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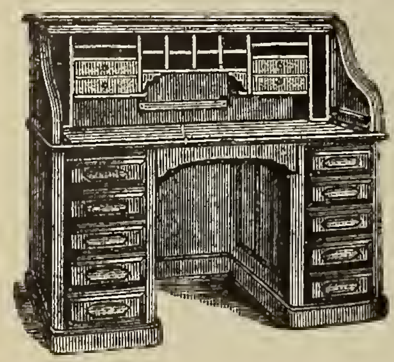

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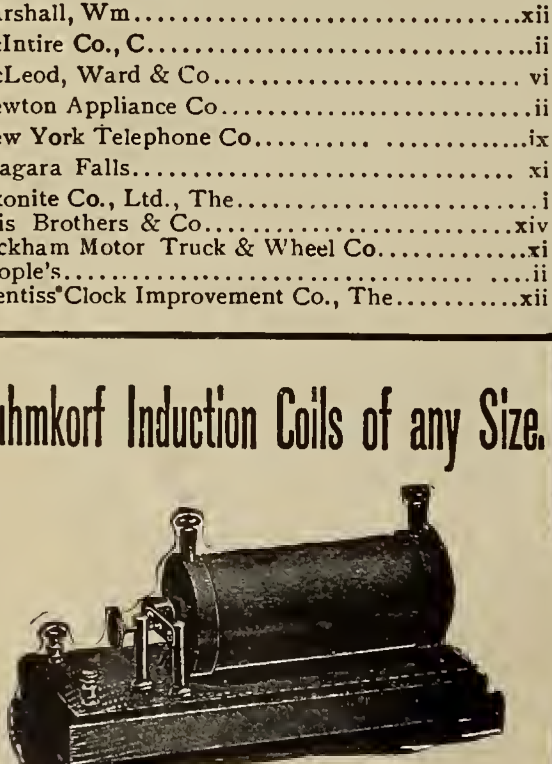

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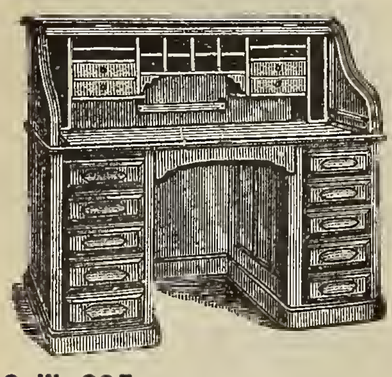

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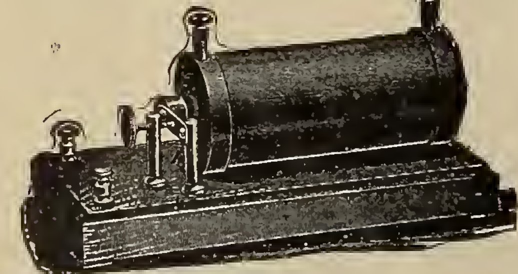

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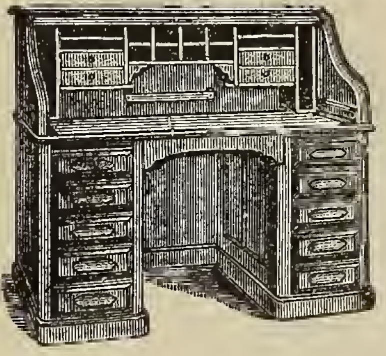

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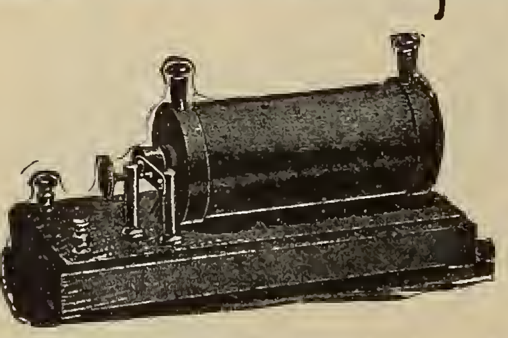

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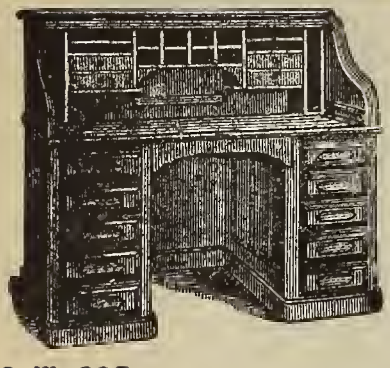

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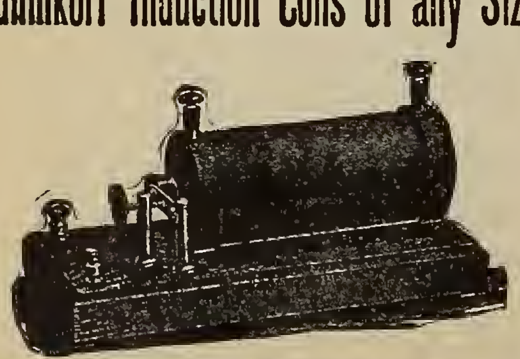

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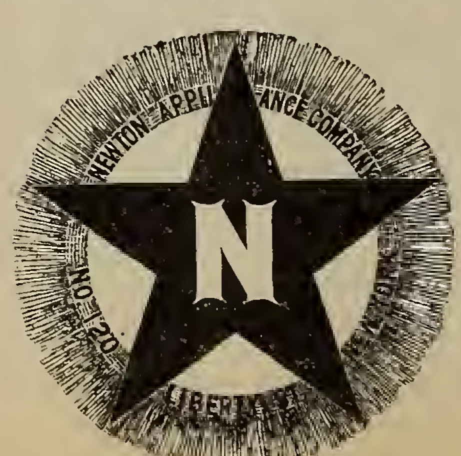

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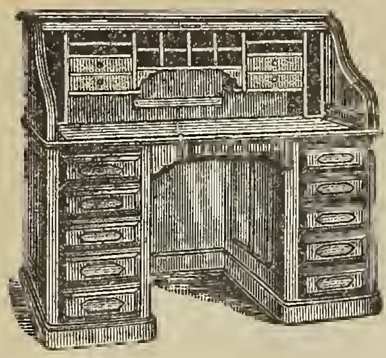

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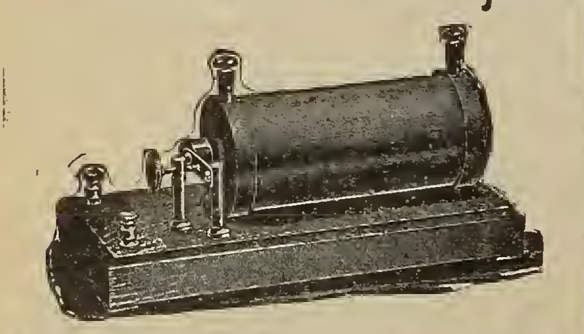

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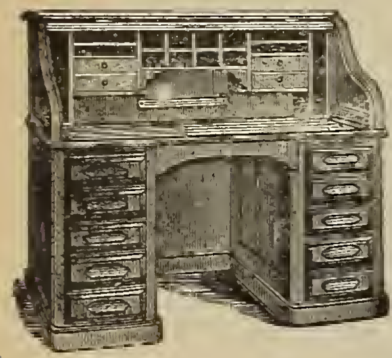

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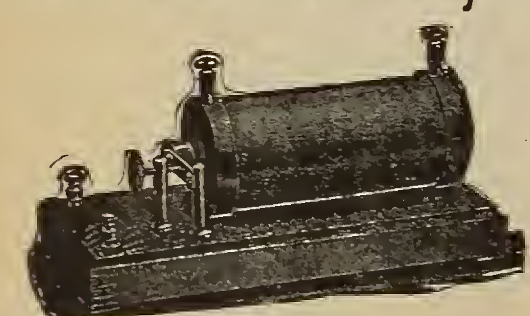

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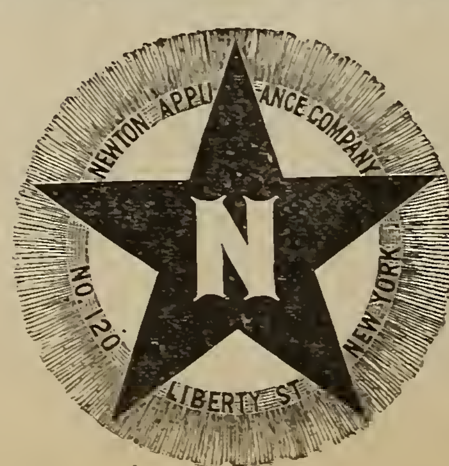

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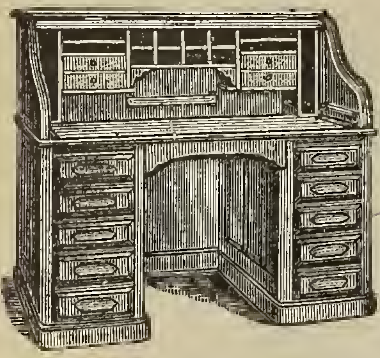

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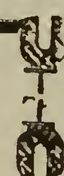

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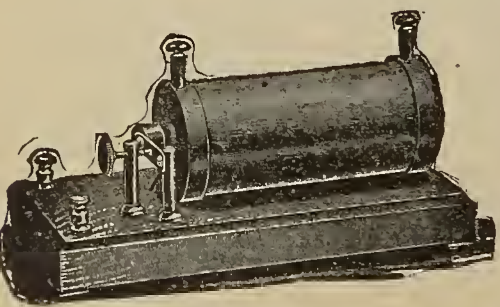

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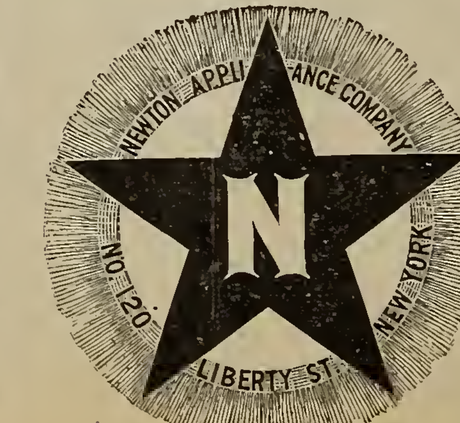

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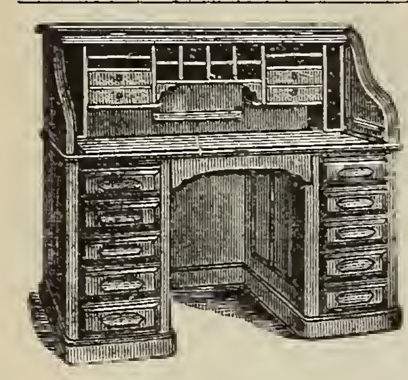

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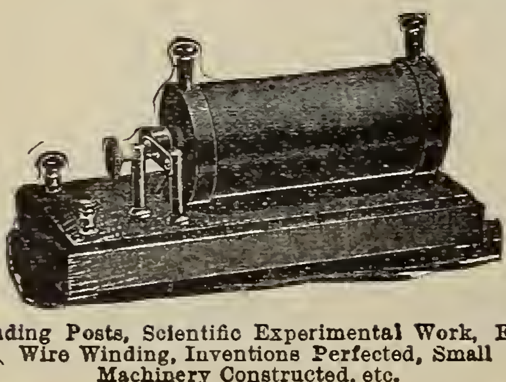

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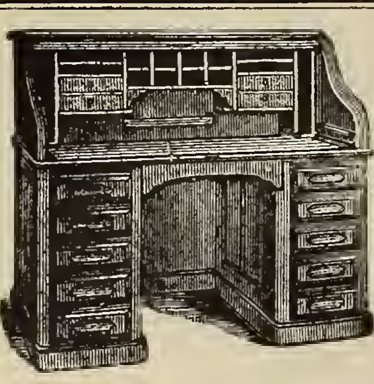

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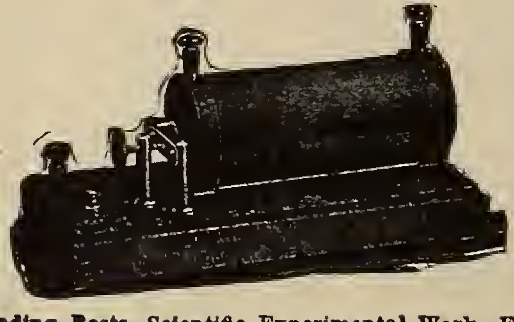

