit open due to: (*a*) Safety fuse melted, (*b*) connection to motor broken or slipped out of binding post, (*c*) brushes not in contact with commutator, (*d*) hood or canopy switch open, (*e*) broken or imperfect contact in controlling rheostat. (*f*) failure at generating station. Trouble due to any of these causes is indicated if the car fails to move when load is removed or when load is light. In such cases the current should be turned off immediately at the hood switch, and the break looked for as indicated. The lamp circuit should be turned on. If lamps burn or other cars are found to be moving, the trouble does not lie with the generating station.

SPECIFIC DIRECTIONS TO MOTORMEN.

Some of the electrical companies furnish, and all of them should furnish, a list of empirical rules for the management of their motors. It is too often that the motormen never see these rules at all, but receive them by word of mouth from the foremen or whomever they look to for instructions. It is very desirable that each motorman should have these rules in convenient form for reference, and they are herewith reproduced. They are essentially the same for all makes of motors and are as follows:

1. In taking a car out of the barn where it has been standing with trolley off, put on the trolley, place handles on controlling stand, and see that the current is off; then throw in the hood switch.

2. On most modern equipments there are two levers—one for reversing, the other for controlling the current and speed of car. In starting, move the controller quickly from right to left until you feel the contact touch the first point, and then slowly move it farther until the car moves. Allow the car to gain a little headway, and then move on as the car gains headway till the lever is as far as it will go. Usually the controller switch should be allowed to rest on each successive notch long enough for the car to gain the headway due to that combination before it is moved to the next notch. In the Westinghouse control, the first notch throws the whole resistance and the two motors in series. The second notch cuts out half the resistance, and the third notch the whole resistance. The fourth notch throws both motors in parallel with one another and each in series with half the resistance. The fifth notch cuts out the resistance of one motor, and the sixth, or last. notch cuts out the resistance of the other motor, leaving them in parallel, which gives the greatest speed and highest efficiency. In this arrangement, which is a series-parallel arrangement, the first two notches are merely starting points, and the handle should only be allowed to rest momentarily on each. The third is a good slow speed running notch. To obtain greater speed or more pressure, the handle should be moved slowly but continuously from the third to the fourth notch. This and the next notch should be used only momentarily, not steadily. In this, as with all other arrangements, the last notch should be used for heavy work or fast running.

3. Before leaving the car barns, however, the motorman should examine carefully the grease cups and see that they are filled. Examine brushes and motors, making sure they are in fit condition to begin the day's work.

4. With hood switches open, try the reversing lever and controller lever to make sure they are in good working order. Then with controller lever off, close hood switches, note that trolley is on the line and that you have a current by lamps being lighted. Now move controlling lever around slowly. If car moves off, all is probably right. If car refuses to move after controlling lever is moved to last notch, turn lever back to "off" point, get down from car and note that rail is clean, that the fuse plug is is place, that the ground wire from motors is attached to truck frame and that the cut-out switches for both motors are closed. If the above conditions are filled then examine car wiring for a broken wire or a loose connection. Failing to find the trouble, report to the car starter or person in charge.

5. If the General Electric Company's series paral el controller, form K, is used, the motorman's attention is directed chiefly to noting that everything about the switches and contact points and cable connections in the controller are in good order. Two switches are located in the lower part of these controllers. The one to the right when thrown up as far as it will go cuts out motor No. 1, or the motor nearest the fuse box, the switch to the left when thrown up cuts out motor No. 2, or the one farthest from the fuse box. A small quantity—enough only to form a very thin film—of vaseline should be used on the contact strip in all controllers, to prevent any cutting or wearing.

In both controllers of this type the upper cut-out plug cuts out the same motor, which is designated as No. 1. The motorman should find out which is motor No. 1, so that he will be able to remove the proper cut-out in case of trouble, without experimenting. It is recommended that the number of each motor be painted on it where the motorman can see it. These cut-outs are designed to be used only in case of trouble. When either plug is removed, the starting of the car is delayed until after the controlling handle has passed the third notch. *Hence, in starting with one cut-out plug removed, throw the handle directly to the fourth notch.*

The reversing switch determines the direction in which the current shall flow through the motor fields when it is turned on by the controlling handle. In the Westinghouse apparatus, for instance, the reversing switch has three notches. The central one, at which the handle is placed, cuts off all current from the motor fields, so that in this position operating the controlling handle has no effect. When it is desired to start the car, first see that the controlling and reversing handles are at the "off" position; second, close canopy or hood switch; third, throw the reversing switch forward or backward, according as it is desired to go in one direction or the other; fourth, throw the controlling handle, when the car will start.

Throwing the reversing switch entirely over reverses the direction of the current in the fields, but this should never be done unless the controlling handle is at "off," otherwise the rush of current through the coils which will be due to the *counter-electromotive* force of the motor *added* to that of the line and that due to the discharge of the magnetism of the fields will be so great as to endanger the coils.

7. When throwing the controller arm to "off" the movement should be rapid, especially in passing the first point, so as to avoid drawing an arc.

8. If the controlling arm should go hard or stick, do not force it, as this would only make matters worse. Pull down the trolley or open the canopy switch, or, better, do both, then remove cover of controller. An inspection will probably show that the trouble is due to want of oil, roughness of contacts, or something of this kind, which can easily be corrected.

9. Never run with trolley in wrong direction except in cases of extreme necessity, and then very slowly.

10. Never stop car so that the trolley wheel will be directly under a circuit breaker in the line.

11. Always have current shut off when trolley-wheel is passing over a circuit breaker in the line, else the wheel in passing off will draw an arc, which tends to damage both line and wheel.

12. Never leave car without removing the controller handles and opening canopy switches.

13. Never reverse the motors when the car is running, except in cases of extreme necessity, such as avoiding a collision or to save a life. In these cases reverse the current in the controller, keeping the handle on the first or second notch until the

car begins to move backward. Remember that if reversal takes place with controller at too high a notch the wheels will lose their adhesion to the rail and spin around backward and the car will not stop so quickly as if they kept revolving in a forward direction.

14. Go around curves slowly, using third notch.

15. When entering a turnout or curve, the conductor should be on the rear platform and should have the trolley rope in hand.

16. Slow up at all street and railway crossings, at all rough places in the track, and pass overhead switches with the current thrown off.

17. It is better not to stop on very heavy grades, or on or just before entering curves, if it can be avoided, on account of the extra current required for starting up again under such conditions.

18. Ordinarily in stopping the car, always release the brake somewhat, just before the car comes to a dead stop. Do not let the brake fly, or kick the brake dog off, for if you do the amature will take up the lost motion in the gears, and when starting again it will necessarily be with a jerk. This is unpleasant to the passengers and hard on both motors and gears.

19. Do not keep brakes on in rounding curves. This has been advocated, but is wrong and involves a useless waste of power at the worst possible time. It is one of the commonest and worst mistakes motormen make. It is well to have the brake in hand so that it can be instantly applied, if necessary, but it should be entirely "off."

20. Motorman should never run the car when the trolley is off, especially down grade, for if the brake should fail he could not reverse.

21. In descending a grade it is best to run slowly, for should it be necessary to stop suddenly it would be impossible to do so if the speed were high.

22. If, in wet weather, when climbing a grade the wheels slip, gradually work the controller arm toward the first point, throwing it to the position of "off" if necessary, until the wheels get a grip, then work the arm gradually over toward "full power" again.

22. In applying brakes on down grade be sure not to allow the wheels to get to slipping, for when they once commence to slip or "skid" they are of very little use in stopping the car. Many accidents have occurred in this way. This precaution is especially necessary where stops are made on a descending grade. Should the wheels begin slipping, however, better let the car run faster for a few moments until they get hold again, and then apply the brakes gradually until the car is under control.

23. Run slowly through flooded places if possible, with current cut off. When examining motors never allow water to drip from clothing or hat into the motors.

24. If car won't start on dry or dirty rail put controller arm on first or second point and rock the car. If this fails to accomplish the purpose have conductor take a piece of wire or switch stick and rub one end of it against the rear tread of the wheel while the other end is pressed against the rail. In case an uninsulated wire is used, *break contact at the wheel first*, keeping the other end against the track, else a shock will be received.

25. Never attempt to put in a new fuse unless canopy switch is open or the trolley is off; otherwise you may get a shock and damage the fuse connections also.

26. Should it be found impossible at any time to start the car, try the following until the trouble is located.

(a) If there is no evidence of current, notice other cars. If they are all right, the trouble is in your own car.

(b) Throw on lamp circuit. If the lamps light up, the trolley and ground wires are all right. Now work controller, and if the lights go down or out the trouble is probably due to poor contact between the wheels and the rails (try 24), or the section of track on which the car is standing may be "dead." Use a longer wire and connect wheel with another rail, as in 24.

If lamps do not light, examine lamp fuse box to see that fuse is not blown and make sure that ground connection is not broken. Make sure that lamps have good connection in the socket. If they still fail to light, you may be reasonably sure the power is off.

(c) Ascertain whether the fuse has been blown. If so, throw canopy switch and put in new fuse (25).

(d) *See that both motor cut outs are in place.*

(e) Try both controllers, and if one works the trouble is probably due to poor contact in the other. In this case throw canopy switch, remove the cover of the controller and examine the contact blocks to see that they all make proper contact.

COMMENTS AND VIEWS OF CONTEMPORARIES.

CAUSE OF ACCIDENTS.—Another source of danger, especially in Philadelphia, is the great number of covered wagons. This kind of vehicle is probably more numerous here than elsewhere. The driver sits securely behind his awning, unable to see anything that is not directly ahead of him, and the motorman of an electric car, unless he can see through thick oilcloth, has often to guess whether the vehicle intends to cross first or wait for the car. Escapes from accidents under these circumstances are more frequent and more narrow than is generally known. A city ordinance is needed which will compel leaving the sides of a vehicle open to at least one foot in the rear of the driver, so that he can obtain an unobstructed view. If this were done, and the electric car lines employed only motormen with good eyesight, the liability to accidents in this city would be greatly reduced.—*Philadelphia Press.*

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

WILLIAMSBURG AND NORTHAMPTON, MASS., eight miles apart, are now joined by an electric railway which was put into service last Saturday. The road cost $100,000, and was built in six weeks.

FROM LYNN TO BEVERLY.—An electric railway is to be constructed between these two Massachusetts towns to accommodate the Beverly people who do business in Lynn.

EAST BOSTON CONSTRUCTION of the West End Street Railway Company's extensions is being pushed as rapidly as possible.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

DECREASING DEMAND.—There has been a notable falling off in recent days in the demand for street railway stocks and bonds. As has been noted in these columns in previous communications the discrimination in favor of street railway securities by reason of the widespread distrust in steam railway mortgages following upon the bankruptcy within one year of half a dozen of the most prominent railroad systems in the country, has led to such continued absorption of street railway issues, along with other good investment securities, that the present scarcity has put prices to a figure where they yield the lowest returns known in years. These high prices have not exactly destroyed all demand, but investors are exercising some caution in placing money in high-priced securities and are confidently awaiting a drop in quotations as a result of the restricted buying. There is, however, so much idle money in the market that capitalists are seeking every opportunity to secure better returns than money rates allow and the demand from these quarters is sufficient to hold quotations of street railway securities at the present high level. With advancing money rates must, however, come lower quotations. Many money lenders, including banks, will then seek to make money in their usual field, and will thrown on the market sufficient securities to bring about some decline in values.

LOCAL TRADERS have been giving some attention to the shares of the Dry Dock, East Broadway & Battery Street Railroad Company. Resumption of dividends, with prospects of no further interruptions, is promised for August, and while there is very little of the stock floating in the market, there has been a demand for it noticeable of recent days, and all that comes to light is quickly absorbed. It is held now as high as 131 bid.

THE METROPOLITAN TRACTION COMPANY presented before the State Railroad Commission this week the arguments in its application for permission to build a cable railroad from Broadway through Twenty-third street and Lexington avenue to Thirty-fifth street to connect its Broadway and Lexington avenue cable lines. There was no opposition manifested, and it is fully expected that the Commission will soon announce a favorable decision from Albany. The Traction Company is evidently getting all it wants from the city and State of New York, and the confident boast of insiders that they will win their fight against the Third Avenue Railroad Company in the attempt to secure the franchise for a street railroad on upper St. Nicholas and Manhattan avenues seems to have some basis of realization. The field fought for is a most profitable one, and will be a source of large revenue to any one of the corporations controlling it.

EARNINGS OF METROPOLITAN TRACTION.—Some figures of earnings of the Metropolitan Traction Company's local lines, for the March 31 quarter, just filed with the State Railroad Commissioners, are of interest. The Metropolitan Street Railway Company reports: Gross earnings, $976,156; expenses, $566,295; other income, $634; charges, $402,538; cash on hand, $139,229; profit and loss surplus, $167,344. The balance shows: Assets—Cost of road, $8,773,002; stocks of other companies, $49,723; other permanent investments, $53,827; supplies on hand, $74,040; accrued interest, $542; due by companies and individuals, $5,233,505; cash on hand, $139,220; total, $14,323,861. Liabilities—Capital stock, $8,200,000; funded debt, $500,000; due companies and individuals, $5,456,517; profit and loss (surplus), $167,344; total, $14,323,861.

THE METROPOLITAN CROSSTOWN RAILROAD reports: Gross earnings, $294,885; expenses, $205,066; other income, $98; charges, $120,807; cash on hand, $29,529. The balance sheet on March 31 showed: Assets—Cost of road, $1,273,849; stocks of other companies, $7,500; other permanent investments, $5,725; supplies on hand, $6,436; due by companies and individuals, $228,571; cash on hand, $29,529; total, $1,551,612. Liabilities—Capital stock, $300,-000; interest, $7,080; funded debt, $900,000; due for wages and supplies, $34,781; due companies and individuals, $217,474; profit and loss (surplus), $92,276; total, $1,551,612. The Forty-second Street & Grand Street Ferry Railroad, leased by the Metropolitan Crosstown, reports a net income of $33,660 for the quarter ending March 31. The balance sheet shows a surplus of $48,120.

SECOND AVENUE is again becoming prominent in the dealings; there is a great scarcity of the stock, and it becomes more pronounced as the demand increases. Nothing new develops, however, regarding the deal herein spoken of some weeks ago. Third Avenue shares are for the moment neglected; but reports continue as to the big traffic, earnings since the warm weather set in being understood to have increased at a prodigous rate.

MATTERS REGARDING LONG ISLAND TRACTION are quiet. Its Brooklyn lines are understood to have done the biggest business in their history on Sunday last. Brooklyn City Railroad stock has on these reports recovered all of its recent loss. Brooklyn Traction is also higher. It reports for the month of May gross earnings of $80,466, an increase of $6,270 compared with 1893. Net earnings were $31,074.

OUT-OF-TOWN STOCKS dealt in here are not very active just now. New Orleans is offered without receiving a bid. North Shore Traction shares the same fate. Worcester Traction is a little steadier on the report that net earnings for May show an increase of $9,383, which is $306 more than the total net earnings of May, 1893. Buffalo Street Railway stock shows signs of advancing on the early prospects of dividends.

PHILADELPHIA STOCKS are all a little higher, although manipulation is mainly responsible for the advance. People's Traction will, it is rumored, call another assessment of $10 per share or to make an allotment of 40,000 additional shares within a short time. Philadelphia Traction stockholders to-day voted to increase the capital stock $5,000,000 to $15,000,000. Metropolitan and Baltimore Traction are steady.

NORTH AMERICAN.—At the annual meeting of the stockholders of the North American Company held in New York, Wednesday, President Wetmore had this to say regarding the Milwaukee Street Railway Company: "The earnings of the Milwaukee properties for the first seven months of 1893 showed a large increase over the period of 1892, the net earnings for the month of July alone having been $61,518 and the increase would undoubtedly have continued, had normal business conditions prevailed. The City of Milwaukee was, however, most seriously affected by the financial distress and, beginning with August, 1893, there came a heavy falling off in the earnings of the company, which continued during the remainder of the year, so that the net result for the year 1893 was $408,625, as against $405,495, for the year 1892. The gross earnings for the first five months of 1894 show an increase, as compared with the same period of 1893, which was before the panic or before its effect began to be felt; and the increase in net earnings has been considerably larger than the increase in gross. In November last an arrangement was entered into whereby the properties and franchises of West Side Street Railroad Company, Whitefish Bay Company and Milwaukee Street Railway Electric Company were converted to and consolidated with the Milwaukee Street Railway Company, and brought under the lien of the consolidated mortgages of the last named company. The North American Company received in settlement of its cash account for advances to the Milwaukee Street Railway Company, and its interest in the West Side Street Railroad Company, $1,291,000 of the consolidated mortgage bonds, and $1,275,000 of second consolidated mortgage bonds, issued by the Milwaukee Street Railway Company. The principal holders of the bonds have canceled or agreed to cancel the coupons on the bonds held by them, maturing December 1, 1893, and June 1, and December 1, 1894. The Milwaukee company now owns all the street railways of the city, constituting an admirable system."

Financial Notes.

Failure of Goodwin & Swift.—Goodwin & Swift, electric railway builders and promoters, of No. 66 Broadway, New York, made an assignment this week to Arthur F. Waldrat, of the law firm of Deming & Waldrat, 11 William street. Mr. Waldrat was unable to say more than that the liabilities were well over $500,000 and inside of $1,000,000. No definite valuation of assets could be made. They consist largely of bonds and the controlling stock in electric railways. Mr. Waldrat felt sure that the true value of the assets would more than offset the liabilities. There are about forty or fifty creditors, many of them being individuals and banks who had loaned money on the bonds and stocks of roads which the firm was building. Their assets are the Lock City electric railway, of Lockport, N. Y., about half finished and bonded for $150,000; the Mobile & Spring Hill Railroad Company, of Mobile, Ala., finished and running; and the Colonial City electric railway, from Kingston to Rondout, still unfinished.

Kansas City Receiver's Report.—Robert Gillham, receiver of the Northeast Electric Railway Company, of Kansas City, made his report to the court last week. The gross earnings of the road since January 1st were $7,644 and the gross disbursements were $6,078. The receiver asked leave to issue $21,505 receiver's certificates to pay off pressing claims, the amount realized to be distributed as follows: The Westinghouse Company, of Pittsburg, Pa., $14,350; the R. J. Boyd Paving and Constructing Company, $4,655; the McGuire Manufacturing Company, of Chicago, $2,500. The total debt of the road is placed at $124,969, of which $104,969 is floating debt, and $20,000 interest on first mortgage bonds. The car equipment, Mr. Gillham says, is badly in need of repair.

Philadelphia Traction's New Stock. — The stockholders of the Philadelphia Traction Company have voted to increase the capital stock 100,000 shares, or $500,000. It will be issued at par, in the proportion of one share of new stock for every two shares of old; a cash payment of $20 per share will be required, the balance to be paid in 60-day installments, covering a period of six months. The new issue will bring the total capitalization of the company up to $15,000,000, or 300,000 shares—just one-half of the total amount authorized, the last legislature by special act having granted an increase of the capital to $30,000,000.

Nashville, Tenn.—The receivers of the United Electric Railway Company have been discharged. The balance of the funds in their hands was turned over to the master commissioner on order of the court, and all other questions deferred until a full and final hearing of all matters in dispute, when the funds will be distributed under the decree to be then rendered as to priorities, etc.

Earnings of the Worcester Traction Company.—E. W. Clark & Co. have just issued a comparative statement of the operations of the Worcester Traction Company for May. It shows gross earnings of $32,927.45, an increase of $1,091.45, operating expenses, $14,467.22, a decrease of $8,291.68, and net earnings of $18,460.23, an increase of $9,383.13.

Increased Earnings.—The earnings of the New England Street Railway Company for the week ending June 16 were as follows:

	1894.	1893.	Inc.
New Haven	$5,239	$4,605	$634
Plymouth	632	572	60
Total	$5,871	$5,178	$693

Earnings of the West End Company.—The gross earnings of the West End Street Railway, Boston, for May increased about $30,000. Officials of the company are not much disturbed by the passage of the Meigs bill, as they believe that the inability to command the necessary money to pay heavy damages will make it impracticable to build the line.

Sioux City, Ia.—Receiver A. M. Jackson, receiver of the Sioux City Rapid Transit Company, has filed a report. During the first four months of the receivership, when the line was operated by steam, there was a loss of $802.37. During the last nine months, since electricity was introduced, there has been a profit of $152.43.

Richmond (Ind.) Railway Receivership.—A. D. Titsworth, receiver of the Richmond (Ind.) City Electric Street Railway Company, has filed his report for May. The receipts were $1,978.80 and the disbursements $1,447.85. Of the expenditures $781.89 was paid for wages and $665.96 was paid for improvements.

Boston, Mass.—The Railroad Commissioners have authorized the Norfolk Suburban Street Railway Company to increase its capital stock by an issue of $25,000 and to issue $75,000 bonds. The company will now be enabled to raise funds for building its extension from Hyde Park to Forest Hills.

Westinghouse Dividend. — The Westinghouse Electric and Manufacturing Company has declared its regular quarterly preferred stock dividend of 1¾ per cent., payable July 2. Transfer books close June 25 and reopen July 3.

Louisville Railway Bonds.—The Louisville Railway Company has just issued $137,000 5 per cent. bonds to be used in taking up the same amount of 6 per cents. maturing July 1st.

NEW INCORPORATIONS.

Hartford, Conn.—The Hartford, Manchester & Rockville Tramway Company has been organized by the election of the following officers and directors: President, M. S. Chapman; secretary and treasurer, H. J. Wickham; directors, E. Stevens Henry and William H. Prescott, of Rockville; Elisha Morgan and R. W. Day, of Springfield; G. Henry Whitcomb, of Worcester and E. C. Hilliard and M. S. Chapman, of Manchester. The company will build a road to Rockville within a short time.

Newark, N. J.—The North Jersey Street Railway Company has been incorporated with a capital stock of $5,000,000. The promoters are: Jas. K. Corbiere, Caldwell, N. J.; Daniel V. Harrison, Wm. H. Power, Montclair, N. J.; Jas C. Beach, Halsey M. Barrett, Bloomfield, N. J.; Wm. J. Davis, Harrison, N. J.; Henry M. Doremus, Newark, N. J.; John L. Johnson, Verona, N. J.

Council Bluffs, Ia.—The Council Bluffs & Lake Manawa Electric Railway Company has been incorporated with a capital stock of $50,000 to construct and operate an electric railway in Council Bluffs and Pottawattamie County, Ia. The promoters are Jeff W. Bedford, J. P. Findley, D. D. Gregory, Isidor Gluck, L. H. Kent, H. B. Coryell, E. S. Rood, Council Bluffs, Ia.

New Haven, Conn.—The Connecticut Electrical Company has been incorporated, with a capital stock of $10,000, by E. B. Baker, New Haven, Conn.; Legrand Johnson, Willimantic, Conn.; Geo. D. Foote, Middleton, Conn.; G. W. Hoyt, Danbury, Conn.

Columbus, O.—The Westerville & Worthington Street Railway Company has been incorporated with a capital stock of $35,000. The promoters are W. E. Hoyer, W. T. Thorne, D. E. Sullivan, William Pinney, H. E. Guerin.

NEWS OF THE WEEK.

Milwaukee, Wis.—The Milwaukee Street Railway Company in 1893 paid $20,000 taxes on an assessment of $1,000,000. Under the ruling of City Attorney Hamilton it is expected that this year the railroad company will be assessed on $4,000,000 worth of property and the taxes will be $80,000, or four times that of a year ago. Mr. Payne declares that the proposed assessment of $4,000,000 on the street railway property would be entirely unjust and would be almost ruinous in these stringent times. It would mean $100,000 a year out of the pockets of the owners of the road, he asserts, and that would be equal to a tax of 10 per cent. on the gross receipts of the company. Mr. Payne says the company, under such circumstances, would have to discontinue the issuance of transfer tickets and the sale of tickets at reduced rates and a cessation of the carrying of passengers across the city for one fare. Mr. Payne avers that the company is paying its just proportion of the taxes and that any increase would be unjust.

Atlantic City, N. J.—The directors of the Brigantine Transit Compay, J. R. Ritter, J. McKeen, William Hacker and J. McCook, in company with the contractors, Stern & Silverman, of Philadelphia, made a formal inspection of the electric railway at Brigantine this week. The construction of the road is a good piece of engineering. Fully two-thirds of the road has been built upon trestle that stands the heavy inroads made by the ocean. The structural work is massive, and a novelty in railway construction. But 75 days have been occupied in the building of the entire road, seven miles in length, and more than 30,000 cubic yards of gravel and 4,000,000 feet of yellow Georgia pine have been used in the construction, the cost of the construction alone being more than $50,000. Stern & Silverman have formally delivered the road over to the Brigantine Transit Company.

Trenton, N. J.—Chancellor McGill has filed an opinion that the electric railway system is nothing more than a modification of the horse railroad system, and that the companies operating such roads have the right to erect poles on the edges of sidewalks and string wires on such poles without the consent of abutting property owners and without paying the latter anything in the way of compensation. The sidewalks, he holds, are portions of the highways, and as such are subject to public easement. Inasmuch as Chancellor McGill is a noted jurist and his decisions are rarely, if ever, reversed, his opinion is looked upon as of great importance and will probably result in the extension of the trolley system all over the State of New Jersey.

Chicago, Ill.—The Supreme Court has affirmed a verdict rendered against the North Chicago Street Railroad Company of $5,000 for the death of Willie Wixon, a nine-year-old boy killed Aug. 17, 1890, by an Evanston avenue horse car. The boy jumped off the car while it was in motion, and one of the rear wheels ran over him, causing his death. Counsel for the complainant contended that the company was liable because it failed to have a fender before the wheels. The defendant argued that it was only required to place fenders on the cable cars. The case went to the Appellate Court, where at first it was reversed, but eventually on a rehearing affirmed. It was then taken to the Supreme Court.

St. Louis, Mo.—Franchises have been granted to three electric railway companies by the County Court of St. Louis County. The Kirkwood & St. Louis Railroad Company, known as the "Houseman Air Line," will connect with the Lindell Railway at the southwest corner of Forest Park, running west through Kirkwood to Meramec Highlands. The Midland Railway Company will be allowed to extend its line from Page avenue to Creve Coeur Lake. The Clayton & Creve Coeur Lake Company will be allowed to run a line from Central and St. Ferdinand avenues to the lake.

Third Track on Ninth Avenue.—An order was signed this week by Justice Ingraham of the Supreme Court, modifying the injunction which was granted last February enjoining the Manhattan Railway Company from building a third track on Ninth avenue above Twenty-sixth street, New York City, so as to permit the Elevated Railroad Company to construct a continuous third track along Ninth avenue from Gansevoort to Eighty-third street, and thereby have a continuous track for the running of express trains.

Philadelphia, Pa.—The judgment for $148,078.98 obtained by the city in its suit against the Thirteenth and Fifteenth Streets Passenger Railway Company has been sustained. The defendant contested the claim of the city that it was required to pave certain streets from curb to curb. On its refusal to do the work the city paved the street and brought suit for the cost. It received the verdict mentioned, which has just been sustained.

Chicago, Ill.—Honora Payne, of the suburb of Edgewater, has brought suit against the North Short Street Railway Company demanding $10,000 as compensation for the damage which she alleges she has sustained by reason of the operation of the company's power house. She asserts that her residence, which is near the station, is subject to constant vibration, and that she has suffered physically in consequence.

Boynton Bicycle Road in Massachusetts.—In the Massachusetts Legislature this week a substitute for the bill to incorporate the Boston, Somerville & Lowell Street Railway Company providing for the incorporation by E Moody Boynton and others of the Boston & Lowell Bicycle Railway Company, capital $3,000,000, to construct and operate an elevated and surface road under Boynton patents between Boston and Lowell.

White Plains, N. Y.—A new electric railroad company, composed of local business men, will apply to the Board of Trustees in White Plains soon for a franchise for the building of an electric railroad through the village from Elmsford to Mamaroneck. Among the promoters of this new corporation are S. L. H. Ward, E. C. Suiffin, John Duffy, S. Gainsboro, Edward Phelps and others.

Competition with Steam.—It is reported that an official of one of the strongest lines running out of Jersey City says the trolley systems running out of that place are playing havoc with local passenger earnings of all the great railroads. When the trolleys and cables are extended in New York City as is planned, he thinks that Manhattan earnings are bound to suffer greatly.

Kansas City, Mo.—As the transfer arrangement of the West Side Electric Railway Company with the Kansas City Elevated was abruptly terminated recently, an omnibus service has been organized by the former company, the vehicles running from the packing-houses to Riverview.

Middletown, O.—It is announced that work will soon commence on the Hamilton, Le Sourdsville & Middletown railway which will connect Hamilton and Middletown. The county commissioners have granted a fifty-year franchise to the company.

Kansas City, Mo.—The temporary injunction obtained by the Kansas City Cable Railway Company restraining the Metropolitan Railway Company from discontinuing its transfer arrangement with the former has been continued until June 30th.

Will Not Reconsider.—The Massachusetts House of Representatives has refused reconsideration of the vote on the bill authorizing Lynn & Boston Railroad to increase its capital stock and to lease the Boston & Revere electric street railway.

Woodbury, N. J.—Chancellor McGill at Jersey City last week dissolved the injunction restraining the Camden, Gloucester & Woodbury Electric Railway Company from crossing the track of the West Jersey Railroad at Cooper street.

Chicago, Ill.—The ordinance giving a franchise to the Northern Electric Railway Company, which proposes to build an electric railway starting from West Forty-seventh street, has been recommended for passage by the council.

Locomotive Testing at Purdue University.—A pamphlet has just been issued by Purdue University of Lafayette, Ind., containing a concise statement of the facilities possessed by the University for locomotive testing.

Chicago, Ill.—On the petition of the Northwestern Elevated Railroad Company the Lake Street Elevated Railroad has been enjoined from proceeding with the construction of its down town loop.

Pittsburgh, Pa.—A charter has been granted at the State Department to the Monongahela & Allegheny Railroad Company, capital $60,000 which will build a line from Pittsburgh to Homestead.

Keokuk, Ia.—The operation of the Gate City electric railway which was purchased at foreclosure sale by J. C. Hubinger will be resumed at once. Cars have not been running for several months.

Baltimore, Md.—The Halls Springs electric line of the Baltimore City Passenger Railway Company will be extended to Clifton as soon as the rights of way are secured from the city.

Columbus, O.—The Columbus Central Street Railway Company has determined on an extension of its lines southeasterly from the city to Groveport and Winchester.

Baltimore, Md.—The contract for building the City & Suburban power house, on Pratt street, has been awarded to John Hiltz, Henry Brauns being the architect.

Nebraska City, Neb.—The barn of the Nebraska City Street Railway Company was burned last week. The loss was $6,000 and the insurance $2,500.

San Bernardino, Cal.—The supervisors have granted the petition of the Terracina & Redlands Street Railway Company for a fifty-year franchise.

Bridgeport, Conn.—The Bridgeport Traction Company has 400 men at work in rebuilding the line and in new construction for all electrical equipment.

Rochester, N. Y.—The Rochester & Irondequoit Street Railway Company has begun to run cars on its new line to Windsor Beach.

Half a Million in a Day.—Over 500,000 passengers were carried by the Brooklyn Heights Company's trolley cars on last Sunday.

Falls City, Neb.—A Kansas City syndicate has made a proposition for installing an electric railway in Falls City.

Kankakee, Ill.—The Kankakee electric street railroad is to be extended.

PERSONAL.

L. E. Meyers, general manager of the Electrical Installation Company, of Chicago, was in New York yesterday.

Chas. P. Breese, of the Breese & Mansfield Company, of Philadelphia, was in New York City early in the week.

F. A. Seiberling, of the Akron Street Railroad Company, was in Chicago this week.

TRADE NOTES.

The Berlin Iron Bridge Company, of East Berlin, Conn., will build the new boiler-house for the Coe Brass Manufacturing Company, at Torrington, Conn. The new electric light station for the Flatbush Gas Company, at Flatbush, N. Y., will be 60 feet wide and 73 feet long, divided into a dynamo-room and boiler-house. The roof of the building will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn., and will be covered with that company's patent anti-condensation corrugated iron roof covering.

The Clonbrock Steam Boiler Works has closed the following contracts for Climax boilers: The United Electric Light and Power Company, East Twenty-ninth street, New York City, 10,000 H. P.; Thomson-Houston Electric Company, East Twenty-fourth street, New York City, 1,000 H. P.; Newark Electric Light and Power Company, Newark, N. J., 2,000 H. P.; Central Railway and Electric Company, New Britain, Conn., 1,000 H. P.

The Composite Brake Shoe Company, of Boston, of which Geo. C. Ewing is superintendent, has succeeded to the business of the Safety Brake Shoe Company. In spite of the hard times the company reports a growing business. Wm. W. Whitcomb, president, has gone west to arrange with more foundries for the manufacture of the shoe, which remains as before.

The J. G. Brill Company, of Philadelphia, has sent us a very neat desk clock and calendar combined, which has been prepared as a souvenir for the company's patrons. The clock and calendar are mounted upon a red morocco case, with an appropriate inscription to remind its users that the company builds railway, cable and electric cars and trucks.

The J. G. Brill Company, of Philadelphia, is now represented in Chicago by F. C. Randall, whose office is at 1038 Monadnock Building. Mr. Randall has a wide acquaintance in the street railway field and without a doubt will be successful in his capacity as Western selling agent.