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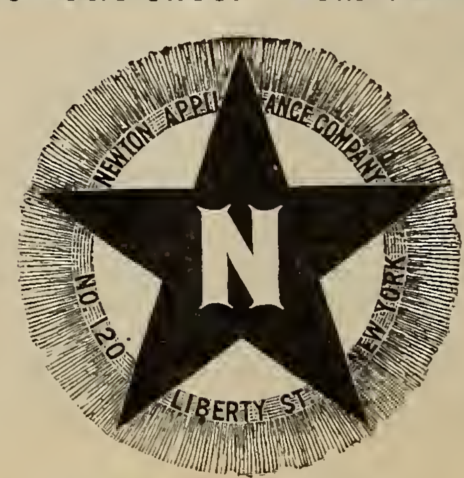

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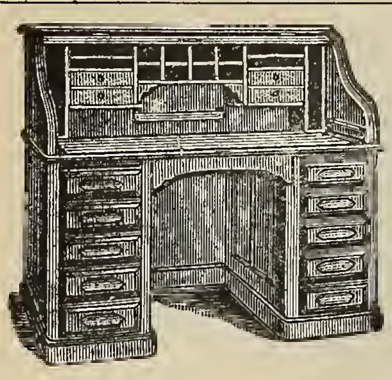

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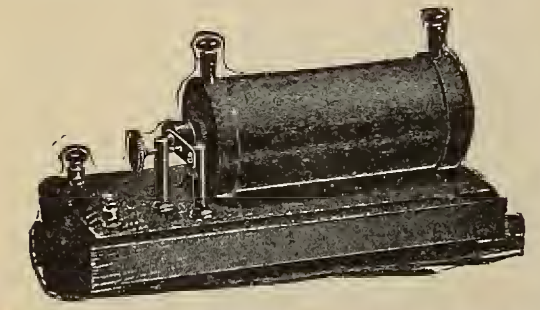

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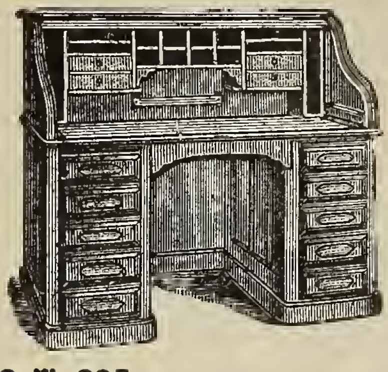

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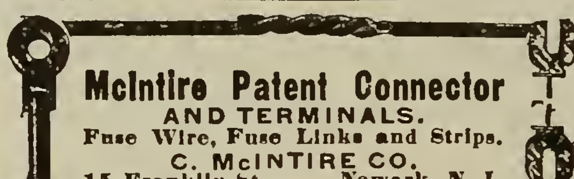

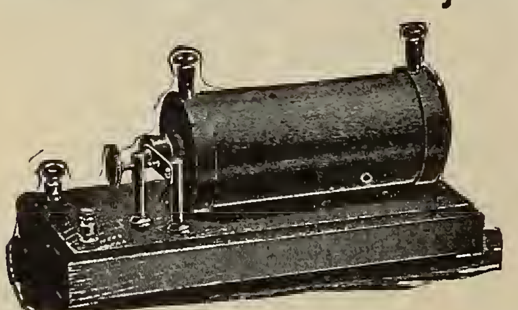

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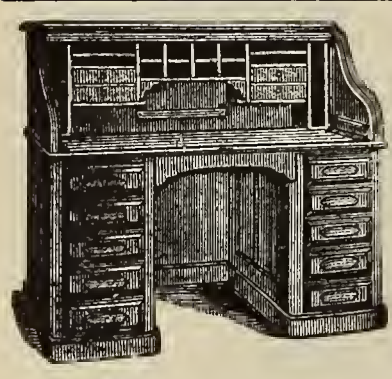

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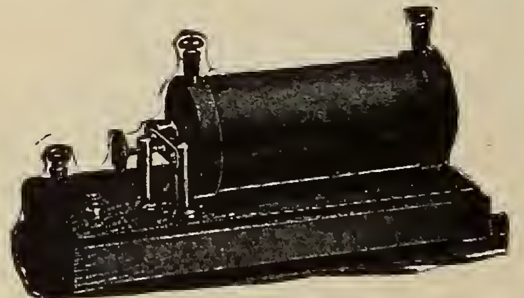

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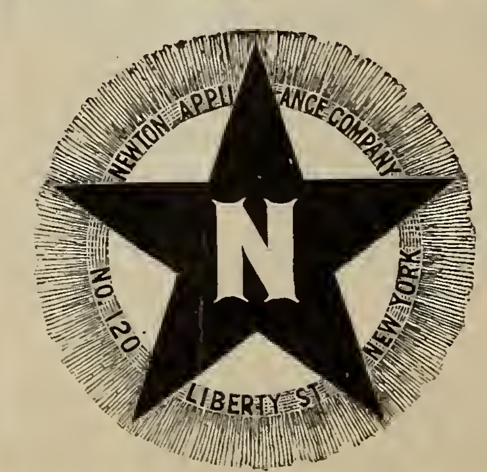

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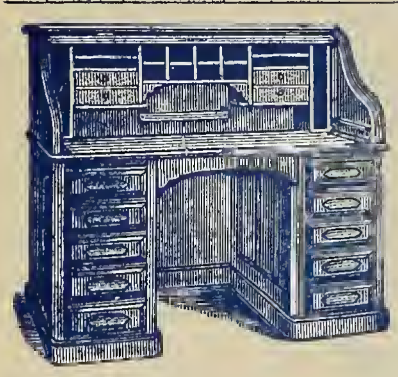

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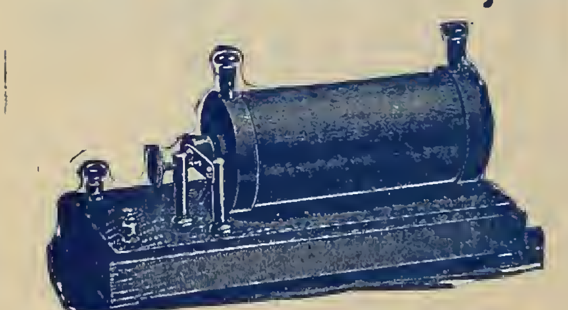

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THE ELECTRICAL SHOW in full blast when you get this Number. See page 250.

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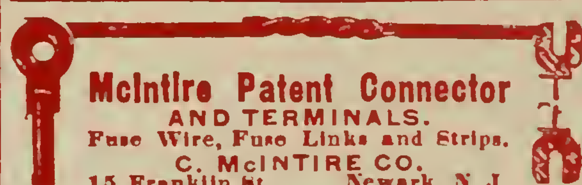

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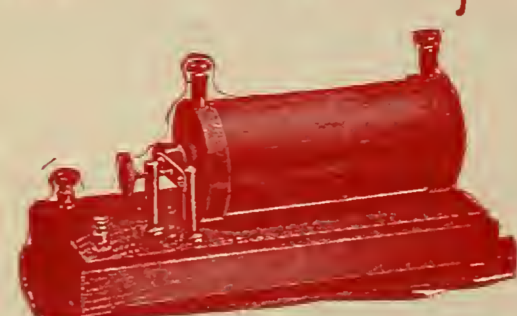

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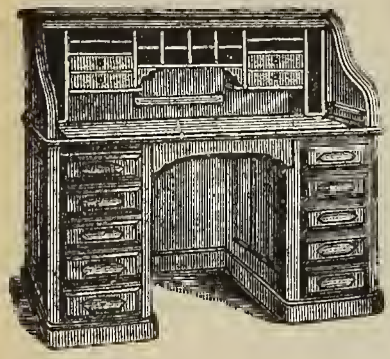

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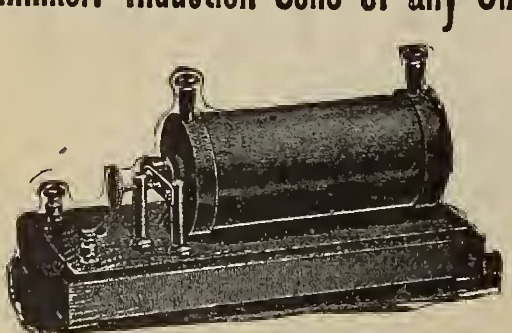

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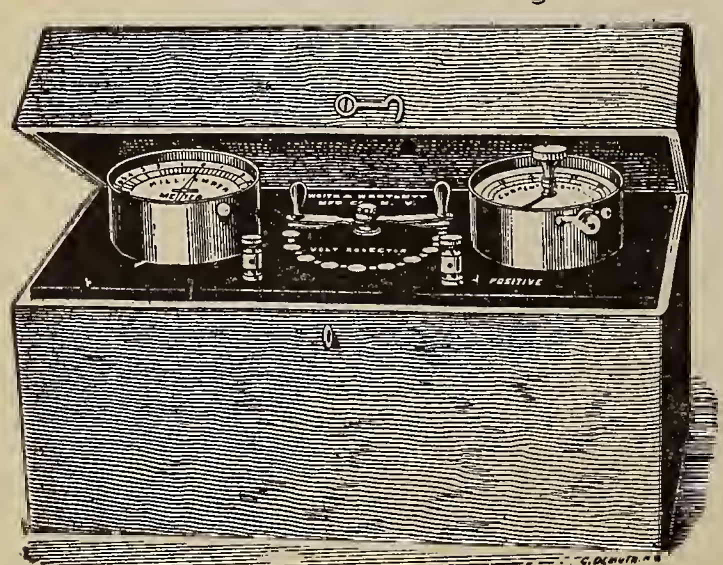

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VOL. XXI —No. 580. NEW YORK, JUNE 25, 1898. Subscription, $2.50 per year. Foreign Countries, $3.50 per year

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We are receiving...

Constant Inquiries for Second-Hand and New Dynamos, Motors and Electrical Apparatus generally. To meet these requests we begin a column under the above heading in this number, on page xvi.

The Electrical Age, New York.

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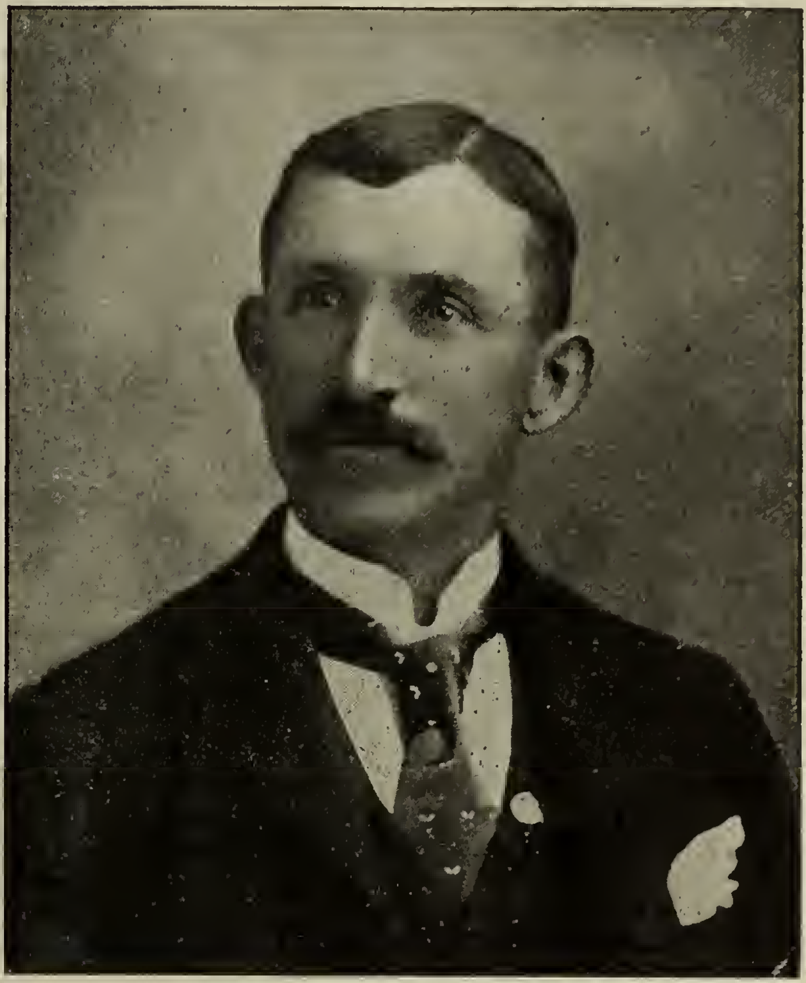
The Electrical Age.

Vol. XXI—No. 1 NEW YORK, JANUARY 1, 1898 Whole No. 555



Capt. John McLeod Murphy, Inventor of the Safety Third-Rail Electric System.

THE SAFETY THIRD-RAIL SYSTEM.