Walker Motors for Rockford, Ill.—The contract for six car equipments for the electric road has been placed with the Walker Manufacturing Company, of Cleveland, O. The track and overhead construction is to be done by the Electrical Installation Company, of Chicago.

The Standard Electric Company, of Chicago, has just issued an unusually handsome catalogue, descriptive of the standard system of electric machinery. The catalogue consists of 86 pages, and is handsomely illustrated throughout.

The Carpenter Enamel Rheostat Company has quite recently moved into its new factory building at Hoboken, N. J., and is now in a position to supply the rapidly increasing demand for goods of its manufacture in its various lines.

The Metropolitan Electric Company, of Reading, Pa., is putting up a new power station, and has placed the contract for the iron roof and traveling crane with the Berlin Iron Bridge Company, of East Berlin, Conn.

The Crescent Electric Company, 18 West Randolph street, Chicago, reports a steady improvement in armature repair and commutator work. This company's new shop is perfectly equipped for this class of work.

The Jenney Electric Motor Company, Indianapolis, has recently booked several good orders, and reports the outlook more encouraging than for a long time.

The Berlin Iron Bridge Company has appointed W. E. Stearns purchasing agent, to fill the vacancy caused by the death of Wm. H. Riley.

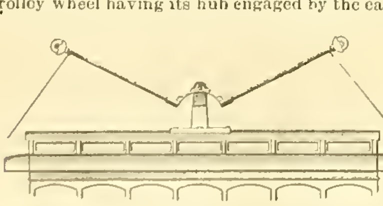
The Washington office of the General Electric Company has been transferred to 227 East German street, Baltimore, Md.

RECORD OF STREET RAILWAY PATENTS.

U. S. Patents Issued June 12, 1894.

521,163. Contact Trolley. Robert W. Hawkesworth, East Orange, N. J. Filed March 15, 1894. This is the combination with a railway car of a standard and a trolley bar pivoted to said standard and provided with trolley wheels, and consisting of two arms in the same vertical plane having an intermediate spring connection, whereby one can move to a limited extent independently of the other. (See illustration.)

521,184. Trolley; Henry Scheele, John P. Scheele and Henry A. Rust, Milwaukee, Wis. Filed Feb. 23, 1894. This is the combination of a head having a pole-socket lower end, a horizontal chamber and upwardly extended ears arranged in pairs at the extremities of the chamber; a lever pivoted between the ears in each pair, and provided with a bearing surrounded by a cap, a trolley wheel having its hub engaged by the caps and

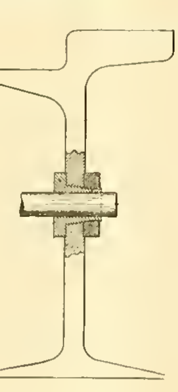


No. 521,163.

bearings on the levers, and a spring in the head chamber under compression between said levers on that side of their pivots opposite said bearings.

521,205. Car Truck; Edward Cliff, Newark, N. J. Filed Sept. 8, 1893. In a car truck the combination with a stationary frame supported upon the running gear, said frame having sections extending outwardly from the axle, of a movable frame supported upon said truck, spiral springs located between the movable and stationary frames, and portions of elliptic springs located between the two frames and connected to said frames by pivotal bearings only.

521,238. Bond for Electrical Conductors; John Herr, Philadelphia, Pa. Filed May 11, 1894. The combination with an electrical conductor, of a tapered hole therein, a split bolt having a head and a conical



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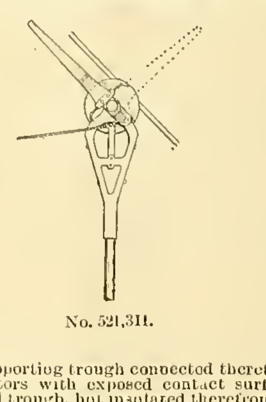
shank externally threaded, and a hole passing longitudinally through said head and shank, a nut adapted to be screwed up on said conical shank of said bolt, and a wire adapted to enter and be grasped by the sides of said hole in said bolt. (See illustration.)

521,291. Safety Guard for Street Cars; Stephen Norton and William H. Rice, Rochester, N. Y. Filed Sept. 20, 1893. This includes the combination of the guard frame, composed of two sections, pivoted together so that the outer one can be turned up, and provided with pivots at the top, the open hooks with which said pivots connect. The off-set arms at the top of the guard frame, the springs interposed between said arms at the bottom of the car, and the pivoted stay bars connecting the guard frame and truck.

521,307. Pilot or Guard for Cars; Robert A. Crawford, Allegheny, Pa. Filed Sept. 27, 1893. This is a pilot or guard having yielding rods secured to the lower end of said pilot to support it at the proper angle, sensitive springs interposed between shoulders on said rods and permanent abutments, tubular sections surrounding said rods, and a swinging toe at the lower end of said pilot or guard operated by a powerful spring.

521,311. Trolley Wire Finder; Theophilus E. Gressle, Indianapolis, Ind., Assigner of nine-tenths to Frank Hittle, Baltimore, Md. Filed Oct. 28, 1893. This is the combination with a trolley support and trolley, of directing bars or guides adapted to be elevated by movement upon the axis of the trolley, a double free-ended spring attached to one of said bars or guides.

521,326. Conduit Supply System for Electric Railways; Harry Alexander, New York, N. Y. Filed Jan. 9, 1891. This is the combination of a slot iron, a



No. 521,311.

conductor-supporting trough connected thereto, one or more conductors with exposed contact surfaces supported on said trough, but insulated therefrom, and of a length equal to the length of the trough, whereby the troughs and conductor sections can be made up as complete articles, and placed end to end in a conduit.

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CONTENTS.

Metropolitan Elevated Equipment. The equipment of the Metropolitan Elevated, Chicago, will be, according to the announcements made this week, in all essential particulars similar to that of the Intramural road at the World's Fair. In its details, however, a number of changes will be made wherever the experience of last year's operation of the Intramural indicated that improvements could be made. That the same general design would be followed was to be expected since the same manufacturing company will furnish the equipment and the plant will be installed under the direction of W. E. Baker, formerly general manager of the Intramural road. It is of interest to note, however, that an apparently radical change has been made in the capacity of each car equipment. If our information is correct each motor car, which will be attached to a three-car train, will be equipped with only two 100 H. P. motors, whereas the Inmural cars were each equipped with four motors of 133 H. P. each, and the work required of them was the hauling of three trailers, making the total weight of the train when empty 62½ tons. It was found, however, that to draw these trains during the months of July and August of last year required an *average* of only 31.4 kilowatts per train, or about 42 H. P. This, it would appear, is considered a much wider margin of reserve than is thought to be necessary, as it was found that the Intramural equipment was sufficient to draw as high as eight or nine fully loaded cars around the severest curves on the line. The operation of the Metropolitan equipment will be watched with great interest since it will afford a basis for the only just and reliable comparison of the relative cost of operating such roads by steam and electricity.

Street Railway Mail Service. Since rapid transit has been introduced on surface street railways the fact has been appreciated that their usefulness could be extended beyond the mere transportation of passengers. Already suburban lines are profitably employed in carrying freight, express matter and mails, and service in all these departments seems bound to increase. But even in the large cities where with one or two exceptions the surface railways are engaged solely with passenger traffic it seems certain that the street car companies will enlarge their business by extending it to the carrying of freight and mails. Certainly manifest advantages must accrue to the public from such a course and there is no apparent reason why the innovation should not in many cases prove profitable to the companies. St. Louis has been alone in the possession of a street railway mail car equipped as completely as any in the regular railroad postal service, and projects for the operation of similar cars in other cities are now under discussion, as a result, no doubt, of a suggestion to this effect contained in the report of Postmaster-General Bissell. Apart from the direct profit that the operation of mail cars might bring to the street railway companies, other advantages well worth considering might be gained. In times of strikes, which seem bound to occur, no matter how wise a policy may be pursued, there would be far less danger of interference with the operation of cars, for strikers, no matter how violent they may be, hesitate about rendering themselves liable to the charge of stopping the transportation of mail. Another advantage, as we have already pointed out, would follow from the fact that street cars could not be delayed by parades and processions in the same outrageous fashion that is noticeable at the present time in so many cities. Mails could not be stopped, so cars would have to be kept in motion. There are certainly many advantages to be reaped by the company that engages in this sort of service, and if the disadvantages exist they do not appear on the surface.

Grade Crossing Accidents. The serious accident last week in Paterson, N. J., in which a fast express on the Susquehanna road collided, while running at about fifty miles an hour, with an electric car that was crossing the tracks of the steam road, emphasizes once more the failure of the "human machine" as a protection for such crossings. The crossing was equipped with gates, but the gateman was leisurely talking with one of his neighbors fully fifty feet away from his post, although the express was overdue and might therefore have been expected at any moment. This careless manner of the gateman apparently threw the car conductor off his guard, and instead of being more vigilant than usual, he assumed that because the gates were not down there could be no danger in crossing, and he immediately gave the motorman the signal to proceed. This of course is put down as another "trolley" accident, although the same thing might have happened, had no more watchfulness been exercised, if the car had been drawn by a pair of slow-going mules. Indeed, if the reports are accurate, the trolley is to be credited with the almost miraculous escape of the seven or eight passengers who were in the car at the time; for the motorman, with remarkable coolness, reversed the car as soon as he saw the impending danger and thus avoided the much more serious collision that would have occurred, since the steam locomotive would otherwise have struck the car squarely in its center instead of near its front end as was the case. The car had moved backward about three feet when the collision took place. Grade crossings of steam roads are, without doubt, places of great danger, and too great care cannot be exercised by car conductors at such points. With one exception, however, they are no more dangerous for electric cars than for horse cars. Indeed, they are safer, for the electric car can cross more quickly and can reverse its direction of motion if the necessities of the case require it. The only point in which the greater danger lies with the trolley car is the somewhat remote possibility of the trolley breaking contact with the overhead wire, because of the severe jolting to which the car is subjected when passing over a number of steam tracks and the greater height of the trolley wire above the car at such points. Such an occurrence would, of course, suddenly leave the car stranded in the middle of the tracks, and leave the motorman helpless in what might be a most dangerous position. Steam and electric road crossings at grade should be better protected, since the cars run more frequently and are more heavily loaded than is the case at ordinary grade crossings. Automatic signals should be used to give due warning of the approach of trains, whether the crossing is protected by a gateman or not.

Vestibule Law Constitutional. It can scarcely be doubted that the time is not far distant when motormen and gripmen in all Northern cities will be protected from the cold during the winter months. Drivers of horse cars cannot expect protection of this kind from the very nature of the case, but their number is growing smaller with every month. In five States a law providing for the equipment of cars with vestibules is in effect, and although the measures have not in all instances met with the approval of the companies, they are now more inclined to view the matter philosophically, and are coming to the conclusion that the application of storm fronts may prove desirable after all. In the two instances in which courts have been called upon to pass upon vestibule laws they have affirmed their constitutionality, and have found that in compelling street railway companies to protect their men against the inclemencies of the weather, the State is not exceeding a proper exercise of its police powers. The Supreme Court of Minnesota has just declared that the law is valid, and has pronounced against all of the familiar grounds on which it was attacked. Most important of all of its findings is the affirmation that the law cannot be considered as class legislation. If such an act cannot be successfully assailed on that ground, there seems to be no reason for believing that it will fail of approval whenever its validity is questioned. No particular significance attaches to the finding of the court in Minnesota so far as that State is concerned, for the reason that while the law was attacked, the companies decided to comply with its provisions; in fact they went even further than they were required to do. According to the act they were compelled to vestibule only one-half their cars last winter, but before the close of the season almost all the cars in operation in Minneapolis and St. Paul at least were equipped. The decision of court, however, is of importance in that it will have the effect of aiding in the passage of similar legislation in other States. Motormen in several States are uniting in petitions to legislatures to pass vestibule laws, and now that the constitutionality of the measure has been again affirmed the lawmakers will be the more inclined to heed their requests. This being the case managers may as well make a virtue of necessity and prepare to add the desired storm front to their cars. They have been very bitterly opposed to the innovation in many quarters, not so much because they dreaded the expense, as for the reason that they were convinced that the protection would lead to an increase in accidents. So far as our knowledge extends this assumption is not proved to be correct by experience. The men who have tried the vestibules where they were honestly made tell a very different story. They assert very positively that with good vestibules the liability to accident is much lessened in severe weather, for the simple reason that the trainmen are better able to control their cars when comfortable than when chilled to the bone. It seems to be the fact that whether desired by companies or not the vestibule is bound to be adopted more and more generally, for the men are demanding it, legislatures are seemingly inclined to pass the necessary laws, and courts do not hesitate to approve them.

STREET RAILWAY ACCIDENTS.

The record for street railway accidents for June is presented herewith. The number exceeds by 78 the number which was recorded for the month of May, and is 51 in excess of those reported for April. While the number of casualties has increased, the fatalities are two less than appeared in the May record, but at the same time the number of persons injured have more than doubled, the figures being for May 128, and for June 266. It is a noticeable fact that the number of passengers and employes who were injured has greatly increased, the numbers for June being respectively 119 and 35, and the corresponding figures for May being 27 and 8. The increase is easily accounted for by reference to the list of causes. Collisions of cars were five times as many as in the month of May, when only two accidents of this character were noted. All the classes of accidents in which passengers and trainmen are likely to sustain injuries have very materially increased during June.

Following is a list of cities in which more than three accidents were noted: Philadelphia 19, Chicago 14, Brooklyn 11, Newark 9, Kansas City 9, St. Louis 9, Minneapolis 7, Baltimore 7, Cincinnati 7, Cleveland 6, Columbus, O., 5, Buffalo 4, Milwaukee 4. The June record is as follows:

Number of places in which accidents were noted	90
Total number of accidents	239
Number of accidents due to electric cars	192
Number of accidents due to cable cars	33
Number of accidents due to horse cars	14
Number of fatalities	45
Fatalities due to electric cars	35
Fatalities due to cable cars	3
Fatalities due to horse cars	7
Number of persons injured	266
Number of persons seriously injured by electric cars	71
Number of persons seriously injured by cable cars	9
Number of persons seriously injured by horse cars	4
Number of persons slightly injured by electric cars	151
Number of persons slightly injured by cable cars	26
Number of persons slightly injured by horse cars	2
Accidents sustained by adults	238
Accidents sustained by children	73
Number of passengers injured	119
Number of employes injured	35
CAUSES OF ACCIDENTS.	
Attempting to cross in front of cars	47
Collisions with vehicles	36
Fell from cars	28
Attempting to board cars	13
Alighting from cars	13
Collisions of cars	10
Cars jumped the track	6
Collisions with railroad cars	4
Collisions with bicycles	3
Cars run into an open switch	3
Struck by broken trolley pole	3
Fell under trailer	2
Car struck obstruction	2
Struck by passing car	2

CHICAGO STREET RAILWAY MAIL SERVICE.

Postmaster Hesing, of Chicago, has become convinced that the postal service of the city would be materially benefited if the street railways should engage in the transportation of the mails. A few days ago he invited representatives of the three cable railways of Chicago to attend a conference in which the matter of carrying the mails by the street railways should be discussed. There were present General Manager Parsons of the West Side Cable Company, Vice-President W. F. Furbeck of the North Side Street Railway and Superintendent Bowen of the Chicago City Railway. On the part of the Government there were present, besides Mr. Hesing and his assistants, Col. J. S. Cooper, who has the contract for the mail messenger service of the city, and J. M. Masten, of Washington, who is the agent of the postmaster-general in making contracts for carrying the mails.

Three plans were submitted by the postmaster and were discussed. The first was for the companies to build mail cars to be run in cable trains; these cars to be railway postoffices, in which the mails can be distributed *en route*. The second plan was to place messengers on ordinary cars to receive mail pouches and interchange them at the postal stations; these messengers are to have space on the cars to take proper care of mail bags. The third proposition was for the companies to carry the mails themselves, placing the pouches in the care of the conductors.

It was agreed that either the second or third plans should be adopted at once. The introduction of mail cars will not be considered for the present.

MINNESOTA VESTIBULE LAW CONSTITUTIONAL.

The Supreme Court of Minnesota has declared constitutional the law which requires that street railway companies in the state shall equip their cars with vestibules for the protection of motormen The case was brought before the court on appeal from judgments in the municipal courts of St. Paul and Minneapolis, which found the superintendents of the Twin City Rapid Transit Company guilty of violating the law by failing to equip cars with vestibules as provided by the legislative act. The courts in each case imposed fines. The company proceeded to equip its cars as it already had been doing, but it appealed the case. The law was attacked on the ground that it was unconstitutional because the power which it conferred could not be assumed as belonging to the police powers of the State; that it was class legislation; that it impaired the obligation of contracts with cities; that the fine for violation—$50 to $100 for each car not vestibuled—was excessive. The court disagreed with the company's counsel in each of these grounds, and found that the law was constitutional. The finding of the court is not a matter of significance, as the company has already complied with the law. The fines of the superintendents simply stand.

NORTHWESTERN ELECTRICAL ASSOCIATION.

The summer meeting of the Northwestern Electrical Association will be held in St. Paul July 18, 19 and 20. At the last meeting, held in Milwaukee, 150 persons were present, and a larger number is expected at this meeting. Representatives from Illinois, Michigan, Wisconsin, Iowa, and North and South Dakota, have written that they will be present. An excellent programme has been prepared, and the best expert and electrical talent of the United States has been secured to address the convention. Current will be furnished to illustrate lectures as well as to accommodate exhibitors. Manufacturers and supply houses will be accorded every courtesy by the association.

SIGNAL WIRES IN THE CABLE CONDUIT.

The Broadway and Seventh Avenue Railway Company, of New York City, has won a decided victory in its fight with the Empire City Subway Company, Limited, in regard to its right to use the conduit running along its line of road from the Battery to Fifty-first street, for wires and electrical conductors in order to signal to any portion of the road in case of accident or for other cause. Judge Ingraham this week in the special term of the Supreme Court, gave a decision holding that the subway company has no right to maintain action to enj in the railroad company from maintaining electrical conductors in its conduit for the necessary and proper operation of its road. Judge Ingraham holds that the license of the Subway Company is not an exclusive right to maintain subways in New York City, and that this complaint must be dismissed.

CONTRACT FOR METROPOLITAN ELEVATED ELECTRICAL EQUIPMENT AWARDED.

The contract for the electrical equipment of the Metropolitan Elevated Railroad of Chicago has just been awarded to the General Electric Company. The contract covers the generators, switchboard, motors, line and construction work. Four generators are provided—two of 1,500 kilowatts each, to be operated at 75 revolutions per minute, and two 800-kilowatt machines designed for 100 revolutions. Thus the total initial capacity of the station will be 4,600 kilowatts, or over 6,000 H. P. The generators will all be directly coupled to the engines, but the type and make of the latter have not yet been announced. The amount of the contract has not been stated, but it has been estimated that it will be from $200,000 to $225,000.

According to existing plans 55 three-car trains and the same number of motor cars will be operated at the start. Each motor car will be equipped with two 100 H. P. motors—one on each truck—and 110 motors will therefore be necessary. Series parallel controllers, improved somewhat over the type in use on the Intramural road, will be used, and the current will be transmitted to the motors by a third rail at 500 volts pressure. In general, the system of operation in use will be the same as that adopted for the Intramural road at the World's Fair, but many changes will be made in matters of detail.

CAST IRON vs. FORGED SOFT STEEL BRAKE-SHOES.

The question as to what metal is best adapted for use for brakeshoes is of vastly more importance than one would suppose, if only a passing thought be given it. The main points to be considered in deciding the question are: First, economy in wear, considering the first cost of each; second, relative wear of wheels; third, the coefficient of friction or retarding power.

It has been demonstrated by tests in service that one brakeshoe made of forged, soft, low carbon steel will outwear about seven cast iron shoes; or, in other words, the wear is one pound of soft steel shoe to eight pounds of the cast iron shoe for the same service. This answers the first question to be considered in favor of the soft steel shoe, because the cost of it per pound is but three times that of cast iron, while the demonstrated practical value is eight times.

The second proposition is the relative wear of wheels, and there has been room for doubt whether the soft steel would not wear the wheel faster than cast iron; this doubt comes from the fact that friction has generally been connected with wear, the assumption being that the greater the wear the greater the friction, but this is now known to be dependent upon the nature of the material. The results, from a long period of tests, show that soft steel does not wear steel tires or chilled wheels any more than, and not as much as, cast iron shoes. The reasons for this are obvious: The steel shoes to wear the wheel faster than cast iron would have to be harder, but the fact is they are softer, having only 0.10 carbon. The question naturally arises, if the steel is softer, how is it that it only wears one-eighth as fast as cast iron? The answer is simple, and embodies the secret of the economy of the soft steel shoe. Soft Bessemer steel is homogeneous, and the molecules, although soft, hang tenaciously together and resist separation, so that they are not readily pulled apart by the friction, thus reducing the wear. Cast iron, on the contrary, is not homogeneous, and the molecules are not held together with anything like the force that exists between the molecules of soft steel, and the particles separate easily and fly off, just as the particles fly off from emery wheels. In other words, the real cause of the excessive wear of cast iron shoes is the waste occasioned by the separation of the particles from each other and the falling off without having performed any really useful function in braking.

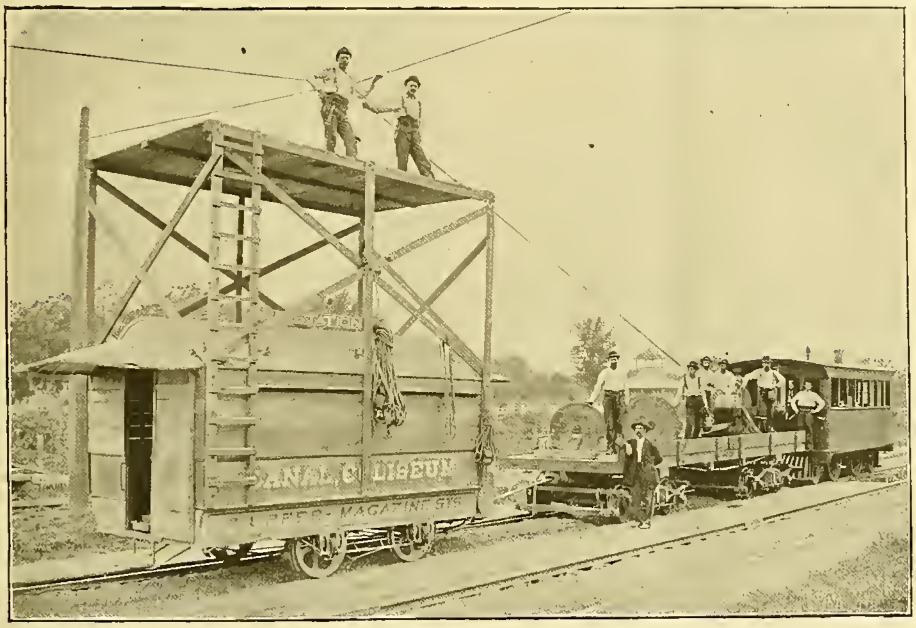
The third question about the coefficient of friction, or retarding power, is one that is still unsettled. The reports of tests show that the retarding power of the soft steel is a great as, if not greater than, that of cast iron. Yet we can easily see how the retarding power would not be as great with hard steel shoes as with cast iron, but on this point it is well to wait for the data from the M. C. B. Committee on Laboratory Tests before going too far in reaching a decision as to the coefficient of friction.

Besides other incidental advantages of a long wearing soft steel shoe, there is the all important one of the less number of times the shoe has to be changed, and the decreased inspection required to keep up the slack.—*Charles T. Schoen, in the Railroad Gazette.*

A STEAM LOCOMOTIVE USED FOR STRINGING TROLLEY WIRE.

The New Orleans Traction, which operates the lines of the New Orleans City & Lake Railroad and the Crescent City Railroad, and owns the "Judah Hart" franchises, is equipping its lines with electrical apparatus. The total mileage of the lines will be about 135 miles of track. Of this, seven miles of double track is a steam dummy line, running from the business center to West End, a popular summer resort on Lake Pontchartrain, owned by the company. This line also operates with horse cars as far as Metairie Cemetery, 3¾ miles from the city terminus, and as the animal power is soon to be displaced by electric, both steam and electric motors will operate over this portion of the line.

As the West End business is too extremely important to be subjected to any interruption, the trolley wire work had to be done for the most part between the hours of midnight and 6 A. M. The rolling stock shown in the accompanying engraving was called into requisition for the purpose. An old horse car was converted into a very convenient tower wagon, as shown, and a flat car carried the reels of wire and the frame on which they were mounted for paying out. The motive power was a steam dummy locomotive, such as are in daily operation on the line, and the vacuum brake with which it was equipped proved a very desirable feature for making the frequent stoppages necessary, and for holding the slack when pulled up preparatory to guying. The entire outfit, as may be readily seen from the illustration, was found to be very satisfactory for quickness and general handiness of working—very necessary requisites under the conditions imposed. To string the 3¾ miles of trolley wire, tie it up to the span wires and temporarily guy both ends, took one night between the hours mentioned for each track. The work of fastening on the clamps, insulators and hangers, complete, was also done in one night on each track. The number of men in the gang, of which Mr. W. B. Eicholtz is foreman, including the engineer of the steam dummy, averaged six. Permanent guying, and the building of a reverse curve at the outer end of the line, were done subsequently and in the daytime.



STRINGING TROLLEY WIRE WITH A DUMMY LOCOMOTIVE.

Instead of the usual method of pulling up the slack after stringing the wire, double or treble blocks and a long row of men on the tackle, the locomotive was employed to pull it up direct, and did so with ease, though the engineer bad to use quite a little sand to pull out the last few feet, as the track was moist at that early hour of the day.

The electrical construction of all the lines is under the supervision of Mr. B. Willard. Work on other portions of the system is progressing rapidly, and it is expected that the first motor cars will be started within a few weeks.

PHILADELPHIA TRACTION LITIGATION.

In Philadelphia last week answers and demurrers were filed in the suit of William E. Evans against the Pennsylvania Traction Company. The suit was instituted last April with the object of setting aside as illegal the merging of a number of companies into the defendant corporation. The proceedings were begun against the following companies in addition to the Pennsylvania Traction Company: Lancaster City Street Railway Company, the Lancaster & Millersville Railroad Company, the Lancaster & Columbia Railway Company, the Columbia & Ironville Street Passenger Railway Company, of West Hempfield township; the Lancaster & Strasburg Railway Company, the Columbia & Donegal Railway Company, the Lancaster Traction Company and the Provident Life and Trust Company, of this city.

In his complaint Mr. Evans alleged that he was a holder of 32 shares of stock of the Lancaster Traction Company, which he had bought on Feb. 3 last from John N. Eby. When he presented the certificates at the office of the Lancaster Traction Company for transfer to himself on the company's books, his request was refused, because, as alleged, the Pennsylvania Traction Company had unlawfully acquired control of the property, and it was apprehended that the plaintiff might, as a stockholder of the Lancaster Traction Company, bring proceedings in court and nullify the alleged acquisition of the property. The bill also set out the organization of the defendant companies, under various acts of Assembly, the merging of some of them with others, and finally the obtaining control of them by the Pennsylvania Traction Company by such merger, leases, etc. The things done, it was alleged, were not authorized by any acts of Assembly of the State. The Pennsylvania Traction Company was incorporated, it is related, under the act of 1887, for "the construction and operation of motors and cables or other machinery for supplying motive power to passenger railways and the necessary apparatus for applying the same." It was averred that, without having built any road whatever, the Pennsylvania Traction Company secured control of the other roads named, by leases for 999 years, and executed a mortgage, covering the property of the roads mentioned, to the Provident Life and Trust Company for a sum largely in excess of that fixed per mile by the act of May 14, 1889. It was further stated that at the time of the making of the mortgage there had not been paid in sufficient on the capital stock to warrant its execution, and that the giving of the mortgage was part of a device to enable the Pennsylvania Traction Company to get possession of the roads, and that under the methods adopted the result would be that the property of the roads would be acquired, not by means of money paid into the capital stock of the Pennsylvania company, but by a mortgage placed in advance upon the property sought to be acquired.

In its answer the Lancaster Traction Company denies that Mr. Evans is the owner of 32 shares of the company's stock. But it is alleged that on the 3d of February last he made a contract with John N. Eby for the purchase of the stock, and on March 6 presented the certificates, requesting to have them transferred to himself. Refusal to comply with the demand was not made because the Pennsylvania Traction Company had acquired control of the property and direction and books of the company, nor because there was apprehension that the plaintiff might, as a stockholder of the defendant company, by any proceedings in court, nullify the acquisition of the property, but because John N. Eby had entered into a written contract with John J. Patterson to sell and transfer to him the stock at $60 per share, to be delivered on or before February 4, 1894, deposit of $5 per share as security having been made with Bernard J. McGrann. It is asserted that the plaintiff, knowing this, purchased the stock from Mr. Eby for $55 per share. Mr. Patterson, it is said, has tendered the plaintiff $60 per share for the stock, but Mr. Evans refuses to accept it. It is asserted that the railways, etc., which were leased by the defendant company were lawfully acquired, and the allegagations of the plaintiff of impropriety or illegality of the deal are denied.

The answer of the Pennsylvania Traction Company is of a similar character, as is also that of the Lancaster City Street Railway Company. The court is asked to dismiss Mr. Evans' bill of complaint. The demurrers without answers were filed by the other companies.

GETTYSBURG RAILWAY CASE.

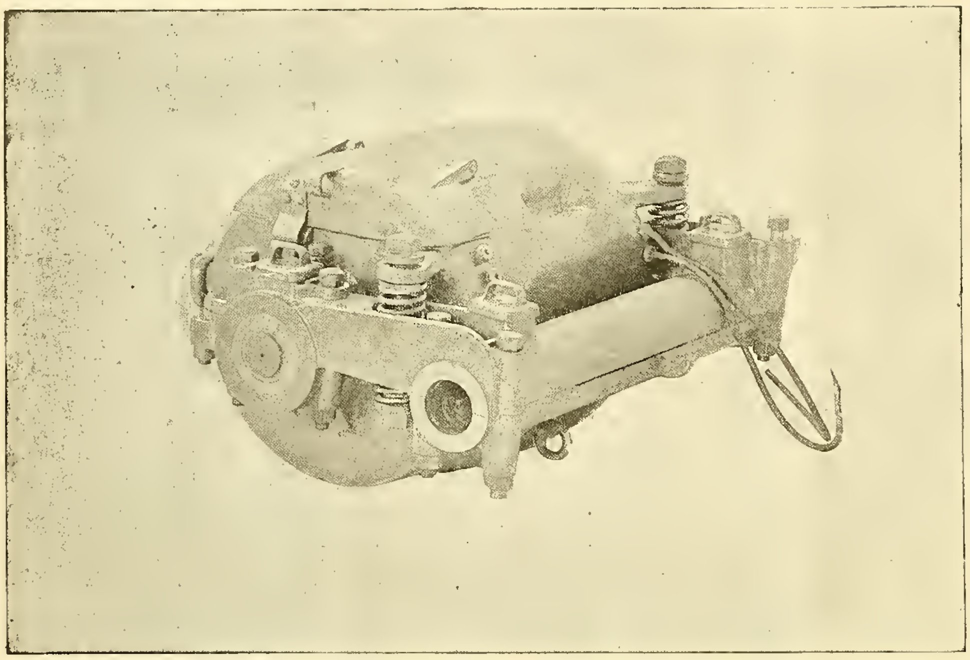
Judges Dallas and Butler, in the United States Court in Philadelphia last week, dismissed the motion made on behalf of the Gettysburg Electric Railway Company to quash the petition of the United States for the appointment of a jury to condemn a strip of the company's property on the Gettysburg battlefield. The petition was attacked on 14 grounds, the most important of which were that the act under which the proceedings were instituted was unconstitutional, and that sufficient money was not available to pay for the property it taken from the company. The court decided that the motion to quash the petition for condemnation should be denied, without prejudice to the presentation of the same questions upon the coming in of the report of the jury of condemnation. Judge Dallas also said that of course this did not give the slightest indication of what the opinion of the court might be on those questions, and if there were an application for an injunction embodied in this motion to quash, that would necessarily be also denied, in view of the order that the court had made.

Judge Dallas has appointed seven citizens of Adams County to serve as the jury to assess the value of the strip of land in possession of the road. The strip is 6,000 feet long and 30 feet wide.

Philadelphia, Pa.—The Hestonvile, Mantua & Fairmount Passenger Railway Company has filed a bill against the Forty-second Street & West Park Passenger Railway Company, asking for an injunction to prevent the defendant from building its line on Spring Garden street, between 25th and 31st streets, on any part of the Fairmount or Spring Garden bridge, or on any part of 25th street from Spring Garden to Callowhill street, on which are laid the tracks of the Hestonville company.

WALKER COMPANY'S ELECTRIC RAILWAY MOTORS.

During the last two or three years since electric railway motors have reached a high state of perfection, a vast amount of attention has been devoted to the problem of overcoming the deterioration of the track. As traffic has increased and as cars have been built more heavily and have run at higher speeds, the problem has become one of great importance. As the heaviest item in the cost of maintenance is that for the roadbed, the solution of the problem is a matter of the utmost concern to every street railway manager and stockholder. In overcoming the difficulties it is obvious that an essential condition is the avoidance of all rigid contact between the motor and the axle. In this way the impact of the wheels at the rail joints is reduced.