The inventor of the above system, Capt. John McLeod Murphy, comes of old American stock. His grandfather, during the years 1802 and 1803, was mayor of New York City. The fighting blood of the family showed itself in his father, Capt. William Jay Murphy, a captain in the Civil War and pilot of the famous steamship Great Eastern. His uncle, John McLeod Murphy, was an officer in the United States Navy, and the author of the above invention was born and bred in New York City. His varied and interesting career may be outlined briefly by saying that he served as an apprentice boy on the frigate Minnesota; in 1875, nearly three years on the sloop of war Supply, during which time he saw the Madeira Islands, the West Indies, and the southeast coast of Africa. In 1880 he joined the New York Fire Department, being the first member and practically the originator of the present Life Saving Corps. In 1881 the first call for volunteers was made for the purpose of organizing a Life Saving Brigade. For several weeks the only name on the list was that of Capt. John McLeod Murphy. During the famous fire on Leonard street in 1887, when the building collapsed on four men, he was the only survivor. In 1889 he left the fire department and went into mining in Nevada. He served as engineer at the Butte City mines, returning in 1891 to his birthplace.

From this period his time was devoted to the study and development of electric roads. He is the creator of the third-rail system, and a road built under his direction operates successfully at Westport, Conn. On the basis of his further work he has organized a corporation called the Safety Third-Rail Electric Company, with William M. Keepers, president; David F. Halstead, treasurer, and Capt. J. McLeod Murphy, secretary. This is a New Jersey corporation with a capitalization of $500,000.00, and paid in capital of $10,000.00. The office of the present company is in Temple Court Building, New York. The model displayed for inspection there combines all the essential features required for the successful operation of a safety third-rail electric system.

The general operation is as follows: The motorman turns a switch and thereby allows current, coming from storage batteries within the car, to enter an automatic electro-magnetic switch, a succession of which are arranged within a vault at intervals along the road, each vault containing switches sufficient to control one block of the system, that is, about two hundred feet. When the current circulates from the storage cells into this switch, the main feeding circuit is closed at once and the local circuit causing this operation is instantly and automatically opened. As the car moves along each device performs its function in like manner, the switch being primarily controlled by a few cells of storage battery within the car. The sections of middle rail are less than the length of the car, and contact is made with them by a device attached to the bottom of the car. The car always rests above two rail sections, and therefore can always move the instant the switch operates. At an exhibition given in Washington, D. C., at Odd Fellows' Hall, Seventh and E streets, lasting two days during the fall of last year, some very notable people were present—United States Commissioner Black with two associates. In addition, his electrical staff, of which Inspector Allen is chief; Mr. M. D. Helm, of Washington, D. C., representing several surface roads, with his consulting engineers; Chief Electrician Beardsley, of the Government Printing Office; a representative of Munn & Company; Deputy Commissioner of Patents; several examiners and several electrical experts from Philadelphia, Wilmington, Pittsburgh and Richmond, as well as members of the press.

In order to obtain the opinions of experts regarding the safety third-rail electric system, the following gentlemen were called upon to examine and criticise the invention of Capt. Murphy:

OPINIONS OF EXPERTS.

MR. R. H. BEACH, OF THE GENERAL ELECTRIC CO.

I have examined the Safety Third-Rail Electric Company's System, and have witnessed an exhibit of the same, and cheerfully endorse the system. I believe that all of the objections which have been found in other surface contact systems have been met and overcome, and I believe that this system will revolutionize the methods of operating long and short distance roads as well as street railroads. The switch used in this system is the only non-arcing to my knowledge that will fill the bill.

MR. AMSTERDAM'S OPINION.

I have watched the progress for a number of years in the matter of improvements in electrical propulsion, and have always denounced the possibility of operating successfully a *surface contact system* with any degree of *safety* and *economy*, but I am forced to admit that it is a perfected success in the invention of the Safety Third-Rail Electric Company's System. I witnessed an exhibit of their *system* and cheerfully endorse it. In their switch they have an invention perfected, which, as an expert of many years, I am surprised that it is possible to get the result in such a simple and inexpensive manner, and dispense with *arcing* beyond a question of a doubt.

MR. VANDERVEER, OF THE BROOKLYN HEIGHTS RAILROAD COMPANY

I personally tested the switch of the Safety Third-Rail Electric Company, at the Power Station at 52d Street and 2d Avenue, Brooklyn, N. Y., on the main line circuit, with a voltage of 560 volts and 200 amperes, and the switch operated beyond all expectations, and was a complete success. It made and broke contact without the slightest indications of arcing and in dead short circuit. I am satisfied the switch is a grand success and cannot fail unless some one is guilty of some dirty trick.

MR. E. V. BAILLARD'S OPINION.

I made the switch for the Safety Third-Rail Electric Company, and was present and assisted in the test at the Power Station of the Brooklyn Heights Railroad Co., at 52d Street and 2d Avenue, and testify to the truth of the statement of Mr. Vanderveer.

P. M. MOWREY & COMPANY'S REPORT OF THE SAFETY THIRD-RAIL COMPANY'S SYSTEM MADE TO MR. WM. M. KEEPERS UNDER DATE OF SEPTEMBER 7TH, 1897.

After a very careful examination of your Safety Third-Rail Electric System, and carefully looking into all other systems, and making examinations of patented systems of record to date, we beg to state that our judgment is, that in the Safety Third-Rail System you have an invention that will *revolutionize the present methods of electrical propulsion for long and short distance as well as surface street railroad systems.* In your switch we claim it is impossible to create an *arc.* In our report we have carefully prepared estimates taken from actual operations, and are thoroughly correct and reliable in every respect for strictly high grade first-class construction work, but they can be reduced by at least 25 to 33⅓ per cent. for in-inferior grade of work such as is used in inter-urban work, which report shows your system stands really without competition. A very important feature of your system is, you do away with deep excavation.

In reviewing the features of the safety third-rail system it appears to the engineer as a surface system that carries all the features of both overhead or conduit, and is adaptable to either horse, cable, underground, elevated or steam roads.

It is a third-rail surface system in which the current (electricity) is only applied to the third rail by the motorman upon the front platform of the moving car, where he has absolute control through the medium of the controller of the power from the power-station, thereby rendering all rails non-electric, rails upon which the car stands inclusive, and removing any and all danger from a shock.

If a main feed-wire should, from any cause, become broken, or the power-house become temporarily disabled, provisions are, in this system, provided whereby the car can be continued (en route) to the end of its destination (limited). At the same time the lights, as well as the heat, are very ingeniously cared for. The losses atributable to other systems are greatly reduced; gas and water pipes, to say nothing of electric-bell equipment along the route are not affected by electrolysis. This system saves 30 per cent of the losses practically attributable to any other systems. The system of feeding is absolutely insulated, not alone on the positive feed circuits, but also on the return or negative circuit. The contact maker or breaker is a non-arcing switch, and can only be effected by the motorman, and *not the car.* Cost of construction is not in excess of the overhead, and much cheaper than the underground or conduit systems, and its cost of maintenance is much less than half of any other system. In practical operation this system not only provides light for the car but also light along the entire route, which lights are effected by the passing car, and can be lit as signals at grade crossings, etc., and dispenses with continuously lighted circuits. The lighting and extinguishing of the lights does not require the attention of the motorman, but is automatically operated by the car. One, two, three, or a large number of cars can be operated, dash-board to dash-board, as often occurs in blocks, break-downs, etc., and each car independently manipulates the switches without interfering with the car ahead or behind.

The switches can be buried even with the surface, or can be clustered any number together, placed in the most convenient locality. It is not necessary to excavate to a depth greater than that of the ties, thus largely decreasing cost over any other system. Horse, cable, overhead, conduit, steam or elevated can be equipped with this system without interfering with a single trip. This system does not require specially constructed motors, controllers, etc., but is operated with the electrical epuipments now generally in use; and overhead or conduit electrical cars can, at a very small cost, be changed to operate under this system.

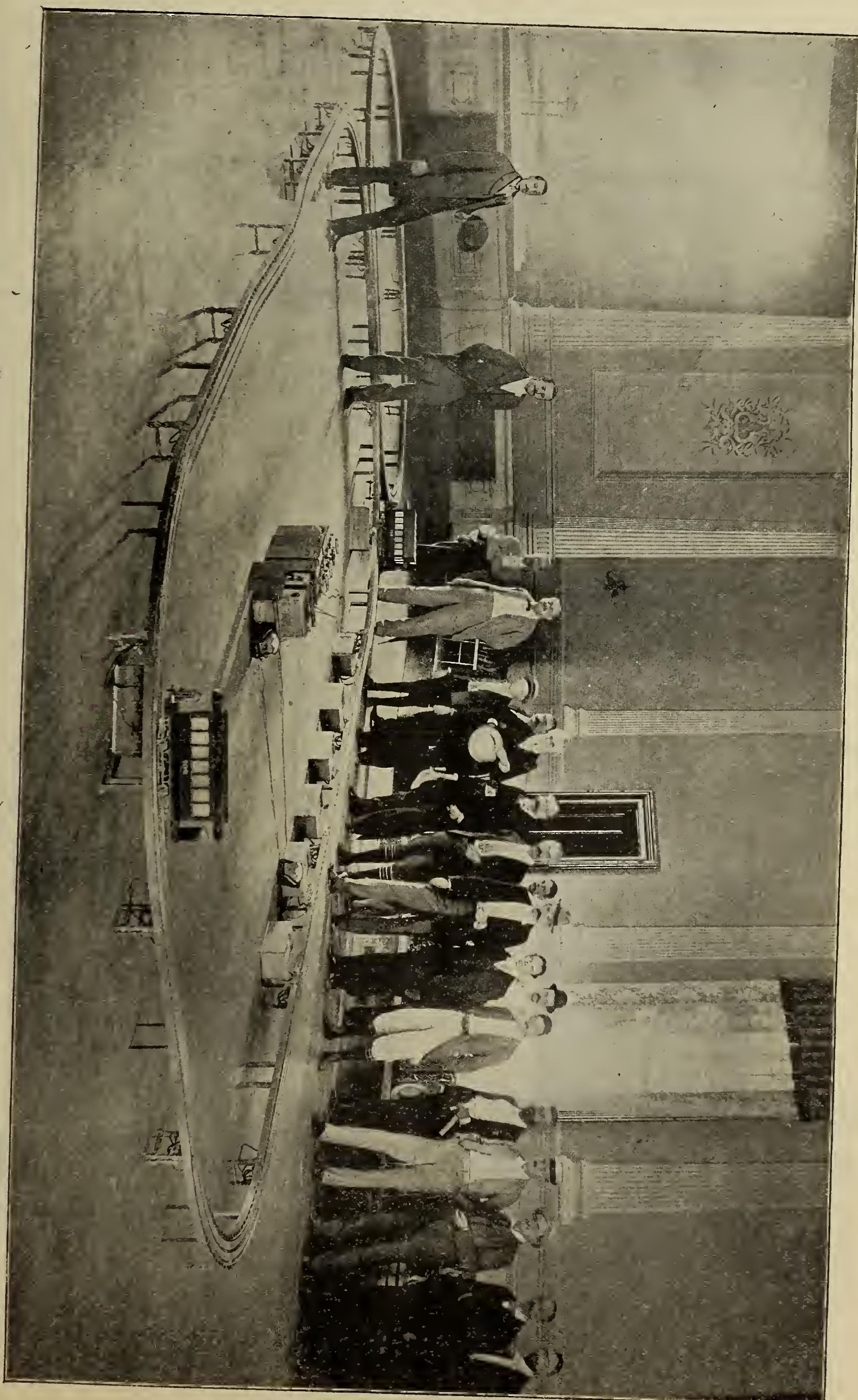
Short circuiting impossible.

In suburban steam roads the equipment of this system forms no obstruction to general traffic by steam cars, should it be deemed necessary to run over the rails of this system.

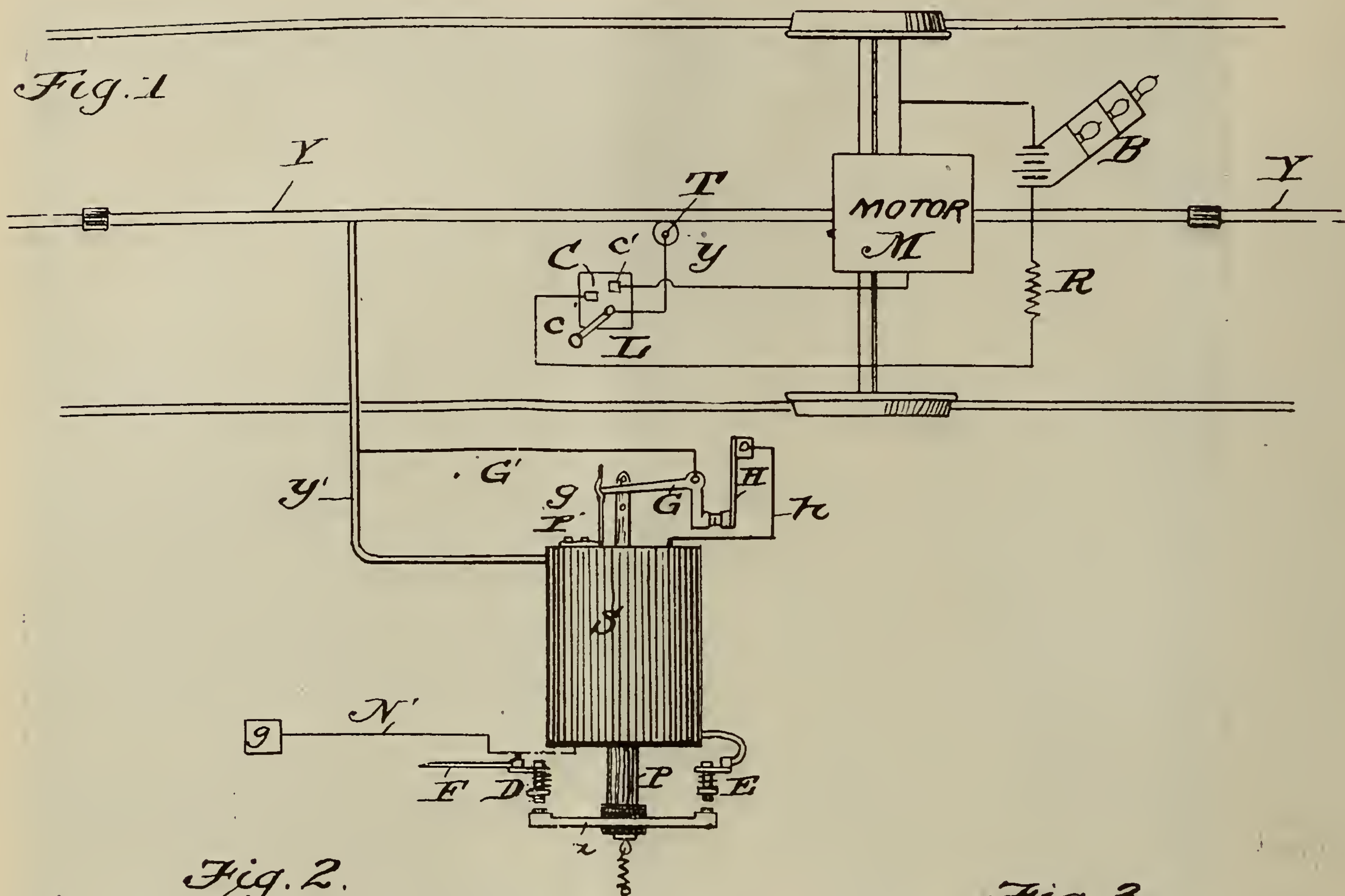
ANALYSIS OF ESTIMATE FOR INSTALLING FIVE MILES OF THE MURPHY THIRD-RAIL SYSTEM (DOUBLE TRACK).

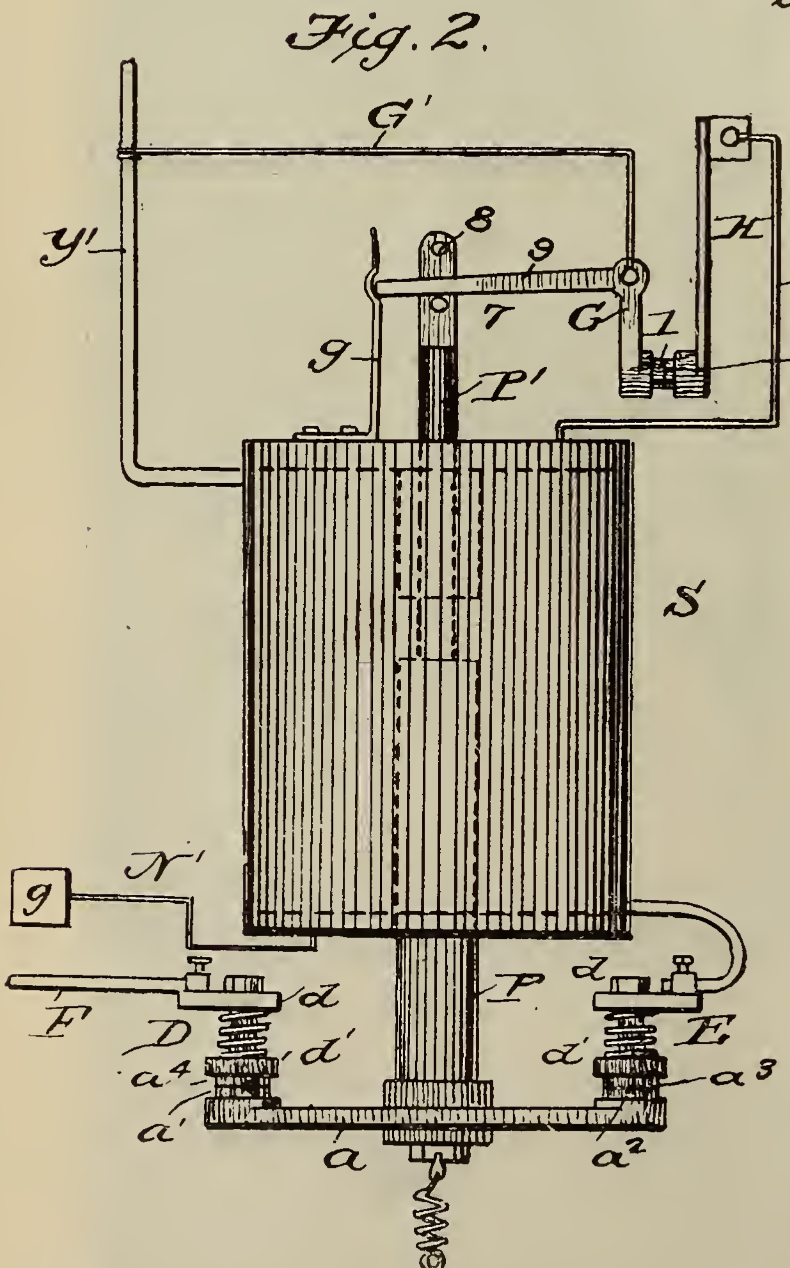
1515 tons of 90 pound Girder Rails	$32,300.00
270 tons of 30 pound "T" Rails	5,400.00
13,500 Split Oak Ties	6,750.00
2,850 Switches (570 per mile double track)	11,400.00
95 Vaults (at $100 per vault)	9,500.00
27,000 feet of Conduit for track and feeders	4,050.00
54,000 feet No. 4/0 Lead Covered Wire (Feeders)	15,120.00
35,000 feet No. 2/0 Lead Covered Wire (Switch Feeders)	7,700.00
23,500 Cubic Yards Broken Stone	2,350.00
35,000 " " Excavation	17,500.00
13,000 Cubic Feet Asphaltum for Roadbed	8,125.00
Incidentals 10 per cent	12,019.50
Labor	8,000.00
Profit	14,021.50
Total	$154,236.00

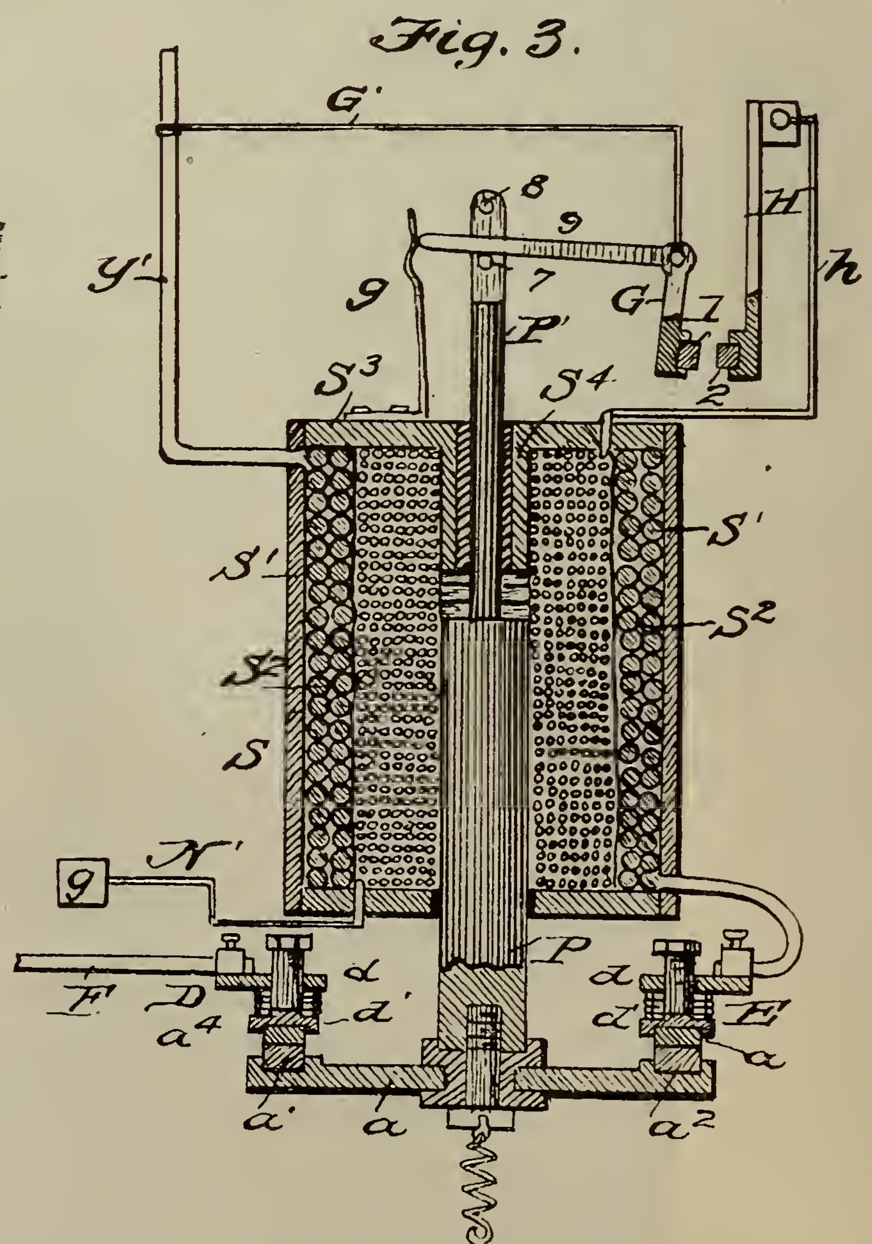
or at the rate of $30,847.20 per mile of double track.



Exhibition of the Safety Third-Rail System at Odd Fellows' Hall, Washington, D. C.