WALKER MANUFACTURING COMPANY'S STREET CAR MOTOR.

In the earliest application of electricity to street-car propulsion the motor was supported at one end by springs, while the other was journaled directly to the axle. But this was done more for the purpose of relieving the gear teeth from shock than out of any consideration of the the impact effect upon the rails, and it is only recently that this latter consideration has been seriously taken up by manufacturers.

In placing upon the market a new system of electric railway equipment the Walker Manufacturing Company, of Cleveland, O., has aimed to produce a system that should combine all the long tried and approved principles of construction with the solution of the problem of suspension. In addition the matter of cleanliness and exclusion from the commutator, armature and field coils of all oil and grease has been studied, and a design has been produced which is thoroughly effective.

The method of suspension embodied in the Walker Manufacturing Company's system is a very simple one, and accomplishes very efficiently and practically its purpose. As above stated the only way to remedy the very serious evils due to impact at the rail joints is to reduce this impact to a minimum by disconnecting the motor from rigid contact with the axle in such a way as to prevent not only the hammer blow due to the weight of the motor, but the inertia blow due to its yielding mass. Attempts have been made to accomplish this by suspending the motor at or near the center of gravity. While this eliminates the weights, it does not do away with the inertia blow, which is the most serious.

It is true that suspending the motor at its center of gravity removes the entire direct dead weight from the axle when in a state of rest, but it will be readily seen that any upward thrust, due to imperfect rail joints or other irregularities in the track, is still opposed by the mass of the motor, whose inertia is very considerable and the consequent inertia blow on the rails is not avoided.

The illustrations herewith presented show the ingenious and novel, yet simple, method by which the elimination of both these effects is accomplished in the system under consideration. The motor is trunioned by its bearing cases and swings freely between the arms of a U shaped yoke. The part corresponding to the rounded end of the U is journaled on the car axle in the ordinary way. The motor is then supported at the rear by springs between the arms of the yoke and heavy lugs projecting from the casing At the front end it is supported by a swinging arm from the regular spring crossbar. In this arrangement it is obvious that the only rigid connection between motor and axle is in the horizontal plane, in which lie the gear centers, and the only direct dead weight upon the axle is that of the U shaped yoke, which is insignificant. Thus, not only is the torque of the pinion against the gear doubly eased, but all thrust due to irregularities in the track is immediately met and cushioned by the springs. It is found in practice that this method of suspension combined with the fact that this new motor has been reduced to a very light weight for its output has made possible a very great saving in the cost of maintenance of way, not to mention the increased life of the motor itself, by reason of the reduction of destructive vibration and shocks.

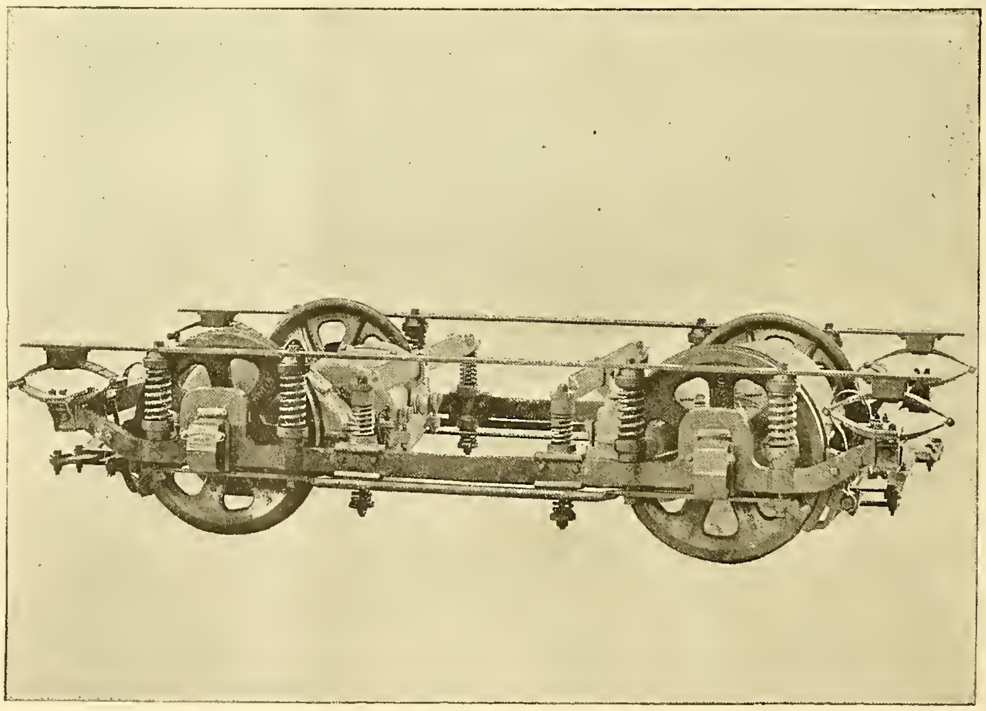
Another feature of this system well worth mentioning is the disposition of the bearings. These are made extra long and large, and their inside ends are removed about three inches from the openings in the housing, which is only just large enough to allow a small clearance for the shaft in passing through. In this three inch space there are the thrust collars; and all the grease that is forced out between the ends of the bearings and these collars is thrown by the centrifugal action against the walls of the recess, from whence it finds its way through a large opening at the bottom to the ground. Thus no oil or grease can possibly get to the commutator or windings.

The shaft is so constructed that in case of wear of the journals it can be withdrawn from the armature body on the removal of a single locked nut, and a new one can be inserted without the least disturbance of the windings. The motor, as will be seen by the illustration, is entirely encased and proof against snow, dirt, moisture and physical injury. The gears are in a detachable dust-proof housing and run in oil.

ELECTROLYSIS DISCUSSED AT THE FRANKLIN INSTITUTE.

At a meeting of the Franklin Institute last week there was a general discussion on the subject of electrolysis. A paper by J. H. Vail, of New York City, was read by Dr. Wahl, the secretary of the institute. This paper embodied Mr. Vail's well-known opinions on the subject of rail bonding, already published in our columns.

Dr. Wahl also read a few notes from Professor Edwin J. Houston and A. E. Kennelly, who were unable to be present. They took the ground that the current should either be prevented from entering the iron pipes, or, having entered them, prevented from leaving. Under the first plan the ground system of the trolley should be of low resistance, and the pipe system of such high resistance that the amount of current which will be



TRUCK EQUIPPED WITH THE WALKER MANUFACTURING COMPANY'S MOTOR.

diverted from the trolley returns to the pipes will be small. The execution of the second plan requires that the conductance of the pipe system shall be great and that it shall be connected with the trolley system. The problem is a perfectly definite one, its limitations are within engineering capabilities, and there is no reason to fear that the bright future of the electric railroads will be marred by the barriers of municipal water pipe systems. The subject was also discussed by Fire Inspector McDevitt, of the board of fire underwriters, and by A. Langstaff Johnston, chief engineer of the Hestonville, Mantua and Fairmount Passenger Railway Company, who spoke of the need of perfect contact in bonding rail joints to secure the best results. Several others discussed the subject briefly and illustrations of pipes corroded by electrolytic action were thrown upon the screen.

ELECTRIC RAILWAY CONDUIT SYSTEMS.—I.

BY LIEUT. F. JARVIS PATTEN.

To merely glance over the patented systems for electric railway conduits is no ordinary task, and if the examination is made with care one cannot avoid the conclusion that it is almost impossible to contrive any new thing in this line. A classified list contains more than four hundred patented systems presenting altogether an interesting display of ingenuity and invention.

As in most fields that captivate the mind of the average inventor we find the production of electric conduit systems out of all proportion to the demand for them. Thus while more than four hundred systems have been patented and new ones are coming at the rate of about two a week, the number that have been given any practical development or test will probably not exceed twenty-five. It may also be confidently added that seven-eighths of the entire lot are already dead inventions serving only to perpetuate the enthusiasm and folly of self-confiding inventors, of whom it may be said as a class that, whenever a problem arises that has a hundred possible solutions, there will always be more than a hundred fairly ingenious men who are anxious to prove their solution the best and stand ready and willing to pay for the privilege.

In the early eighties European engineers looked to the storage battery as a probable solution of electric traction, while, in the mean time, the overhead trolley was making rapid progress in the United States simply because it was evidently cheaper than any conduit system could be, and electric traction was wanted even if the plan adopted must be changed to another system at an early day. Conduit systems were, however, by no means neglected in this tentative period. The Bentley-Knight, Van Depoele, Short and a few others were given trial contemporaneously with early trolley systems, which, because of their greater reliability in service and cheaper first cost, easily won the competition for the time. It is probable that the rapid growth of cable systems in the United States for city traffic, and the frequent unsatisfactory service they have given, have kept inventors plodding away at conduit systems. This seems apparent from the fact that by far the greater number of earlier systems were designed and planned with a view to being substituted for the cable, most of them showing similar conduit arrangements, with a slot at the middle of the track to admit a trolley carrier dependent from the car.

A few such systems may come into use where a conduit system of electric road is substituted for a cable, but more improved systems that do not require a slot along the track offer superior advantages, and will doubtless have the preference where a new road is to be built. Furthermore in considering the future of conduit systems for electric roads it seems a safe prediction, for the next decade at least, that they will be confined to city roads, because the overhead trolley, having shown itself much cheaper in first cost and fairly efficient in service, is not seriously objectionable on suburban or country roads, and will therefore doubtless hold this field for some time to come.

In Europe few conduit systems have been put to the test of practice, whereas American enterprise has ventured upon the trial of many. The same may be remarked in passing of the storage battery systems of traction upon which millions have been vainly spent in the United States.

The Siemens company, of Berlin, however, laid down a very simple conduit system under the best possible conditions and has kept it running, it is stated, at a profit to its owners and with general satisfaction of the public for five or six years. This is the celebrated Budapest electric conduit system, celebrated, however, because it is the only attempt thus far made that has been maintained in continuous operation for any extended time.

The conditions under which this road is operated are exceptionally good. The surface of the city is nearly flat, grades are nowhere severe, and yet the drainage is so good that there is little liability of the conduits becoming filled with water, as the rainfall is moderate and snow is never a serious obstacle. Such conditions would seldom be found in large American cities. Perhaps the best in most respects is Washington, where a system similar to that in Budapest, known here as the Love system, is being tried. It has also been working recently in Chicago.

It is selected for description here because it is a type of the oldest and simplest of all conduit systems and is a fair representative of a very large class. Its general features are shown in Fig. 1, and consist simply of a continuous iron conduit connected in short sections along the middle of the roadway. There is a slot along the middle to admit the trolley arms, of which there are two.

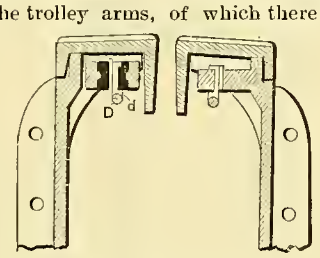


Fig. 1.

The edges of the slot are turned down some distance to protect the feed wires D, D from contact with extraneous matter or with each other. These feed wires, in contact with which the trolleys run, are bare throughout their entire length, being suspended or hung along a niche in the top of the conduit box, one on each side. There they are fairly well protected unless the conduit box becomes filled with water, snow or mud.

This system evidently is nothing more than a two-wire trolley system with the wires placed in a trough under ground. In respect to the protection afforded the underground wires it may therefore be regarded as the crudest of all systems, and its continuous working for years at Budapest should be ample evidence of the feasibility and operativeness of any system that better protects its feed wires, and is equally good in other respects. It will be observed that as two wires are used in this system, for "go and come" leads, there is no earth connection as when a return rail is used, so the only danger to the system seems to lie in the possibility of the conduit becoming filled with water, which would short-circuit the two main feed wires. This is the serious objection to any system of the Love type. Early systems show attempts to avoid this, and in a very large class we find the main conductors exposed only at occasional points where, through suitable contacts, a traveling shoe hung from the car takes the current. A typical system of this very large class is the Short system, Fig. 2, which in various forms and under other names has received quite a number of practical tests in this country.

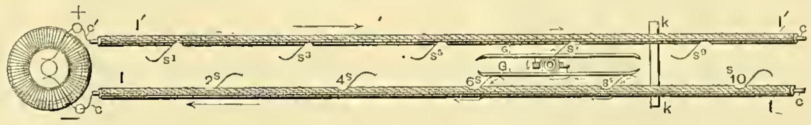


FIG. 2.

The two mains placed in the conduit as before are insulated throughout their entire length, that is to say, nothing laid across the mains as at K, K, Fig. 2, can short-circuit them. At points four or six feet apart on each main, exposed contact points S^1, S^2, S^3, etc., are placed and these are alternated in position, so that those from the opposite mains will not be near each other, but as far apart as possible. The car carries a traveling shoe, GG, having two connecting or conducting sides, one pressing against the contact points of each main, and made long enough to be always in contact with one or two such contact points on each main, thus insuring a fairly certain and continuous contact with the two main conductors which themselves are not exposed throughout their length, but only at the contact points and over the live portion of the shoe surface. This seems to be a marked advance in the way of protecting the feeder mains, but if water should rise to a level above the shoe there would be a leak as before; the effects, however, could not be so disastrous as if the entire conductor surfaces were exposed. Speaking of this system in general terms and as a class, it has met with considerable success in the trials that have been given it. The system shown in operation at Coney Island, New York, about a year ago, and which attracted considerable attention at the time because of the severe tests to which it was exposed by flooding the conduit with mud and water for a considerable distance, was a system of this general type, and the reports of experts state that the current loss under the unusually severe conditions of trial given was not great.

There is great variety of what for convenience I will refer to as the shoe system just described The plan illustrated in Fig. 2 is only typical of the lot. It is easy to see that ingenuity can be displayed in properly devising the contacts from which the sliding shoe takes current from the mains. More recent systems of this class use sealed cast iron boxes, placed at intervals around the main conductor, having a hinged arm that projects out through one side of the box, and which carries at its outer end a bare copper point, or roller, against which the contact-making shoe slides, while inside the box are contact-making brushes that bear on the exposed conductor when the arm is turned to one side or the other by a car shoe moving in either direction. This is a general description of the plan used at the Coney Island tests. The chief difficulties were in keeping the boxes tight, and preventing sparking of the brushes inside the boxes, which in time would destroy the contacts. The Kintner system, the general features of which are shown in Fig. 3, is of this same type, and serves well to illustrate this class of systems using sealed contact-making boxes with rocking arm contacts, such as that used at Coney

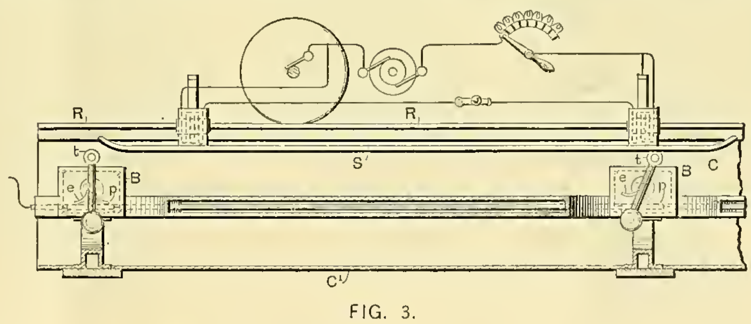


FIG. 3.

Island, and which was probably given as thorough a test as any system yet tried.

If it be remembered that the Kintner system shown in Fig. 3 uses only one feeder main and a return rail instead of two feeder mains as was used at Coney Island, it may be taken as a fair representation of the general features of the latter as last constructed. In the figure C_1 is the main conductor; B,B are closed boxes placed at intervals of three or four feet and when two mains are used they are interspaced. The rocking arm t of the right-hand box is shown tilted by the shoe s, which in riding over it throws the brush inside the box into contact with the main. The shoe must be long enough to strike one rocking arm before it leaves the other. It will be observed that the arm t of the left hand-box B is not tilted and has therefore no connection with the main. In the Coney Island system the rocking arms were in a horizontal instead of a vertical plane and spaced at such short intervals that the shoe would always be in contact with two or more on each main. The Bentley-Knight systems, as well as the Van Depoele, of which there were a dozen or more, all come under the two classes referred to above and require no detailed description. In fact these two earlier types have been models for four-fifths of all the systems yet contrived.

(To be Continued.)

ELECTRIC RAILWAY MOTORS: THEIR CONSTRUCTION AND OPERATION.

BY NELSON W. PERRY.

(Twenty-fifth Article.)

(f) Examine the brushes of the motors to see that they are not broken, and that they make good contact.

26. In case current is shut off at station for any reason while the car is running, bring controller to "off" position immediately. Then turn on light circuit, and wait until the lamps light up; when they have reached their usual brilliancy, *but not before*, start the car. The reason for this precaution is that should you turn the controller far enough to start the car before the full current was on there would be little or no counter electromotive force generated to keep back the rush of current when it did come, and your armature might be injured either by heat or by the sudden jerk that would result.

27. *In case the brakes of a car fail to operate*, there are two methods of stopping the car by the use of the motors. The first consists in reversing the direction of the current in the motor fields as follows:

(a) See that the controlling handle is at "off."

(b) Reverse the reversing switch.

(c) Throw the controlling handle around to the first or second notch—never beyond the third notch, unless the fuse blows; in that case (Westinghouse) move the handle around to the last notch and leave it there. This converts the motor into a generator and it will come to a stop if on level, or if on a grade will slacken up. In other makes (Short) the simple pulling over of the reversing lever after the controlling lever is turned to "off" will accomplish the same thing.

The second method will operate successfully whether the trolley is off or on the wire. It is as follows:

(a) Place controlling handle at "off."

(b) Throw canopy switch to "off."

(c) Reverse the reversing switch.

(d) (Westinghouse.) Throw controller handle around to last notch and *leave it there* until the car stops. The step (c) converts Short motors into generators. The additional step (d) is required in Westinghouse motors.

When cars are running away down hill the method of short-circuiting the motors on themselves and thereby converting them into generators is recommended as a last resort.

28. In case a motor bucks or flashes, examine brushholders, and if they are covered with dirt or mud, open canopy switch and clean them. A loose joint in the circuit between the brushes and the field will almost invariably produce flashing; trace circuit carefully and find it. See that the spring is tight and that there is no dirt coating on the bearing surface of the brush.

29. If the trouble is not found with the brush-holder, and motor has a peculiar smell like burned rubber or shellac, wait for the next car to push her in.

30. Motormen should always have a wrench on car to tighten up a loose nut, and should be constantly on the lookout for troubles of this kind.

31. Always report to inspector any trouble with track, such as "dead" rail, or of trolley wire, such as break of line or insulator, etc., and any unusual noises of motors, having first, however, endeavored to account for these latter yourself.

32. When you desire to run at slower speed and controller is full on, it is usually considered better to first pull it clear back to starting point and then back to position you think will give the desired speed.

33. Never pull reversing lever over while controller is on. If you do you are likely to blow the fuse or burn up the motor, in either case losing control of your car.

34. If in running along you feel the car suddenly let up, throw controller off and ascertain the cause if you can. It may be the trolley is off, passing a trolley break, a fuse blown or current cut off at the power-house.

35. If you do not find any trouble, try to start again. If the car does not move, proceed as directed under such circumstances.

36. Do not run over sticks, wire or other obstructions on the track, as they are liable to get entangled in the motor. Get down and remove them.

37. If paving blocks or other projections stick out above the pavement, slow up and be sure the motor will pass over without touching before attempting to pass. Of course you will remove the obstruction, if possible.

38. In case of the repeated blowing of the fuse without apparent cause, pull down your trolley and wait to be pushed in.

39. The proper handling of the car on a curve is perhaps the most difficult task that the new motorman has to learn. A good rule is the following: In approaching a curve cut off your controller, and bring the car down to a slow walk before entering, and have your brake in hand, but free, unless it be down grade. This will let the car run into the curve easily and without shock. As soon as you feel that the car is fairly on the curve, apply sufficient current to carry the car around the curve at about the same rate of speed, cutting it off again just before leaving the curve. This will allow the car to take the tangent with the least possible shock.

Always bear in mind that *anything that causes the car to jerk* is wrong.

40. If your car leaves the track do not attempt to run her back with the current until you are sure she can roll freely without jamming. Movement of the switch when the wheels cannot turn, or are not turning freely, is likely to cause trouble both with the motor and with the switch.

41. Avoid carelessness. Do not allow any metal, viz., your oil can, etc., to touch brass screws on motor boards unless the trolley is off the wire. Do not handle the screws unless the trolley is off or your person touches nothing but dry wood.

42. When examining the motor while the car is in motion, face the rear of the car or so place yourself that any jerk as in sudden stopping will not pitch you into the machinery.

43. Whenever the trolley leaves the wire the conductor should signal the motorman to stop, and then, after replacing the trolley, he should signal to go ahead. The motorman should bring controller to "off" position as soon as the trolley jams and keep it there until the conductor signals to proceed.

44. If you notice any loose motion about the trolley, or if it leaves the line frequently, or if, when running fast on a straight track there is any flashing between the trolley and the wire, report the same at once.

45. Remember that the trolley wheels need oiling. This should be done as often as necessary. The oil, especially in cold weather, should be of a quality that will not become gummy or sticky.

46. Watch your track joints when going toward a station. If there is sparking ahead of you at the joints the rail connections are broken. If the car suddenly gathers speed after passing any point, or if when the lights are on they become very dim and then suddenly brighten up, a broken or loose track connection is also indicated. Report the fact and place promptly.

47. Observe carefully whether the car takes her natural speed for all positions of the switch, and if not, report trouble, or, better still, find, it yourself and correct if possible.

48. If motor or car seems to work hard, feel of bearings; if one or more are hot, apply oil and watch frequently; if heat increases, the car should be run in and inspected.

49. If journals squeak it means that they are running dry and require oil.

50. When storing your car in the house for the night, remove the trolley from the wire, cut out the safety switch, turn the reverse lever so that the car will be ready to run out. Take off the levers and place them on the hook in the office provided for them and marked by the number of the car.

DESTRUCTIVE ACTION OF ELECTRIC CURRENTS ON WATER PIPES.

At the recent meeting of the New England Water-Works Association a paper on the above subject was contributed by Messrs. Chas. A. Stone and Howard C. Forbes, and read by the latter. So much attention has lately been given to electrolytic action that premature corrosion of water pipes from any cause is likely to be attributed to electricity. Ordinary rusting does not take place at a uniform rate, varying, for instance, with the character of the soil, but often natural corrosion is hastened by the action of electric currents.

Experiments are now being made by the authors, at the request of Mr. Wm. Jackson, M. Am. Soc. C. E., City Engineer of Boston, to find a method of distinguishing between electrolytic and natural corrosion.

The various methods proposed to prevent electrolysis may be classed under three heads, as follows: (1) Complete remedies, such as the double trolley and storage battery systems, complete insulation of the pipes and possibly the alternating system. For the present the first three systems are considered as in themselves impracticable, and it is yet too early to pronounce upon the latter. (2) Partial remedies, such as very heavy return wires from the tracks to the power station, with good bonds between the rails; also returns from sections of track every 500 feet along the route; but this can never entirely do away with the difficulty; the three-wire system, regarding which little is actually known and which is not as yet promising; insulation of tracks, which, as indicated, only tends to reduce the injury. (3) Schemes which are useless, as connections from the tracks to the pipes, bringing the pipes to uniform potential and reversing the current at frequent intervals.

In addition to the above methods the connection of the pipes to the negative plate at the power station has been tried several times and with beneficial results. The problem here is to get the current through the joints in the pipe without injuring the latter.

At the opening of the discussion of the paper on electrolysis Mr. I. H. Farnham was called upon. He described a simple method of testing for corrosion by electricity, consisting of placing two short pieces of pipe near a pipe in the distributing system at the suspected point and connecting one of the pieces with the main pipe. If corrosion was afterward shown in the connected pipe, but not in the unconnected, the conclusion is obvious. If pipes could be made to carry current without a change in the resistance caused by poor joints, etc., it would be possible by making proper connections with the water mains near the power station to prevent corrosion.

In most cities, Mr. Farnham stated, the trolley wire is positive and the danger district is then near the power station, and the current can be conducted to the station by wiring. With a negative trolley wire the danger district would be at the extreme end of the railway. Copper bands can be used to diminish the resistance at poor joints.

Mr. Geo. E. Winslow thought that the storage battery system was less likely to give trouble than the double trolley.

Mr. Sparks said that in 1890 a 12-inch main was laid from a pumping station at Veazie, Me., across the river to Brewer. Water and electric railway plants were run by the same company, and the return was made by connecting with hydrants. After a few months of use the submerged main broke in 35 feet of water. It was repaired, but broke again after a few months, and later still again. The broken pipe was so badly decayed that a ring nearly around it could easily be broken out with a hammer. A new main was laid and about the same time seven strands of No. 6 copper wire were carried beneath the river and connected with the pipe at each end. Since this was done there has been no trouble.

CARD ELECTRIC COMPANY'S RAILWAY APPARATUS.

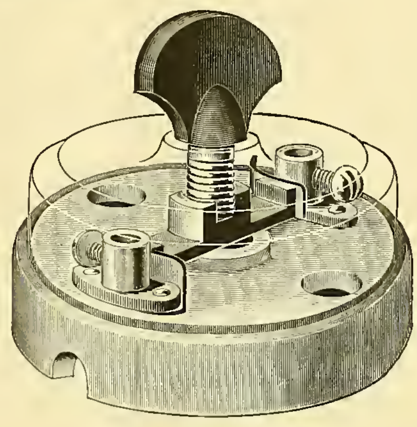
The railway apparatus built by the Card Electric Company, of Mansfield, O., recently described in our columns, is said to be attracting considerable attention from prospective purchasers. The controlling stand has been well received on account of its simplicity. On a central shaft are placed eight cams, insulated by hard rubber tubing and held in place by hard rubber pins. Opposite each cam is a switch fastened by a bracket to the back, near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. It will be seen, therefore, that the controller consists simply of a series of break switches, doing away entirely with all the sliding contacts.

Card motors have been in operation for some months in Fremont and Mansfield, O., where they are reported to have given entire satisfaction.

CAR AT FREMONT, O.—CARD MOTORS AND FULTON FOUNDRY & MACHINE CO.'S TRUCK.

THE GIBBS SNAP SWITCH.

The accompanying illustration represents a new switch, designed to make and break 500-volt circuits. It is particularly adapted for electric railway currents, and is the only snap switch in the market, it is stated, that can be successfully used for this purpose. The break is 1¼ inches long, or about ½ inch longer than has ever been obtained in snap



The Gibbs Snap Switch.

switches before. It will be known in the market as the Gibbs 3-ampere 500-volt switch, and it is manufactured by the Perkins Electric Switch Mfg. Co., Hartford, Conn. The western office is in charge of G. W. Conover, formerly purchasing agent for the late Ansonia Electric Company, and the office is located at 1,536 Monadnock Block, where a large stock of Perkins specialties is carried, and any orders received will be promptly attended to.

HOW ABOUT THE OTHER FELLOW?

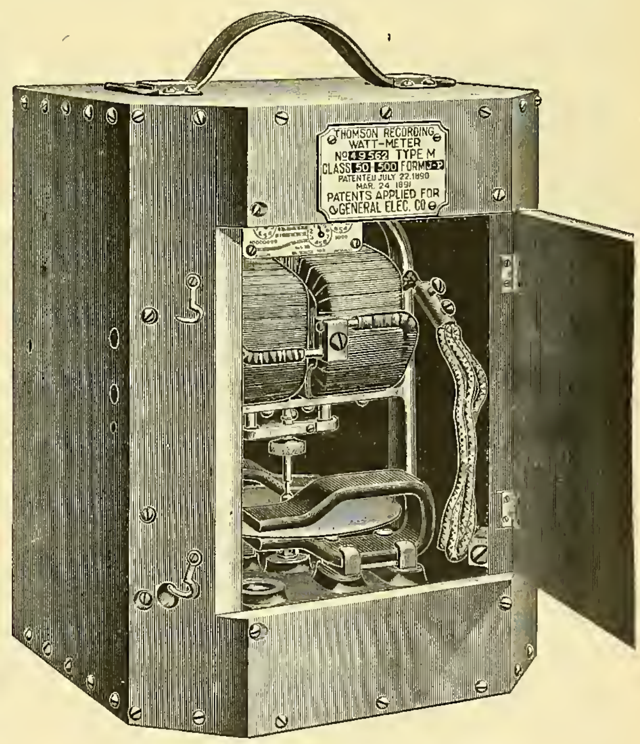
Under the above heading the Brooklyn *Eagle* prints a communication from J. H. Griffiths, of Brooklyn, that is worth reproducing as it gives the views of a citizen who thinks that the electric car is a much abused public servant. The letter is as follows:

"At a Friday evening prayer meeting in Plymouth church several years ago, a gentleman arose and desired Mr. Beecher and the brethren to thank the Lord for a marvelous escape he had just had. A large block of stone had fallen from the roof of a building and struck down a man at his side. Mr. Beecher listened to the request, thought a moment and said, 'How about the other fellow?' He then gave one of his characteristic talks about our proneness to think of ourselves and not of the other fellow. In this matter of the speed of the trolley cars every one seems to be thinking of the victims of accidents and of the railroad company, but no one pays any attention to the other fellow who rides in the cars. The change of motive power very naturally resulted in a large number of accidents, but there is no evidence that they have been caused by the speed of the cars. In fact it is a question whether the wholesale dread of a rapidly moving car is not an element of safety. But aside from the question of safety to pedestrians the time and convenience of the passengers in the cars should be considered. Five minutes saved each day in a run of two miles would mean to a business man an hour each week, or 52 hours in the year, or six days of eight hours each, or pretty nearly the time of the average vacation of the clerk or business man. People must learn to keep out of the way of the cars. There is no reason why thousands of people should be delayed solely because a few careless people will not take care of themselves or their children. What aggravates me beyond endurance is the way passengers grumble at the slowness of the trolley cars and at the same time curse the company for accidents which it is claimed result from fast running. The man who is walking never thinks of the other fellow in the car and the fellow in the car is transformed the moment his feet strike terra firma. As a matter of fact, notwithstanding all the accidents and delays, the trolley cars have done more for Brooklyn than all other public improvements since the opening of the bridge."

PORTABLE RECORDING WATTMETER.

The latest development in the electrical meter line is the new Thomson portable recording wattmeter, which, indentical in general character with the standard meter of that type, is constructed with special provision for transportation from place to place, and is intended for use in points where it may be exposed to jarring and rough shaking. While it may of course, be used for any and all classes of testing work in which a portable recording meter is requisite, its special use is for the testing of street car work and in this field it will be found most valuable.

The meter is mounted on a skeleton frame suspended between strong elastic rubber nettings within the case. Deterimental shocks and vibrations become absorbed in these nettings, and no interference with the movement of the meter occurs. Its accuracy is unaffected even when placed on the floor of a rapidly moving car. The meter is mounted in a handsome polished wood



THOMSON PORTABLE WATTMETER.

case. The 25 ampere size will be found the most suitable for general car testing, it will stand and accurately record extreme overloads for short intervals.

This meter is the result of long and careful experiment on the part of the General Electric Company, and is not to be confounded with the rigidly mounted and bulky portable meters, formerly used for car testing in default of a superior device. This meter is the only portable recording wattmeter on the market, and is the outcome of an important demand from the street car companies for a meter which would enable them to check the efficiency of every car equipment, and the average number of horse power hours needed to take any car over any route of their systems. They are manufactured in the following sizes: Three amperes, 1½ H. P.; 15 amperes, 7½ H. P.; 25 amperes, 15 H. P.; 50 amperes, 30 H. P.; all for 500 volt circuits. They can also be made for any other voltage according to order.

COMMENTS AND VIEWS OF CONTEMPORARIES.