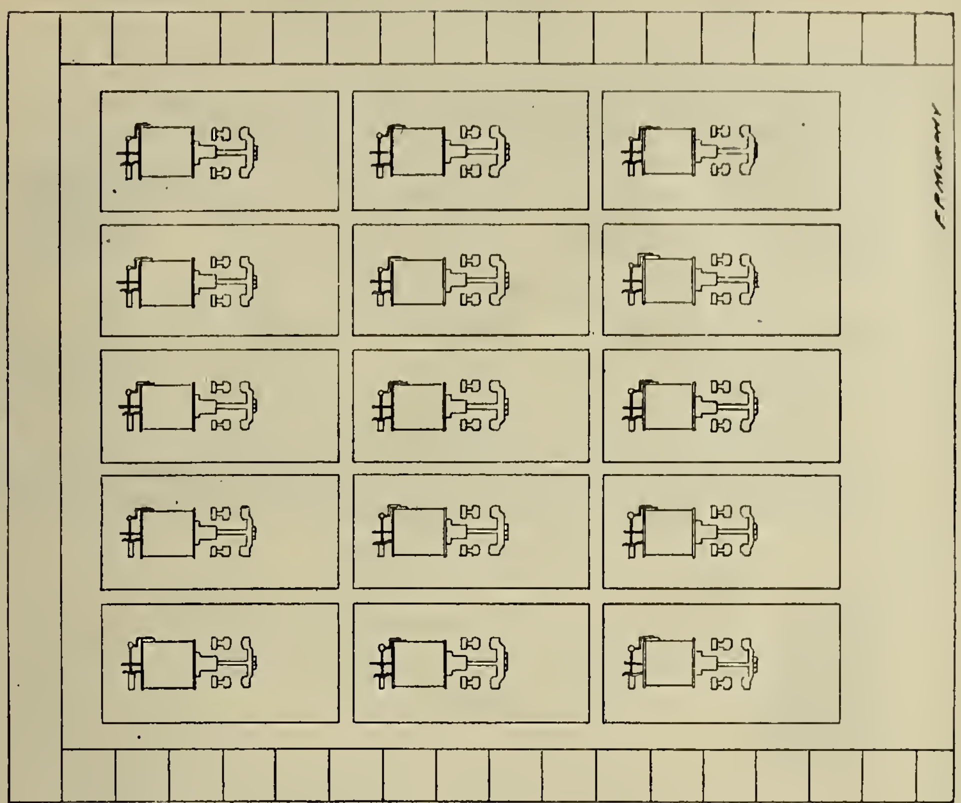






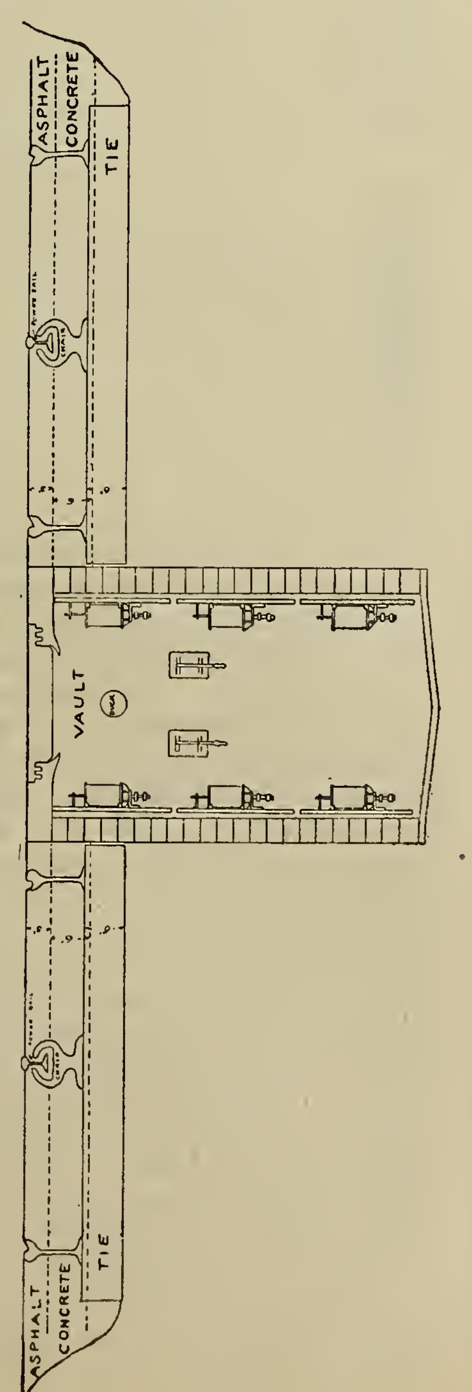
Fig, 1—Connections between Rail, Motor and Switch.
" 2—External Appearances and Connections of Switeh.
" 3—Sectional View of Automatic Non-Arcing Switch.

SIDE VIEW OF VAULT

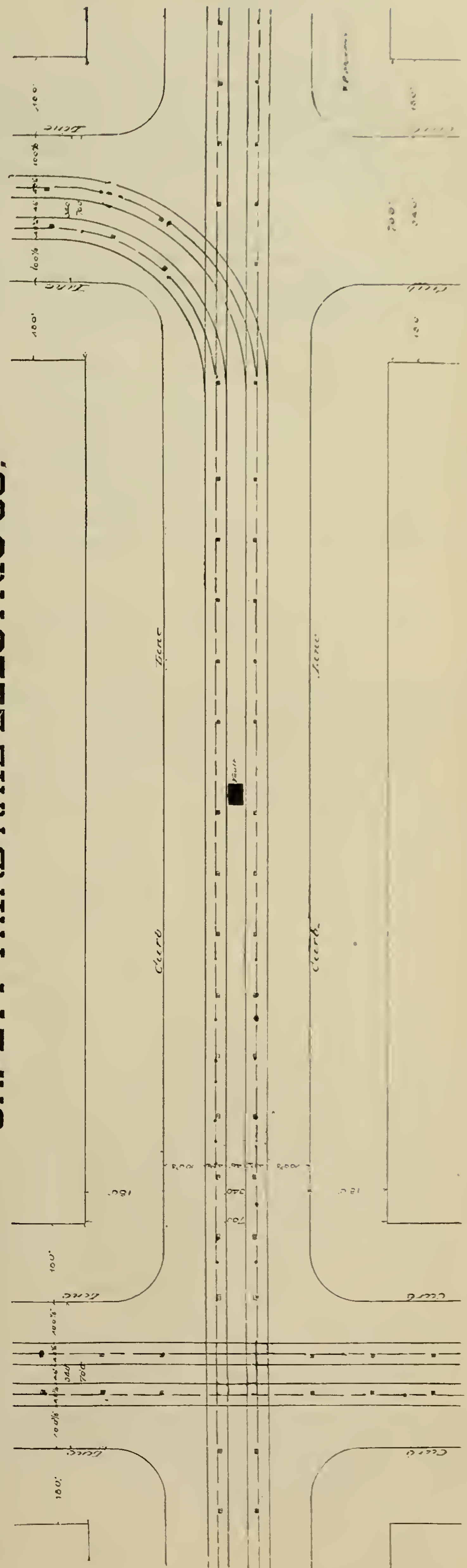


SAFETY THIRD RAIL ELECTRIC CO.

ROADBED & VAULT



SAFETY THIRD RAIL ELECTRIC CO.



Details of Track Construction, showing Vault, position of Switches and Method of turning Curves.

THE ENCLOSED ARC LAMP.

(Continued from page 330.)

(Section of article left out of last issue.)

The best regulation was obtained from lamps Nos. 3 and 7. Although the arc has more chance to move about on the ½-in. carbons than the $\frac{7}{16}$; the lamp No. 3, using the latter, gave no better regulation than the one with the ½-in. carbon.

Life Tests.

The life of a lamp for one trimming depends on a large number of conditions, most of which are self-evident.

1. It is influenced by the size and quality of the carbons. The carbons will not run exactly the proper diameter, even though of the same make. This, while hardly noticeable to the eye, is discovered when it is found impossible to slip the carbon through the gas cap or in the lower socket and hole through the bottom.

2. The life depends upon the current strength. This varies gradually during the run of the lamp, on account of the plunger, caused by the wasting of the upper carbon. The following figures will give an idea of this change :

With upper carbon, full length of 12 in. current taken by lamp was 5.2 amperes. Carbon 9-in. long, the current was only 5.05 amperes; while, when carbon was only 6-ins. long, its final length, current was 4.85 amperes.

3. The size of the enclosing globe affects the life, it being less by a slight amount for a smaller globe. With the same conditions otherwise, a lamp having a small globe will, during a given run, have this globe replenished with air from the outside oftener than a larger globe.

Table VI. gives the carbon consumption in inches per hour for 5-in. and 6-in. globes.

TABLE VI.

Consumption.	5-in. Globe.	6-in. Globe.
Positive	.067	.0687
Negative	.034	.029
Total	.101	.0977

4. The rate of consumption of carbon varies with the height of the arc in the globe. Although the current decreases in value as the upper carbon is consumed, the total consumption per hour is increased as the position of the arc goes downward in the globe. The measurements given below, in Table VII, show this, which is a result of the increased circulation caused by the heat of the arc being lower in the bulb.

TABLE VII.

Position of Arc in Bulb	Positive.	Negative.	Total.
Top	.070	.024	.094
Middle	.074	.034	.108
Bottom	.079	.039	.118

At the middle of the bulb the consumption per hour is 14 per cent. greater than at the top; at the bottom it is 25 per cent. greater. These figures are for $\frac{7}{16}$-inch carbons, and are the largest for any of the lamps tested.

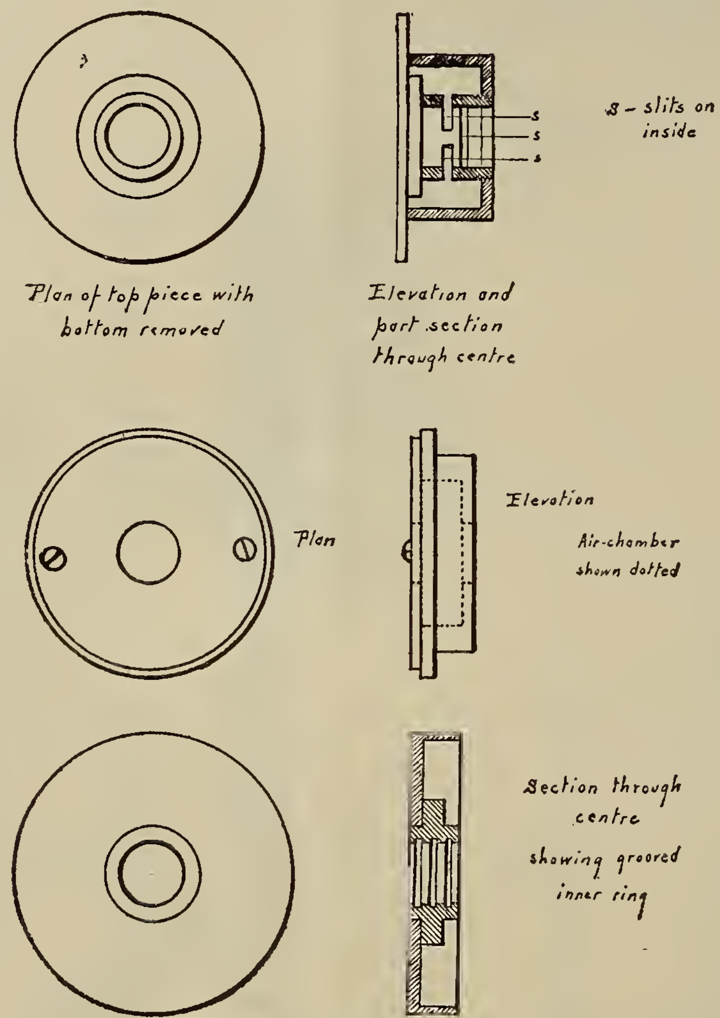


Fig. 7. Gas Caps, Half Actual Size.

5. The form of gas plug used also influences the life. They vary in form from a simple circular plate with the hole for the carbon grooved in two circles parallel with the plane of the disk, to the arrangement having a chamber fitted with slits through that wall which is next the carbon. The object of this chamber is to obstruct the circulation as much as possible, and yet have sufficient air to keep the carbon from depositing on the globe in excessive quantities. For some reason the consumption of negative and positive in one of the lamps having this latter form of cap is in the proportion of from 1 : 5 to 1 : 10. In all the other lamps the ratio of consumption of positive and negative carbons varied from 1.7 : to 2.9 : 1. Since a slow consumption of the negative carbon keeps the arc well up in the globe, it gives an advantage over the other lamps in producing a larger area of distribution of light at the end of the run. On a horizontal plane it will give a little less, as the coating is heavier at the top of the globe. Tnis holds, however, for a continuous run only; the ratio of consumption being 1 : 3 for intermittent runs. This shows how the effect of the gas cap is neutralized by allowing fresh air to enter at intervals.

Fig. 7 shows the different styles of caps.

6. Whether the run is continuous or intermittent will make a difference in the life, although only slight. Theo-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2 50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage." New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, JANUARY 1, 1898.

CONTENTS.

THE EROSION OF METALWORK BY STRAY CURRENTS.

A great question is being agitated by certain electrical engineers in the daily papers regarding the gradual erosion of metal work, exposed to the influence of stray currents. Being of vital importance to those living in large cities, because of the great network of underground conductors laid there, an extensive system of electric roads operating in their midst, investigation has taken such a turn that the question is now about to be considered: whether electrolysis is destroying the cities' water-pipes, attacking the foundation of large structures or creating havoc at places of public interest? The means of judging whether this actually occurs or not, is a simple and practical one. The general proposition may be stated that any metallic body will be eroded if it acts as the outlet for a current, however light. In other words, a metal object positive with reference to the earth is gradually losing, day by day, a collection of infinitesimal particles, which in the course of months and years will invite serious consequences. The data supplying all necessary information may be found in any treatise on electroplating. The pressure required for the disintegration of iron varies from one to three volts. The stray currents leaking from ground returns and underground conductors and meeting in their transit water-pipes, etc., do certainly have an injurious effect in many cases upon the integrity of the water-supply system. To remove so mischievous an effect, a course must be decided upon that will sweep away influence inimical to the well-being of any earth-covered support or pipe. The cry has usually arisen in places where the trolley system predominates. It certainly lies in the power of traction companies to remove this crying evil, whenever it exists. If the current cannot find an easy path through the rails and bonds connecting thereto it will divide up according to Ohm's law, and mingle with the earth whenever the resistance of a bond is high enough to invite that condition. An earth return should be so perfect a circuit, theoretically, that if the tracks composing it were lifted off the ground, the drop in the system would not vary one per cent The point is therefore this, that although the tracks rest upon the earth, it is not the intention of the traction company to depend upon it in any respect, and when leakage does occur from the tracks to earth, and in our present system such leakage is inevitable, it is due to some fault in construction, not a mistake but a lack of care which manifests itself in the form of stray currents, whose influence upon surrounding metal work is apt to be extremely injurious. It is not necessary to conclude, from what has been said, that in all cases poor bonding of tracks will create havoc, but this may be well remembered that in all cases where tracks are not well bonded the company is paying through the nose for its power and is running a very heavy chance of affecting the system of water-pipes in a large city. The recent discussion regarding the supporting cable terminals of Brooklyn Bridge may cause no dismay if it be known that the masonry to which they have been fastened is dry and practically free from conductivity. The myriads crossing the bridge may indeed fear if the self-same supporting terminals are held by damp stones, impregnated with moisture and seamed with stains of iron that owe their origin to the gradual decay of the vital parts of that great structure.

THE FINAL SYSTEM OF ELECTRIC TRACTION.

One of the greatest of English engineers on visiting this country a few months ago expressed his opinion on the subject of electric traction by saying that he believed the only successful electric traction system would be one of an automatic nature; that is to say, a block system. Perhaps the importance of this fact is already appreciated by our well-known engineers; if not, it should be Leakage is suppressed largely and the value of the system greatly increased in consequence of the removal of so many objectionable features, that both the engineering and the financial world should greet a well constructed, simple and efficient block system with every evidence of satisfaction. Certain great changes are imminent in every department of steam and of electrical engineering. One of those, heralded by many signs, is that of an automatic electric block system. It is merely one in which the current is thrown into that section of rail beneath the car, and cut out as the car proceeds. It is one which must have a switch that will not arc and a system devoid of complications, either as regards the operation of this automatic switch, or the means of preventing arcing when its functions have been performed. The system described in this issue, representing the invention of Capt. McLeod Murphy, satisfies the above conditions in every respect. He has carefully studied the situation and designed the mechanism of a road which, in practical operation, will meet with assured success.

Bobcaygeon, Ont.—Much interest is taken in the proposition to build an electric railway betweeen this city and Peterboro. The scheme is to build a line to Scott's Mills, some twelve miles east, thence to Buckborn and Peterboro. The cost is estimated at $200,000.

Woodstock, Ont.—We are informed that no company has been formed to build an electric railway between here and Ingersoll. The franchise for the City of Woodstock is held by the Woodstock Electric Light, Power and Street-Railway Company, who have tried to interest parties in the building of the road, but so far without success.

J. Alcide Chaussé.

retically, the life should be less for the intermittent test than when the lamp is kept burning without any stops. The stoppage allows fresh air to get in, thus increasing the consumption. When the current is thrown off a lamp, it is to be noticed that the CO gas catches fire from the inrush of air and forces its way out against the incoming currents, so that in some instances the force is sufficient to make the cap chatter in its place. This blue flame disappears in a time varying up to ten seconds. The results we obtained were irregular, but show that the life is about the same whether the lamp is burning steadily or at intervals, as shown by table VIII.

TABLE VIII.

Test.	Steady Run. Life in Hours.	Intermittent Run. Life in Hours.	No. of Stops.
a	124	128	21
b	130	143	15
c	28	25.5	22
d		143	15
		141	20
e	128	112	18

Test c is not the full life. An accident compelled the stoppage of the continuous test after 28 hours and the intermittent test was then carried on till the same amount of carbon had been consumed. It will be observed that in two cases the life was longer for the non-continuous run. Another test not given above showed almost exactly the same loss of carbon for each test, the consumption for a given number of hours being measured.

To find theoretically the amount of carbon consumed with intermittent use, we can calculate the weight of oxygen the bulb contains when filled with fresh air, and from this determine the amount of carbon burned before the admission of any more fresh air. For example, one of the bulbs contained 18.8 cubic inches of air. Since the amount of oxygen contained is one-fifth of this, and a cubic inch weighs 343 grains, the bulb contains when filled with fresh air 129 grains of oxygen. In forming CO gas, this amount of oxygen would require .967 grain, or approximately one grain of carbon to combine with. Carbon at a specific gravity of 20 weighs 505 grains per cubic inch. If the carbon is ½ inch in diameter, its section is very nearly 2 sq. in., and a piece one inch long will have a volume of about .2 cu. in. and weigh approximately 100 grains. Then, if one grain of carbon is consumed for each filling of the bulb, it means that .01 in. in length has been used. Taking .07 in. as an average total consumption per hour and only .01 inch is consumed by the air in the bulb at starting, it will take 7 of these renewals to consume an amount of carbon equal to one hour's regular run. That is, if the lamp is run for a few minutes, sufficient theoretically to exhaust the oxygen in the bulb, and if this is done 7 times, it will use as much carbon as if the lamp had been running steadily for one hour. Therefore, taking 4 hours as an average run, a lamp burning 140 hours would have 35 stops, equivalent in consumption to 5 hours run, and on this basis would consume carbon as if it had burned continuously for 145 hours.

7. Some of the lamps make use of an air-tight outer globe to keep down the supply of air. This may make a slight difference in the lamp's life, but it has the disadvantage of raising the temperature inside the lamp to a very high point, making it necessary to use an insulation that will not char from the effect of the heat. It may also cause a coating of shellac that is originally put on the solenoid to deposit on the brass rod, insulating it and causing it to stick. A thermometer placed inside the extra resistance in a lamp that was open at the top, showed 324° F. The temperature of the air around the clutch in a lamp with ventilating hole was 280° F., and that of the shell, 134° F. The inside temperature of a tightly closed lamp would probably be considerably higher.

Ratio of Consumption of Positive and Negative Carbons.

For a given lamp, the ratio decreases as the total rate of consumption increases, both for different sizes of globes and for different parts of the same globe. This is shown by Fig. 8 and table IX.

TABLE IX.

Consumption in Inches per Hour.			Ratio.	Remarks
Positive.	Negative.	Total.		
.070	.024	.094	2.97	Different parts of same globe.
.074	.034	.108	2.20	
.079	.039	.118	2.02	
.0687	.029	.0977	2.37	Different globes.
.0670	.034	.101	1.97	
.0617	.00617	.0678	10.	$\frac{7}{16}''$ carbons largest ratio observed.
.0509	.0227	.0736	2.24	½″ carbons
.0467	.0216	.0673	2.16	
.0543	.0217	.076	2.50	
.046	.027	.073	1.70	
.048	.023	.071	2.08	

It will be observed that the smallest total consumption was obtained with a $\frac{7}{16}$ inch carbon, showing very markedly the effect of the gas cap. The usual method of renewing the carbons is to use the remainder of the upper carbon for the negative in the next run. In the case of the lamp just cited (No. 3) the upper carbon left is about ½ in. shorter than a new lower carbon, but since the life of this lamp is so prolonged the shortness would be no drawback. The lower carbon might even be used for two continuous runs, if the position of the arc in the lower portion of the globe is not objectionable.

The long life of the enclosed arc may be considered its chief advantage over the ordinary open arc, the saving in carbons and trimmers' expenses being very large. The old style of lamp requires two carbons for each trimming, and lasts 6 or 8 hours. The enclosed arc requires to be trimmed about $\frac{1}{15}$ or $\frac{1}{20}$ as often. Furthermore, each retrimming costs less. For, although the cost per thousand for the same size carbon is greater for the enclosed arc, being $23, for 12 in. × $\frac{7}{16}$ in. rods only one is required for re-trimming, while the open arc needs two 12 in. × $\frac{7}{16}$ rods costing $18.70 per thousand and 6 in. × $\frac{7}{16}$ rods costing $8.30; so that one thousand re-trimmings cost $23 for the enclosed lamp, against $27 for the open lamp, or a saving of $4 per thousand trimmings in favor of the enclosed arc lamp.

AFTER January 1, 1898, A. C. Jahl will not be connected with Mr. G. Humbrock, the manufacturers' agent, 39–41 Cortlandt street, New York City. Mr. Humbrock handles all kinds of electric light and railway supplies.

Coburg, Ont.—The town will apply to the Legislature at its next session for the power to construct electric-light plants.

A BUSINESS NEED SUPPLIED.

There are few practical men of business who do not recognize the benefit of advertising in hunting for new and holding old trade. That many fail to show a proper appreciation of this fact by keeping alive an up-to-date and representative line of advertising is largely because to do so requires more time and attention than is available where those who must be entrusted with the work have already more than enough to occupy them. The need, too, of a master mind is an essential that is more than likely wanting in most instances.

Not all of those who find themselves thus situated are aware that there is in existence in New York City a concern whose business it is to supply to manufacturers the time and attention necessary for the efficient and profitable management of the advertising end of a business.

The Manufacturers' Advertising Bureau, 126 Liberty street, New York, is a business need supplied. With the testimony of many of the largest and most prominent manufacturers at hand to back up the statement, we can say it is a thoroughly advantageous business connection for the progressive but pressed-for-time advertiser of today.

The firm that places its newspaper work and advertising in the charge of the Bureau will be relieved of the many vexatious, time-taking, but nevertheless necessary details that combine to make advertising pay, and will at the same time have the benefit of twenty years' experience in trade journal advertising.

Benj. R. Western, the proprietor of the Bureau, is a thorough newspaper man of extensive experience in trade journal advertising. He has associated with him in the conduct of his business a corps of able assistants, qualified by experience to further in every way the interests of the clients of the Bureau.

The methods of the concern are such as the times demand. Their clients are well served and the number, we are pleased to note, is increasing every year.

A little business book, bearing the title "Advertising for Profit," is issued by the Manufacturers' Advertising Bureau, and tells in a brief, busy man's way how Mr. Western and his associates work. Copies, we are informed, can be obtained gratis upon application and a business card.

RAILWAY INCANDESCENT LAMPS.

The important feature in lamps intended for use on railway circuits is long life without decrease in brilliancy. To secure this both mechanical strength and uniformity of product are essential. Railway lamps should be uniform not only in size, shape and appearance, but absolutely so in current consumption. Both length of life and sustained candle-power depend upon such uniformity, and while the former is the most desirable characteristic, it should not be forgotten that lamps are primarily made to give light. Practically any length of life can be secured in lamps of low efficiency—lamps consuming a large amount of power; but power is not had for nothing, and while one lamp may last longer than another, it may consume so much current as to make it cost more than a lamp of shorter life, and yet be so dim as to make it worthless, consuming current without giving a proper return in life. The ideal lamp, therefore, is that on which the average life is combined with average candle-power and energy consumed to give the best lighting service for the least cost, including lamp renewals and power consumed.

In the Edison Railway Incandescent Lamp the results above are obtained first, by its mechanical strength, the filament, of cellulose with a hard graphitic carbon coating, being so shaped and anchored as to protect it as well the bulb from injuries likely to occur from the vibration and shock inseparable from street-car service. The anchoring of the filament is essential. An unanchored filament must necessarily be so stiff and short as to limit the light to a small area. This reduces both the efficiency and sustained brilliancy of the lamp. The position of the anchor is also of importance. To anchor the lower end of the filament to the inside of the bulb is objectionable. The filament is held too rigidly, exposing both it and the anchor to rupture in case of jar or shock. Rigidity can be eliminated by loosely resting the filament in the loop of the anchor, but the friction of the filament in the loop quickly wears it away. In the Edison lamp the anchor is set in the stem and the vibration of the filament is rather checked than entirely prevented. It is thus not strained nor weakened, as both filament and anchor vibrate together, and no chance exists of the branches interlocking and short-circuiting, as would probably be the case if one loop of the filament were anchored to the side of the bulb and the other left free to vibrate and strike against it.

As railway lamps are operated in series the current capacity should be uniform. Edison railway lamps are, therefore, made in three different classes—for 500-volt circuits, for 550-volt circuits and for 600-volt circuits, in each class the lamp being selected for a given amperage. The standard railway lamps have an efficiency of four watts per candle at full 16 candle-power. They are fitted with the standard Edison screw base, or with bases to fit almost any make of socket.

For the decoration of cars or for headlights, or special locations in which a small compact bulb is required, the round bulb lamp is manufactured. Its filament is shaped and anchored as is the standard railway lamp, and both are furnished frosted or of almost any desirable color—either artificially dipped or in natural glass.