CAUTION IN OPERATING CARS.—It is at this season, remembering these things, that the motorman should run with especial care, particularly at the crossings, never exceeding the speed permitted by law. The streets are now thronged and foot passengers apt to be careless, having become so accustomed to the cable and electric cars, and the duty devolving upon those who run these vehicles is particularly stringent. To cause the loss of a human life, even where the act was involuntary and unavoidable, is a distressing thought, likely to cloud the whole future. Many of the motormen are parents themselves, and would be the last persons in the world to willfully injure the little ones playing in the streets. Especial vigilance during the summer is, therefore, necessary.—*Baltimore News.*

FENDER QUESTION.—What the public wants is a car fender that will save life. No one hopes that they will receive a fender that will prevent injury absolutely. This is a case where what is to be done were best done quickly. If everybody's opinion is to be consulted the commission will be in the predicament of the farmer, his son and the donkey in the fable, and they will please nobody.—*Baltimore (Md.) World.*

BLOCKADES OF CARS BY PARADES.—There is no especial significance in a street car delaying a procession for the short space of time it takes for it to cross a street. There may be much significance in delaying street cars for the period of time it takes a long funeral procession to pass a given point. In life all citizens are required to defer to the rights of each other and of the public. There is no reason why in death a larger liberty or license in this respect should be enjoyed. It is a mistaken theory of respect that has impelled the view that the business of a great public should be conditioned on the slow movements of a funeral cortége. The closing of a great avenue of trade to any one entitled to its use for any length of time in order that it may be monopolized for exclusive privileges of any person, living or dead, should be frowned upon.—*Milwaukee News.*

OPEN AND CLOSED CARS.—With frequent changes in temperature and occasional sudden showers, people not in robust health and delicate women and children need the protection of a closed car. Even in the mildest weather there may be danger in open cars for some classes of passengers. The heat is never so great but that a closed car, if there is one on the train, has its proportion of passengers.—*Chicago Herald.*

VESTIBULES.—The last Minnesota legislature enacted a law requiring street railway companies to vestibule their cars in winter, and the Supreme Court has declared the law constitutional. This law is in the interest of simple humanity. The motorman must stand in one place and practically in one position all the working day, which means for him 12 to 14 hours. For his arduous labors and the immense responsibility for human life placed upon him he is never too well and rarely adequately paid. The requirements of vestibules to protect him from the elements is the least that can be done for him.—*Indianapolis Sentinel.*

COMPETENT ENGINEERS NEEDED.—There are plenty of good street railway motors, but there are very few roads where the employment of a staff of competent engineers would not be attended with large savings.—*Electrical Engineer.*

GOOD FENDERS OR SLOWER SPEED.—If there are no good fenders, the only other remedy is a material lessening of the speed of cars. The frequent loss of life cannot and will not be tolerated by the people. The benefits of rapid transit may be great, but they have been earned at an enormous cost.—*Baltimore Herald.*

DEMAND FOR IRON.—And when the increased demand for electric appliances comes—particularly for electric railroad building in streets and between towns—there will be so much added to the call for iron and steel. With the passing of steam railroad demand, as an influential factor in the market, electric roads and electric power appliances of all descriptions are becoming more and more an index of the iron trade. The iron ore interest had begun to look to the expansion of electrical industries that has gone on so rapidly in the past few years, to absorb the increasing output of ores. That was before the depression had confounded all calculations. But whenever the reaction comes, it is plain that electrical equipment manufacturers will be among the leaders on the up-grade.—*Iron Trade Review.*

NEW ENGLAND NOTES.

(From Our Special Boston Correspondent.)

MR. VAN CHOATE, whose name is familiar in electrical circles, is again coming to the front with his system of electric lighting and power. A company has been incorporated under the laws of the State of Maine as the Van Choate Electric Company, having a capital of $6,000,000. Land has been secured and plans fully prepared for an extensive factory at Foxboro, Mass., some 20 miles from Boston, on the Providence line, where there is an important junction of several railways, so that transportation facilities are very good. Several wealthy capitalists have become interested in the company, and it is intended, when the factory is completed and equipped, to manufacture both electric lighting and railway apparatus.

WEST END TRAFFIC.—During the excessively hot weather which has prevailed for some ten days or more, with a slight but chilly intermission last Sunday, the West End Railway Company has had about all it could do to handle the increased traffic over its suburban tracks. The electric cars now run through so many charming districts, that on fine days ladies and children fill the open cars and enjoy the beautiful scenery. In the evenings the people indulge in car rides, knowing that for the expenditure of a few cents they can spend an entire evening admiring nature and breathing the pure air of heaven. There are few, if any, other cities that furnish better transportation facilities than these in and around Boston.

NEW FIRMS IN BUSINESS.—As an indication of the rate at which electric railways are being constructed, the starting up in business of new firms for the exclusive handling of railway supplies in Boston may be noted. There have been five or more new firms entering the field within the past month or so, and all are finding something to do. The old established firms are very busy, there being but slight falling off in volume though collections are somewhat slow.

FINANCIAL DEPARTMENT.

Eastern Stock and Bond Market.

(From Our Wall Street Correspondent.)

REVIEW OF THE MARKET.—With the approach of July 1 it might be of some interest to trace the course of the street railway stock and bond market for the first six months of the current year. It is safe to say that, as a result of the half year's transactions, street railway securities have never, in the history of the companies, occupied so prominent a position in the financial world, nor have quotations ever been so long maintained on so high a level as at present obtains. In this rise toward higher quotations the specialists have been greatly aided by the ease ruling the money market. At no time have call loan rates ruled above 2 per cent., and the abundance of funds has led bankers to look around for other profitable fields wherein to employ their capital. A big demand for municipal bonds soon resulted in these securities being held at figures where they offered hardly any greater return than call money rates. Attention was then called to street railway securities, a field of which most inventors and moneyed people knew scarcely anything. Acquaintance was soon made, however, with the many opportunities awaiting the bargain hunter and the way they have grown in favor has been a revelation to the dealers in investment securities. Orders grew apace and to-day, within the short period of six months, the average Wall street hanger on talks as glibly of Long Island Traction as he does of St. Paul. That street railway securities are now a factor in the financial field has been nowhere more forcibly demonstrated than by the recognition given to this class of securities by the Stock Exchange, which has listed the bonds of most of the prominent local roads and the shares of one or two large companies, and by the calling every day on the Consolidated Stock and Petroleum Exchange of over a dozen traction stocks. Of course the various big street rail consolidations and the floating of their securities in Wall street have been responsible for a deal of the importance now attached to them, but the security hedging around most street railway bonds and stocks is the chief cause of the good will entertained towards them by investors. A genuine market has now been established and it may be fully expected that any general revival of speculative activity will carry with it life to the local street railway stock and bond market. In this respect—that is, so far as trading in street railway shares constitutes a proportionately large part of the daily transactions—Philadelphia and Boston are ahead of New York, but the limited amount of securities listed on the stock exchanges of either city makes the appearance of a new speculative medium very welcome to the traders.

NO ACTIVITY.—The week has been absolutely devoid of interest. The feature of what little trading there is in street railroad shares has been Dry Dock, East Broadway and Battery stock, the scrip being also in demand. Bids of 138 and 138½ are now made for the stock on the almost absolute assurance of the management that dividends, which were passed in February and May, are to be resumed in August at the old 2 per cent. quarterly rate, with the promise of no further interruptions. The new management has effected an annual saving of about $15,000 in salaries and $10,000 in perquisites hitherto allowed insiders in making purchases of hay, ties, etc. Other economies in administration have been introduced, and the road is now not only earning a dividend but is rolling up a surplus above this requirement. It was the confidence in the road's ability to make up losses in traffic that made the stock sell around 130 even when no dividends were actually in sight.

METROPOLITAN TRACTION DIVIDENDS.—This talk of dividends leads traders and brokers to wonder what has become of the Metropolitan Traction dividend now long since due. When a quarterly dividend of 1¼ per cent. was declared early in the year the management announced its intention to continue the regular distribution of profits every quarter at this rate. It will be remembered how a tremendous speculation was started in the stock and its price run up in the 120s, when insiders began to unload. The second quarter has now come and gone, yet not a word has been heard as to the payment of another Metropolitan Traction dividend. There is a suspicion in many quarters that another "coup" is contemplated. It is hinted that a move is about to be made to engineer another boom in the stock. When everything is in readiness the dividend will be declared, up will go quotations (so it is expected), and insiders will have another chance to unload at the higher figures stock acquired around present prices. It is impossible to learn anything from the management. They refuse all information as to earnings, etc., and declare that it is nobody's business but their own as to what their future financial policy is. "Honesty with stockholders the best policy" is a motto, however, whose truth has been often verified in Wall Street history.

THE BOND MARKET.—There is quite an active market for street railway bonds, and, as July 1 coupons are due on a good many issues, the supply is far below the demand. Most of the New York roads make interest distributions on July 1. Among the bonds of out of town roads whose July coupons will be paid in New York are Denver Tramway firsts, Metropolitan Railway of Denver firsts, Columbus Consolidated Street Railway firsts and Bridgeport Traction firsts. The best buying of local bonds has been the purchases of the Broadway and Seventh Avenue series, although Third Avenue fives and Second Avenue bonds are much sought after.

Financial Notes.

Termination of Receivership Asked.—Receiver Moller, of the Sioux City Cable Company, of Sioux City, Ia., has filed a report with the court, and has accompanied it by his resignation, requesting that it be accepted and that the property be turned over to the Consolidation Company. Mr. Moller states that the Consolidation Company now owns all the stock and bonds of the company and that its indebtedness at present does not exceed $14,756.17. He reports having issued $63,110.78 in receiver's certificates against the property, of which practically all have been taken up by the Consolidation Company. These certificates were issued for $35,000 advanced by the Consolidation Company, $20,000 for putting on electric equipment and $3,650 for debts paid. He reports having received cash amounting to $8,700.93 since he made his last report, in addition to $11,000 derived from the sale of the electric light equipment to the Sioux City Electric Company. He concludes by stating that the road, since it was equipped with electricity, has been earning $10 per day in excess of operating expenses and is now solvent, and he recommends that because of the fact that it was put in this shape by the Consolidation Company it be turned over to that company.

Stillwater Reorganization.—The bondholders of the defunct Stillwater (Minn.) Electric Street Railway Company organized last week the Stillwater Electric Railway Company. The new company is organized with a capital stock of $75,000 and it succeeds to all the property and franchises of the old corporation. It is stated that the new company will expend considerable money in improving the system. W. M. Hewitt will continue to be the manager of the railway. The officers of the new company are: President, Allan Curtis, of Boston; vice-president, E. P. Motley, of Boston; treasurer, George E. Warring, of Boston; secretary, J. C. Nethaway, Stillwater. Directors: Allan Curtis, E. P. Motley, Louis Robinson, Thomas Allen, Quincy A. Shaw, Boston; W. W. Greenough, Pittsfield, Mass.; Hartley Lord, Kennebunk, Me., and J. C. Nethaway, Stillwater.

Baltimore, Md.—A mortgage for $100,000 was recorded last week by the Walbrook, Gwynn Oak & Powhattan Railway in favor of the Mercantile Trust and Deposit Company. The mortgage bonds are for $1,000 each, 5 per cent. gold bearing semi-annual, and payable June 1, 1924. The mortgage executed is to obtain funds to build and equip a single track electric railway. The route of the road is from the Liberty turnpike and Windsor Mill road, near Walbrook, to Bull's Corner on the pike, and from thence on turnpike to Gwynn Oak avenue, and on out the avenue to Powhattan, Baltimore County. Work has already been commenced on a park near the termination of the new road.

Richmond, Ind.—In the Richmond City Electric railway case Judge Brown, of the Marion Circuit Court, has decided in favor of the bondholders, making their claim prior to that of the creditors, the road being in the hands of a receiver. The bonds are valued at $200,000, and, with the interest, cover everything, so that the creditors will have to lose. They are the local banks and the Shalebrick Company, of Canton, O. The case will be appealed to the Supreme Court.

Earnings Still Increase.—The earnings of the New England Street Railway Company for the week ending June 23 were as follows:

	1894.	1893.	Inc.
New Haven	$5,908	$4,917	$991
Plymouth	750	555	195
Total	$6,658	$5,472	$1,186

Trolley Affects the Jersey Central.—The Boston *News Bureau* says: "It is reported that Jersey Central May statement will be a bad one. Its revenues have been cut into most seriously by the trolley. What the cable cars have done to Manhattan, the trolley has done to Jersey Central, and the end is not yet."

Street Railway & Illuminating Properties.—The trustees of the Street Railway & Illuminating Properties have further set aside $45,000 to buy in their preferred shares. Proposals will be received until noon, July 5.

Dividend.—The Norwich Street Railway Company has declared its first semi-annual dividend of 2½ per cent., payable at the office of Tucker, Anthony & Co., Boston, July 2, to stockholders of record June 20.

NEW INCORPORATIONS.

Ambler, Pa.—The Ambler Electric Railway Company, of Montgomery County, has been incorporated. The proposed line covers the principal streets of Ambler, and its entire length is two miles. The capital stock is $12,000. The incorporators are James W. Shepp, Daniel B. Shepp, Edgar A. Murphy, of Philadelphia; W. B. Krick, of Reading, and N. H. Larzelere, of Norristown.

Leavenworth, Kan.—The Leavenworth Electric Railroad Company has been incorporated. The capital stock is $300,000. The company is formed to construct and operate a railroad by steam, electricity, cable or other mechanical power, telephone and telegraph lines, etc. The promoters are: W. D. Bethel, Memphis, Tenn.; H. N. Smith, Boston, Mass.; Newman Erb, New York City, N. Y.

Kansas City, Mo.—The Kansas City Electric Street Railway Company has been incorporated with $1,000,000 capital stock. The promoters are: Ernest L. Luggren, Benjamin Jones, Ozone Park, N. Y.; F. B. Wilcox, Kansas City, Mo.; Lewis Hummel, West Chester, Pa.; J. F. Parrott, R. A. Kope, P. F. Spickler, all of Kansas City, Kan.

Pittsburgh, Pa.—The Loyalhanna & Youghiogheny Railroad Company has been incorporated. The capital stock is $1,000,000. The company will construct and operate a street railroad. The promoters are Carl H. Asplunch, Reuben Walker, Philadelphia, Pa.; Chas. S. Smith, Huntington Valley, Pa.

Cleveland, O.—The Cleveland & Elyria Railway Company has been organized with a capital stock of $100,000. The promoters are: Benj. F. Phinney, Jay Comstock, H. D. Coffinberry, J. M. Gasser and Dallas Beebe.

Chicago, Ill.—The Columbia Motor Company with a capital of $1,000,000, has been incorporated. The incorporators are: Walter Sparks, Richard W. Robinson and John C. Wilson.

NEWS OF THE WEEK.

Cincinnati, O.—Hon. O. B. Brown, of Dayton, last week appeared before the County Commissioners for the purpose of securing the right of way over the Paddock road for the Cincinnati, Middletown & Dayton Traction Company, which proposes to build and operate an electric road, carrying passengers only, between Cincinnati and Dayton. The company asks the right to lay a single or double track, as occasion may require. The use of the Paddock road is asked from Avondale to Carthage, the grant to be subject to the consents of the majority of the front abutting on the road. The commissioners referred the matter to County Solicitor Spiegel and County Engineer Krug for examination and report. The act passed several years ago for the improvement of the Paddock road, provides that any street railroad company obtaining a franchise to use the road must reimburse the county to the extent of the interest on one-half of the county's share of bonded indebtedness, and also pay for the construction of the road between rails. This requirement, it is claimed, would involve an expenditure of about $75,000 by any company obtaining the right of way. Mr. Brown stated that the company had secured the necessary right of way in Montgomery and Butler counties, and that a franchise will be obtained in Warren County. The company proposes to carry passengers between Cincinnati and Dayton in three hours at a cost of 50 to 60 cents. Among the parties interested in this undertaking are H. B. Morehead, of Cincinnati, president of the company; Judge Dennis Dwyer, of Dayton; W. A. Mays, of Miamisburg; O. M. Gottschall, of Dayton; Postmaster John Zumstein, of Cincinnati, and O. B. Brown, of Dayton.

Indianapolis, Ind.—Judge Baker has decided the suit in equity of H. Sellers McKee and Murray A. Verner against John C. Shaffer and Augustus L. Mason, to determine the person entitled to the $25,000 street railroad commission claimed by J. C. Shaffer and A. L. Mason. The Court gives the money to Mr. Shaffer. The suit is one growing out of the sale of the plant of the Citizens' Street Railroad, of Indianapolis, to the present owners in the fall of 1892. Mr. Shaffer negotiated the sale, and, as averred in the complaint, was to receive $100,000 for his services. Mr. Mason acted as the attorney for Messrs. Verner & McKee, the principal purchasers. After $75,000 of the commission money had been paid to Mr. Shaffer, Mr. Mason claimed that he was entitled to receive the remaining $25,000 He based his claim on the fact that he had produced the customers for Mr. Shaffer. After the controversy arose, Messrs. Verner & McKee agreed that it should be submitted to Judge Baker. The money was paid into Court, to be held pending the decision of the case.

Pittsburgh, Pa.—The Monongahela & Allegheny Railroad Company, which has just been organized, is formed to build a line about six miles in length between the Baltimore & Ohio Railroad and the Allegheny Valley Railroad. Ultimately it will ramify into other sections, it is stated, and become, as the promoters design, an important belt line road. George T. Richards, mechanical engineer for the Drake & Stratton Contracting Company, is named as president, and James Doig, L. H. Partridge, James Duncan, Jr., William Smith, C. H. Sackrider and R. S. Frazier, all of Pittsburgh, as directors. Mr. Doig is general superintendent of the Drake & Stratton Company, and Mr. Partridge is also with this firm. Mr. Duncan is an official of the Farmers' Deposit National Bank. It is said that the Drake & Stratton Company are interested financially. This company built the Pittsburgh, McKeesport & Youghiogheny and the McKeesport & Bellevernon railroads.