The best lamp can be so misused as to render it worthless, while by proper use the maximum of life and light is

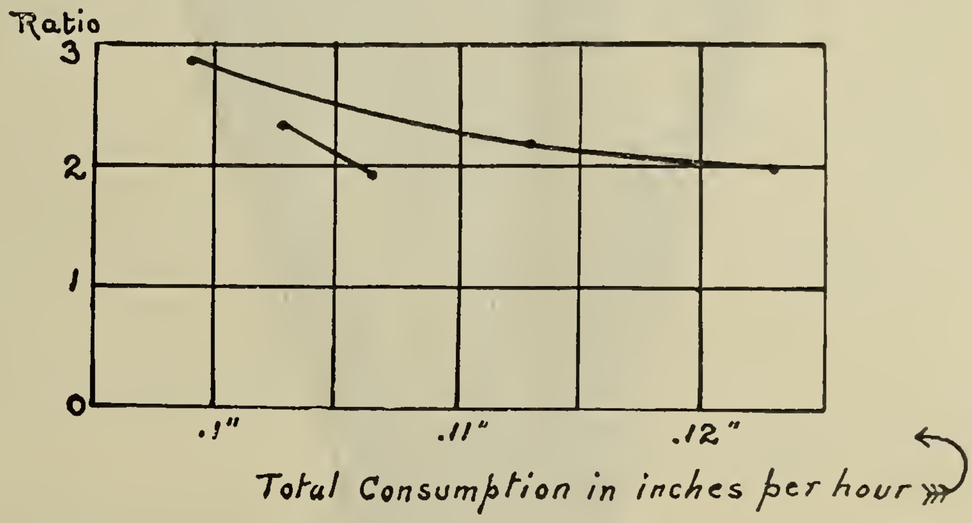
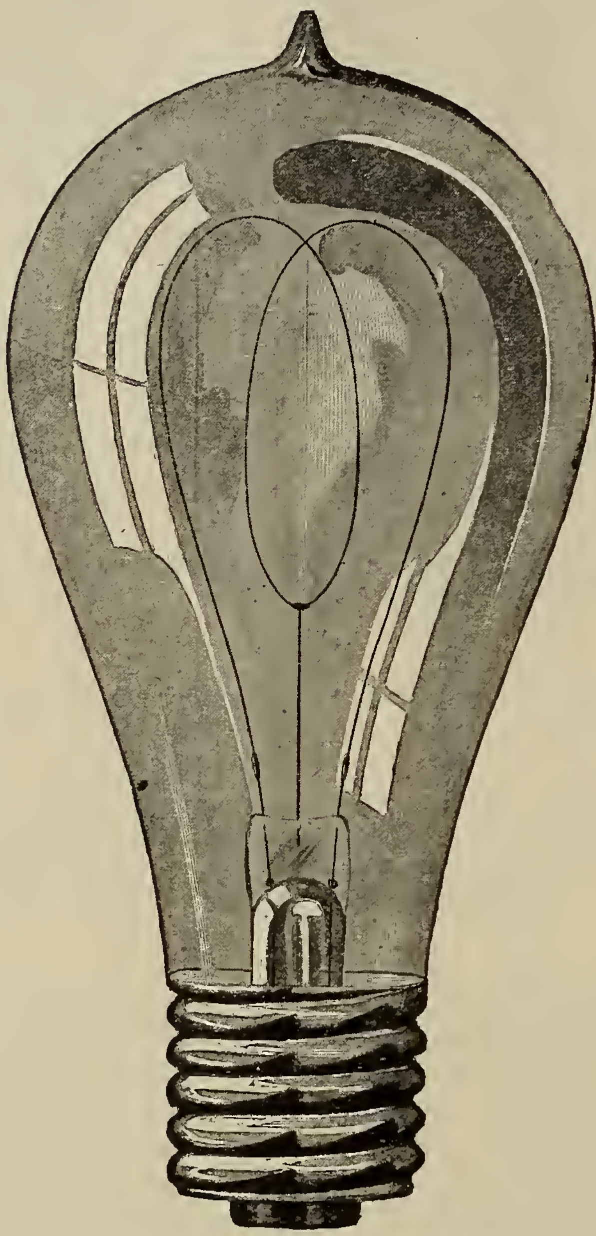


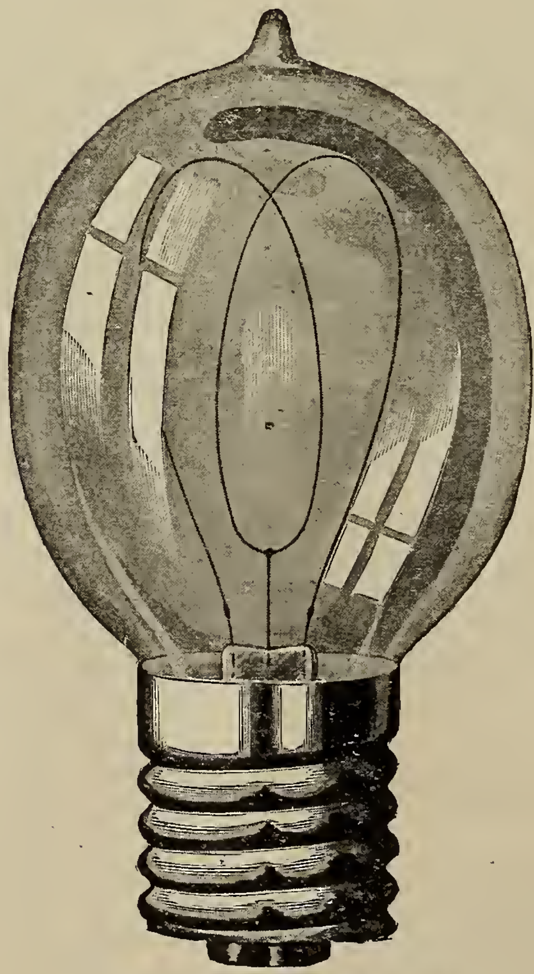
Fig. 8. See p. 8.

obtained. Proper use demands that the same amperage and make in lamps be used on the same car or series; that they be ordered to suit the total voltage of the cir-

Winnipeg, Man.—It has been decided to invite tenders for electric street lighting for a period of three to five years from April 25, 1898.



General Electric Railway Lamp.



General Electric Railway Lamp.

cuit, and that the lamps which have become dim from age be at once replaced by new ones; and this last requirement is necessary if light is to be economically produced.

Brantford, Ont.—Brantford is making estimates on an electric-lighting plant. The present contract will expire next year.

THE MEASUREMENT OF CURRENT.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Electro-Thermal.—If the extent to which a metallic wire stretches when heated be determined by experiment, the term "coefficient of expansion" clearly defines such an effect, if referred to as the increase in length per foot, or even the percentage of increase over all.

A current passing through a wire heats it, although not in direct proportion to the current. If the current is one ampere and the heat be measured, by increasing the current to two amperes the heat becomes four times as great. This is due to the fact that the heat does not depend directly upon the current, but upon C × C, or the square of the current. With a current of three amperes the heat becomes 3 × 3, or nine times as great, etc.

If a wire carrying a current exercise its expansion or contraction upon a hand or pointer placed before a dial, the wire passing over a little wheel attached to it, and a spiral spring hold the pointer at zero when no current passes, the wire would expand when the current flowed through, the spring would gather in the slack wire, and by doing so move the pointer, thus indicating a current. The elements of an electro-thermal instrument are contained in this illustration.

Prof. Forbes, of England, invented an electro-thermal instrument in which a coil of high-resistance metal, being heated by the passage of a current, caused a small windmill with mica blades to rotate.

The current would affect the velocity of the prime mover by the least variation, but its extreme delicacy forbade its use as a practical instrument. This instrument might more properly be classed under the head of recording ammeters, as that was its evident object. There are other types of instruments which record both current and pressure, but the principle of their action is not thermal, and they cannot be included here. Hot-wire instruments or their equivalent have fallen into disuse of late, because of the greater accuracy and more attainable perfection of electro-magnetic devices.

Electro-Magnetic. — Electro-magnetic instruments depend for their current-measuring properties upon the relation existing between a current and the magnetic effects that follow from it. Although the methods of measurement employed under this head are very numerous, the means by which effects are produced may be briefly stated:

(1) A coil carrying a current affects a movable magnet.
(2) A magnet affects a movable coil.
(3) A coil affects a movable coil.

Practically all the devices of the above order, with the exception of the last, might be termed galvanometers.

For the absolute measurement of current the galvanometers of the following order come into prominence; they belong to the first order:

A stationary coil and a movable magnetic needle:

(a) Tangent galvanometer.
(b) Sine galvanometer.

A most unique type belonging to the second class was invented by M. D'Arsonval, with an immovable magnet and a movable coil. The famous Weston instruments act on the basis of this principle.

Under the head of the third class—a stationary coil actuating a movable coil—both of the following are practically dynamometers:

(c) Dynamometer.
(d) Ampere balance.

An intermediate and very common form of current indicator consists of a coil whose entire function is the attraction of a soft iron core. As the extent of the attraction depends upon the current, the movement of the core after the proper attachment to a pointer has been made may be marked on a dial and thus used for future reference.

The process of calibration is adopted with such devices, that is to say, the use of currents whose strength is varied and successive values known and recorded on the hitherto unmarked dial. The Edison Company employed this form of instrument, which is generally known as the Bergmann ammeter.

The tangent galvanometer is composed of a coil of large diameter, more aptly designated as a narrow reel. At the centre is a pivoted magnetic needle above a circular dial marked in degrees. The currents passed into the instrument cause different angular deflections. The currents are not proportional to the angles themselves, because by doubling the current the deflection is not increased twice. The currents, however, are proportional to the tangents of the angles. Triple the current will swing the needle around to an angle whose tangent is three times that of the previous angle. A value termed the constant of the galvanometer is found and the current calculated by the rule—

current = constant × tangent of angle of deflection.

The constant is obtained by sending in a known current —observing the deflection—and its tangent is obtained. The constant which can be used for all future cases is

$$\text{constant} = \frac{\text{current}}{\text{tangent of angle of deflection.}}$$

A sine galvanometer works on an equally simple principle, the current being proportional to the sine of the angle of deflection—the rule being

current = constant × sine of angle of deflection:

the constant is a quantity determined in a similar manner for practical use.

The D'Arsonval galvanometer has a permanent steel magnet with a coil suspended between its poles. A metal cylinder upon which the wire is wound gives to this instrument the peculiar and useful property of being dead beat.

The Weston ampere-meter, or ammeter as it is commonly called, with some slight changes is identical with the above. The coil in this instrument is suspended on pivots. A pair of watch-springs convey current to the coil and bring it back to zero when it ceases.

The springs do not lose their temper, because the entire current passes freely on through the instrument, while a slight portion required for the movement of the coil is shunted into it. The instrument is calibrated by passing known currents into it and the deflections marked on the dial. They are equal, and in ammeters of this particular construction accurate to within $\frac{1}{10}$ of one per cent. The springs unwind as the deflection increases and thus serve in part to equalize the deflections.

Dynamometers record readings which are proportional to the square of the current. A fixed coil is so situated that a coil in the same plane, both being of rectangular shape, is inclined by the effect of the current; the movement of the inner coil acts upon a wire by which it is suspended and also moves the hand of a dial. To bring the coil back to its former position requires a twisting or torsional force, which must be applied to the wire. The current is proportional to the square root of this angle of torsion.

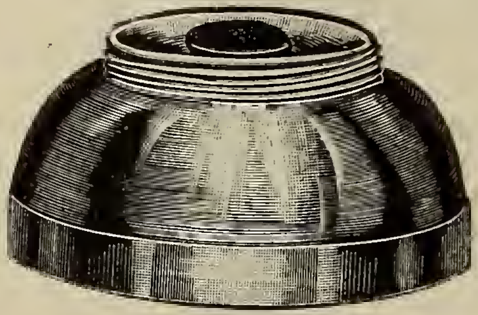
Recording ammeters of a somewhat expensive pattern have been produced by various inventors, but today it can hardly be said that there is really a single moderately cheap form of recording ammeter on the market. The Edison Illuminating Co. still adhere to the electro-chemical method in their meters, and the prevalent types of ammeters that are called recording have failed to appeal to them. The hot-wire mica.vane instrument of Forbes and possibly a system of photographing a moving spot of light reflected from a mirror, employed by the Walker Co., are the few that utilize complex methods for that purpose.

A famous inventor and scientist suggested the use of a wheel of copper, immersed in a copper sulphate solution, for the purpose just described. The copper wheel being gradually loaded on one side with copper that has been

Pressnre Cup of Button.

plated on it would slowly rotate, and thus record the current consumed in the circuit. While the idea is ingenious, the practical development of it is full of difficulties.