New London, Conn.—At the annual meeting of the New London Street Railway Company held this week, Winthrop Coffin, of Boston, was elected president, vice E. P. Shaw, who resigns as be has not the time to give to the active management of the property. Robert Coit, of New London, and Winthrop Coffin were elected directors in place of C. P. Cogswell, of Norwich, resigned, and E. P. Shaw. The company's first dividend of 2½ per cent. was declared out of the earnings of the past six months, payable at the office of Tucker, Anthony & Co., 50 State street, Boston, July 2, to stockholders of record June 20.

Trenton, N. J.—At the suggestion of the engineer in charge of the city water mains, the district commissioners have issued the following order: "It is ordered that before any street railroad tracks shall be laid or relaid on any portion of any street or other highway occupied by a district water main, the street car company for which the work is to be done shall deposit with the collector of taxes of the district an amount sufficient to pay for the work of laterally removing the said main so as to clear the ties of the track, and shall notify the water department of the district in time for it to do the work."

Indianapolis, Ind.—When the county commissioners refused to grant a right of way to the Indianapolis & Broad Ripple Rapid Transit Railroad Company unless the company would lay down, in advance, a $5,000 guarantee that the road would be completed before the first day of September, the company began the work of acquiring a private right of way by purchase. This has been finally accomplished, and about $10,000 has been expended in this way. Work is to be begun at once.

Nashville, Tenn.—The Nashville Traction Company, successors to the Overland Electric Railway Company, has organized by the election of F. W. Hunter, president and general manager; James Compton, vice-president, and Thomas Taylor, secretary and treasurer. The cars on this line are now running out the Franklin Turnpike to Waverly Place and along the avenue in front of Glen Leven Church. The company has completed the construction of five new cars.

Milwaukee, Wis.—The Board of Review has fixed the taxes of the Milwaukee Street Railway Company at $75,000. This is on a total valuation of $3,300,000. This is an increase of 150 per cent. on the taxes which were charged against the company last year, and it is regarded as exorbitant by the railway officials. Vice-President Henry C. Payne stated that the company would fight the assessment.

Shenandoah, Pa.—The borough council of Shenandoah has extended the right of way of the Lakeside electric railway to cover certain additional streets in that place. The extension will form a connecting link between the Lakeside and the Schuylkill Traction Company's lines, and complete a railway 14 miles long from Mahony City to Locustdale, through Shenandoah.

Columbus, O.—The county commissioners have granted a franchise to the Worthington & Westerville Electric Railroad Company. The section of the road from Worthington to Flint, a distance of three and one-half miles, will first be built. Those interested in the project are W. E. Hoyer, W. T. Thorne, D. E. Sullivan, Captain William Penny and H. F. Guerin.

Indianapolis, Ind.—July 5th has been fixed by Judge Woods, of the United States Court, as the date on which he will hear arguments in the case of the Citizens' Street Railroad Company to enjoin the City Railway Company from laying tracks and occupying the streets of the city. Ex-President Harrison and W. H. Miller will represent the Citizens' company.

Philadelphia, Pa.—Counsel for the People's Passenger Railway Company last Saturday filed in the Common Pleas Court a bill in equity against the Union Passenger Railway and the Philadelphia Traction companies, in which it sought to have the defendants restrained from laying tracks in Fairmount Park or across the Girard avenue bridge.

Chicago, Ill.—At the invitation of John Farson a party of twenty gentlemen, accompanied by ladies, made an inspection of the Calumet Electric Street Railway last week. The road is in excellent condition and its equipment is of the best description. The party rode over the line in a special train gayly decorated with flags.

Lincoln, Neb.—The City Council has refused to pass the ordinance asked by the Lincoln Street Railway Company. In view of the fact that its receipts had been seriously decreased, the company requested the council to allow it to charge five cents for fares instead of selling six tickets for a quarter and to dispense with conductors on certain of its lines.

Bridgeport, Conn.—The 300 men employed in constructing the street railway struck last week, owing to a mistake of the timekeeper, by which some of the employes received too little pay. The mistake was rectified later in the day, and work was resumed.

Brooklyn, N. Y.—The Coney Island and Brooklyn Railroad Company has asked the State Railroad Commission for permission to use the trolley, instead of horses, on the line from Flatbush and Ocean avenues to Greenwood Cemetery.

Cleveland, O.—Suit has been brought on behalf of the city of Cleveland against the Cleveland Electric Railway Company to obtain $16,448.21, which it is alleged is owed by the company for paving on Broadway.

Cincinnati, O.—John Kilgour, of the Mt. Adams

& Eden Park Street Railway Company; has decided upon the suggestion of the City Board of Administration to make a trial on one of his lines of steel ties.

New Orleans, La.—The stockholders of the New Orleans Railroad Company have voted to ask the City Council for a franchise permitting the company to equip the road with an electrical system.

Opelika, Ala.—It is formally announced that all the money necessary for constructing an electric railway from Opelika to Auburn has been raised and that work will be begun at once.

Battle Creek, Mich.—The franchise of the electric street railway has been revoked by the Council. The road has just been leased to F. J. Wilson, who intends to run the Lake line alone.

Washington, D. C.—The bill to incorporate the Washington City Railway Company has been referred to the Commissioners by the Senate Committee.

Minneapolis, Min.—It is reported that the Twin City Rapid Transit Company will soon extend its system from Minnehaha Falls to Fort Snelling.

Philadelphia, Pa.—Electric cars are now regularly operated on the Chestnut and Walnut street lines of the Philadelphia Traction Company.

Baltimore, Md.—Work has been begun on the power house of the City & Suburban Railway Company. The dimensions will be 130 by 300 feet.

South Auburn, Neb.—Lambkin & Oakley, of Kansas City, have applied to the local authorities for a franchise for an electric railway.

Redkey, Ind.—An electric railway between Redkey and Dunkirk is projected. S. W. Collins is interested in the enterprise.

TRADE NOTES.

Stern & Silverman, of Philadelphia, report business as very active. In the railway department they have contracts for the reconstruction of the Brigantine Transit Company's road at Brigantine, N. J., seven miles in length on trestle construction; at Altoona the Bellwood extension of the Logan Valley road for the Pennsylvania Railroad, eight miles in length; also the Roxborough Incline Plane and Railway, six miles long, running from Philadelphia to Barren Hill. In the steam department they report 600 H. P. boiler plant for the Roxborough road, and two 300 H. P. Ball & Wood compound condensing engines, one 10 inch by 11 inch direct connected Ball & Wood engine for Dooner's Hotel, Philadelphia; one 10 inch by 11 inch direct connected Ball & Wood engine for the Mann Building, Philadelphia, and one 8 inch by 10 inch engine for the boat "Havana." In the lighting department they have contracts under way for a central station at Overbrook, Pa.; the lighting of the Episcopal Hospital, Philadelphia; electrical equipment of the river boat "Havana," and arc plant for the pleasure pavilions at Brigantine Beach, N. J.

The Mather Electric Company, of Manchester, Conn., is receiving encouraging orders for its new direct connected and belted generators, both for lighting and railway work. The ability of this company to turn out first class and highly efficient apparatus, gained by 14 years' experience in the business, is sufficient guaranty of its work. J. Holt Gates, 1139-1140 Monadnock Block, Chicago, general western agent, reports a good steady business.

The Ohio Brass Company, of Mansfield, O., is distributing to the trade a neatly gotten up price list of railway motor bearings. It includes all the different styles of bearings for the various types of railway motors, and is well worth an examination. This company is pushing this line of material actively, and its increasing orders show that the quality of the stock and the workmanship are the very best.

The McGuire Manufacturing Company, of Chicago, has received orders for 170 of its Columbian trucks from the Philadelphia Traction Company, 50 from Norfolk, Va., 18 from Toledo, 10 from Green Bay, and a number of smaller orders. This would indicate a revival of business in the electric railway line.

The Joseph Dixon Crucible Company has issued a little folder giving a record of service tests of hoisting tackle, made by Robert Grimshaw and Lieut. John A. Bell at the Brooklyn Navy Yard. These tests were for the purpose of determining the percentage of power wasted by unlubricated blocks.

An Order for 80 Trucks.—The McGuire Manufacturing Company, Chicago, in addition to other orders reported this week, has just received an order from the Cincinnati Consolidated Street Railway Company for 80 trucks.

The McGuire Manufacturing Company, of Chicago, has opened a New York office at 171 Broadway. Daniel J. Dowdney is in charge of this office, from which he will look after the Eastern business o the McGuire company.

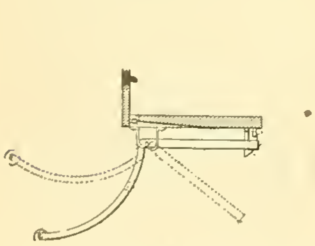
RECORD OF STREET RAILWAY PATENTS.

U. S. Patents Issued June 19, 1894.

521,477. Safety Appliance for Street Railway Cars; Oswald R. Routh, Jersey City, N. J. Filed Dec. 16, 1893. In a safety appliance of the class specified, the combination of a pivoted scoop capable of a horizontal movement, a roller at the front of said scoop, a counterbalance at the rear of said scoop, pivotal movable bearings or supports for said scoop and means for normally holding suspended the said counterbalance and for releasing it to raise the scoop when the latter is moved backward. (See illustration.)

521,500. Cable Street Railway; Fred Hoch, Wauwatosa, Wis. Filed Oct. 27, 1893. The combination of a movable bridge, pulleys axled vertically thereto, an endless cable running about the pulleys adapted to take cars across the bridge, and rollers so placed near to the pulleys as to retain the cable in place thereon when lengthened and loose on the pulleys by expansion under heat or otherwise.

521,562. Conduit Electric Railway; Thomas Armat, Washington, D. C. Filed March 28, 1893. In an electric railway, the combination with an insulated supply conductor adjustably supported within a conduit and provided at intervals with metallic projections is electrically connected with said supply conductor, of a series of swinging frame sections, each carrying suitably arranged conductors, and a current gatherer adapted to engage said last mentioned conductors, rock the frame sections and thereby complete a motor circuit through said metallic projections of the supply conductor. (See illustration.)



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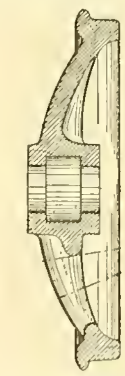


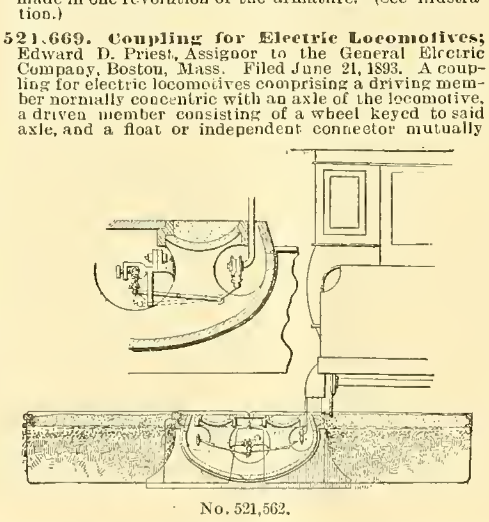
No. 521,587.

521,587. Car Wheel; Louis J. Hirt, Somerville, Mass. Filed Dec. 21, 1893. A car wheel composed of a hub, rim, and spokes separated to leave openings and corrugated in the direction of their length, the outer and inner faces of the said spokes having the curves respectively, substantially at right angles to a radial line through the said spoke and both curves extending from the hub to the rim in unbroken lines, to obtain a corrugated spoke of uniform thickness from the hub to the rim. (See illustration.)

521,602. Trolley Pole Catcher; Owen G. Gates, Jr., St. Louis, Mo. Filed March 12, 1894. The combination with the trolley pole and its means for holding the trolley in contact with the wire, in which means are included springs, of a bolt for holding the springs under tension, a bell-crank lever connected to the bolt, a rod connected to the other arm of the bell crank lever, and projections on the rocker arms of the trolley pole for engaging and operating the arm when the trolley leaves the wire, whereby the bolt is actuated to release the tension of the springs.

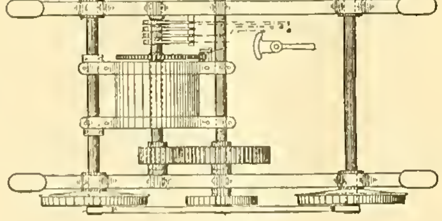
521,651. Electric Railway Car Motor; John C. Henry, Westfield, N. J. Filed Aug. 25, 1892. An electric motor having a multipolar armature with alternating pole pieces of constant polarity, a shunt wound multipolar field magnet, a two-part pole changer in the field circuit, and gearing for rotating said pole changer in a ratio equal to one-half the number of pole changes to be made in one revolution of the armature. (See illustration.)

521,669. Coupling for Electric Locomotives; Edward D. Priest, Assignor to the General Electric Company, Boston, Mass. Filed June 21, 1893. A coupling for electric locomotives comprising a driving member normally concentric with an axle of the locomotive, a driven member consisting of a wheel keyed to said axle, and a float or independent connector mutually engaged by said members, whereby they are held in driving relation but are permitted to move out of their normal concentric positions. (See illustration.)



No. 521,562.

521,670. Safety Car-fender; Friedrich H. Reich, Baltimore, Md. Filed Dec. 4, 1893. In a safety fender for cars, the combination of the two side bars, each made in two sections, which are pivoted together; a crossbar, connecting the lower front pivoted ends of the side bars; another crossbar, connecting the back part or section of said side bars; springs attached by one of their ends to the car front and by their other ends to the lower front section of said side bars—said springs having an inclined position and adapted to draw up the pivoted section of the side bars; an inclined flexible curtain-like buffer; and a latch bar having one end attached to a crossbar of one section and its other end provided with a hook lip to engage a crossbar on the other section—said latch bar serving to hold down the front section of said side bars against the lifting action of the springs.



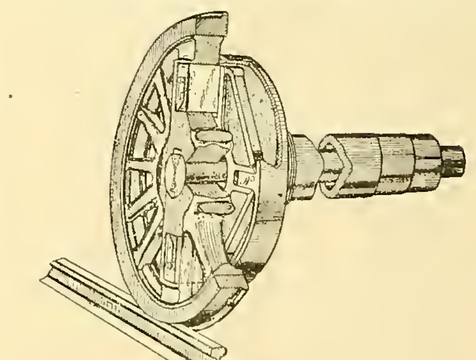
No. 521,651.

521,672. Fender for Tram-Cars; Sam J. Rosenfeld, New York, N. Y., Assignor, by direct and mesne assignments, to himself and Joseph A. Locheim and Edwin S. Simon, Philadelphia, Pa. Filed Nov. 4, 1893. In a car fender, the combination, with a car platform, of fender shafts located beneath the platform, a driving mechanism connecting the shafts with an axle of the car, a series of curved arms radiating from each shaft, the arms being arranged in rows longitudinally of the shaft and in substantially stellated order, the shaft being revolved in a manner to carry the convexed surfaces of the arms upward, and a pilot located in front of the outer ends of the fender shafts, inclining in direction of said shafts.

521,684. Meter for Recording Measurements of Electric Power; Elihu Thomson, Swampscott, Assignor to the General Electric Company, Boston, Mass. Filed Jan. 31, 1894. A recording wattmeter for the three-wire or series-multiple system, comprising an armature in shunt between the mains of such system and two sets of series coils furnishing the field, the sets symmetrically disposed so that some of the coils of each set are upon each side of the armature, thus furnishing a composite field of substantially equal intensity in all its parts.

521,685. Electric Meter; Elihu Thomson, Swampscott, Mass., Assignor to the General Electric Company, New York. Original application filed Feb. 21, 1894. In an electric meter and in combination, a coil in series with the mains, an armature, a shunt circuit supplying the armature, a transformer having its primary in the shunt circuit, a resistance in series with the shunt circuit, and a starting coil in series with the secondary of the transformer.

521,711. Supply System for Electric Railways; Thomas Harris, Detroit, Mich. Filed April 28, 1893. In an electric railway system, the combination with a continuous power line of a working conductor composed of sections normally disconnected from said power line, a switch line and a return switch line extending along the working conductor from a stationary source of electricity, an electromagnet for each section of the working conductor, the armature of which is adapted to connect the section with the power line and with the switch line, two energizing circuits for each magnet, one connecting the section of the working conductor with the return switch line through a normally open and a normally closed break controlled by the next adjacent magnets, respectively, and the other connecting the two switch lines through the said normally closed break of the other circuit and a normally open break controlled by the magnet itself, and a contact on the car adapted to connect two adjacent sections of the working conductor.



No. 521,669.

521,741. Car-Fender; James Tobin, Indianapolis, Ind. Filed Dec. 28, 1893. In combination with a car, a fender consisting of three uprights, one in front and two attached to the car, such uprights being enlarged outwardly at a point about knee high from the ground, and flexible bars connecting such uprights and extending about the outer surface of the same.