A simple form of ammeter of sufficient accuracy to be depended upon, and an equally simple form for the actual recording of the current, would be of value and importance to those practically interested. Were it possible to suppress other phenomena, which invariably make their appearance when a current passes in a circuit, the decomposition of water might be utilized as a possible



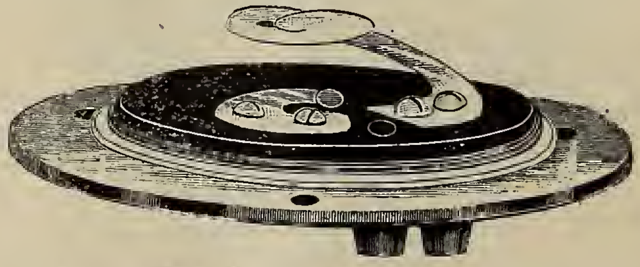
Casing of Button.

means by using its accumulated pressure for the movement of a mechanical system, which would record the volume of gas passing.

An ampere has been defined as the current which passes through a resistance of one ohm at a pressure of one volt.

The true unit of current is based upon the absolute system of units sometimes called the C. G. S. system—the centimeter, gramme and second being the quantities involved.

If an arc of wire of one centimeter radius and one centimeter length be brought near a unit magnetic pole, if the



Contacts of Huebel & Manger Moisture Proof Button.

unit pole be placed at the centre of a circle of which the wire is a part, it will be affected by the force of one dyne. A dyne is the unit of force developed by the unit of weight moving a unit of distance in a unit of time. As the units have been specified, the movement of one gramme a distance of one centimeter in one second brings into being one dyne.

The arc of wire producing such an effect will then be carrying a unit of current. This, however, is so large that the practical unit has been made one-tenth of it, and is called the ampere.

The electro-chemical method of determining the ampere has already been considered. The coulomb comes into direct consideration in this method, it being well known that the transference of a metal never varies in quantity when carried over by one coulomb. Whereas one coulomb of electricity will transfer a different weight of copper than iron, and a different weight of silver than gold, the amount of metal carried over by a coulomb for each particular metal never changes.

Certain fixed proportions always exist, and their immutability has been repeatedly tested without failure.

For Volume Voltmeter $C = \dfrac{v}{t \times .1734}$ v = cu. cms. t = seconds.

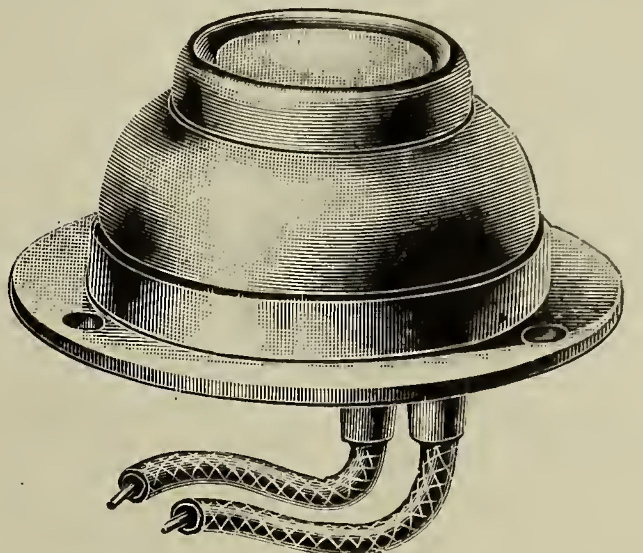
Electro-Chemical Equivalents.

	Grammes per Coulomb.
Hydrogen	.00001035
Silver	.00118
Copper	.000326
Water	.00009315

F. A. Scheffler, M. E., sales agent of the Sterling Boiler, 126 Liberty Street, New York, will take the superintendence of the elevator department at the works of the Sprague Electric Co., Jan. 1.

AN IMPROVED MOISTURE-PROOF PUSH BUTTON.

In a recent issue of The Electrical Age a brief description was given of some important electrical specialties manufactured by Huebel & Manger, 286-290 Graham St., Brooklyn, N. Y. Those interested in annunciator and bell work have no doubt frequently experienced great difficulty in keeping push-button contacts clean, and, in fact, in protecting the push-button from moisture, which, getting into the connection, corrodes them and makes the push-button worthless. This is noticed in a marked degree in breweries, ice-houses, damp cellars or any place of like nature in which push-buttons must be installed. The illustrations show the parts of a push-button that is absolutely moisture proof and after being installed will never develop the faults usually found in the ordinary style of button. It is shown assembled and in parts. Every portion is amply protected and if screwed tightly into place will last for years unaffected by external conditions. The above concern believe in common with their customers that no push-button on the market can equal this in practical use and feel sure that many of the difficulties experienced by bell-hangers will immediately disappear if this button is used instead of the cheap devices thrown promiscuously upon the market.



Assembled Moisture-proof Push Button.

They solicit correspondence and will send catalogues and descriptive matter to prospective purchasers.

THE BEST METHOD OF SETTLING DAMAGE CASES AND THE PREVENTION OF ACCIDENTS BY THE USE OF FENDERS OR OTHERWISE.

BY WILLIAM J. HIELD.

It is hard to handle, in a short paper, this most difficult subject which is today perplexing the officials of all large street-railway systems. However, as the study of these questions is made imperative by reason of their serious importance, I venture to offer a few ideas which I trust may prove of some interest, if not of value. Like all other professions, the law has in late years given rise to many specialists, among whom the personal-injury lawyer is most prominent to the street-railway manager. His untiring efforts have wrought such a change that the question of settling damage cases today is vastly different from what it was a few years ago. The general manager or superintendent can no longer personally adjust the claims against his road, but must employ men for that particular purpose. It is now necssary for him to have a claim department, the system of which should be perfect in detail and work, and work in true harmony with his operating department, both for the prevention of accidents and the settling or fighting of damage cases.

The secret of success in handling damage cases, lies, no doubt, in their being properly looked after from the start, i. e., from the time they are first reported. How to do this varies as do the different cases, but no case should ever be handled by anyone but an honest, careful and experienced claim agent. For such work men must be naturally qualified; they should ever have the interests of their road at heart and yet not be blinded by too great a prejudice in its favor; they should have sound, shrewd judgment and be painstaking and careful of detail to the highest degree. Like the true physician, they should be of a happy, calm temperament, and also like him, should ever be ready to answer a call. The successful claim agent should have the faculty of handling all sorts of people without friction. His keen perception should reveal to him the nature of each case, but he should never betray anxiety for settlement. Every claim department should have a good system for securing reports of accidents, for obtaining evidence, and for keeping such files and records as may be necessary for its work.

The only accidents which demand serious consideration are those in which personal injury is involved. These may be divided into the three following classes :

First. Those in which there is an undisputed liability and which, as a rule, should be settled as soon after their occurrence as possible.

Second. Those in which there is a doubtful liability, generally, and which, should be settled after careful investigation.

Third. Those in which there is clearly no liabilility and which should therefore never be settled.

Frequently cases may prove exceptions to these rules, but in handling them under such a classification or any other, the following suggestions would seem to be of importance.

First. It is of great value in every case to acquire a knowledge of it as early in its history as possible. Procrastination is ever dangerous and the claim agent should have for his motto,—"Time is the essence of success."

Second. Evidence should be carefully secured in every case soon after the accident. Too much can never be reported to the department, and what may seem of little importance at the time of the accident, may prove most valuable in preparing the case for trial.

Third. In nearly all unsettled cases (particularly in serious ones), an examination by one or more surgeons in behalf of the company is desirable.

Fourth. Assistance and kindly tender of services, immediately after a serious accident, are more in place than advances for settlement.

Fifth. Admission of the company's negligence is seldom necessary, but the true rights of the claiment should not be denied; as by antagonizing him all chances of settlement may be lost.

Sixth. Whenever possible, a sworn statement should be secured from the claimant, giving his history of the accident and stating as nearly as possible the damage done. Such an affidavit, carefully and truthfully drawn and signed before witnesses—who should also attest it—may often prove most valuable either in settling or fighting a case. By it the claims of the interested party are clearly defined and limited, so that any subsequent intention to change them may be checked.

Seventh. In every case the claim agent should be fair, but firm. Too cheap a settlement is not the best settlement, but one too expensive is quite as bad, and perhaps worse. However, the claim agent can generally keep the claimant good natured and insist upon his acknowledging that the settlement is a fair one at the time it is made, and thus prevent his feeling or talking ugly about it later.

Eighth. A full release of all claims should be taken from the claimant, and its contents explained to him fully.

This is of great importance, as the validity of releases is often disputed, and it is then quite necessary to show that they were properly taken. On this account, it is best to explain the release to the claimant before witnesses (who should also attest it) or to make him acknowledge later before them that he executed it of his own free will, understanding its nature.

From these suggestions one may deduce that the method best adapted for the handling and settling of damage cases is to be prompt, thorough and careful, with a liberal use of sound common sense. Whether a case should be speedily settled, or not settled at all, is a matter which must be decided from the peculiar circumstances which it presents, and not by any fixed rule. As a general thing, however, it is well to settle all cases where the injured parties are inclined to be fair, according to the merit each case contains, and fight all cases in which the claimants are very unreasonable, or where fraud is apparent. This rule carried out with the right spirit will prove a valuable policy for any road. If a case be settled, let it be done with due consideration of justice, and if it be fought, let every effort be made to fight it in the fairest and most efficient way possible.

It is not usually desirable that the claim agent should make offers of settlement, but rather it is advisable for him to draw his man out and get him to state definitely, if possible, what sum he really thinks he should be paid. Generally, such a sum can be considerably cut down no matter what the case, but if it is not an unfair amount, in consideration of the injury, it should be paid. Seldom pay more to a lawyer than to the injured party himself, and do not settle a case simply because suit is threatened or commenced. Never settle out from under an attorney who has been professional and courteous in his relations to the road, yet when an unprincipled damage lawyer is interested in a case, do not hesitate to disregard him in settling it. When a good one to fight, the case should not be settled simply because it will cost less. It is ever well to remember, both that victories in court are a great benefit and that defeats are a great loss.

While as a strict matter of law it may not be correct, yet it is always well to give some consideration, when settling a case, to the circumstances of the injured party and allowing such personal interest to enter into the transaction as will not be inconsistent with good business. As a general thing, the claim agent should listen with apparent indifference to the claims of such persons as Jewish peddlers, loud talking and bulldozing men, sharp tongued women and all others whose claims have either the appearance of fraud or unreasonableness; with apparrent interest and sympathy to those other few cases which seem to merit it.

The gist of the foregoing may be expressed in these few words: have good claim agents of sound judgment, who will not settle cases by arbitrary rules, but who will rather consider them each in its peculiar details, weighing well the seriousness of the injury, the manner of the accident and hence the liability involved, as well as the circumstances of the claimant.

The old saying that "An ounce of prevention is worth a pound of cure" was never better applied than to the accident features of a modern street railway system. The rapid transit now in vogue upon the busy thoroughfares of our cities, whether by means of the trolley or the cable, has greatly increased the number of street railway accidents, and hence has caused the question "How to avoid them?" to be of very serious interest.

For this purpose the following points seem to be of particular interest:

1. It is very important for the prevention of accidents, as before stated, that the operating and claim departments work in perfect harmony and unison with each other to this end.

2. The employing of none but good men is most essential.

(To Be Continued.)

TO MAKE AN INTELLIGENT SELECTION from among the beautiful calendars we have received up to date would require the judgment of a Paris, but after carefully inspecting them, we have selected the following three calendars, and leave it to the electrical fraternity to decide which one is worthy of the most commendation.

William A. Rosenbaum, E. E., the well-known patent attorney and expert, of the Times Building, New York City, presents a calendar depicting a pastoral scene entitled "A Cool Retreat," a glimpse of which will be like balm to the busy business man. This calendar is certainly a work of art and will be appreciated by all lovers of nature.

The American Electrical Works, Providence, R. I., show a view of their extensive electric wire works at Phillipsdale, R. I., surrounded by an extremely tasty design. This calendar is printed in colors and makes a very artistic effect.

Cleverly Electrical Works, electrical supply makers, of 1018 Chestnut St., Philadelphia, Pa., show an "Old New England Mill," which for tone and fidelity to nature can hardly be equalled. Some people think Philadelphia slow; but Friend Cleverly does not show it.

We have received a beautiful 1898 Calendar from the Shultz Belting Co,, and take pleasure in stating that a copy will be mailed free to anyone accompanying their request with a three cent postage stamp to A. B. Laurence, Manager, Shultz Belting Co., 113 Liberty Street, New York; Shultz Belting Co., Boston, or the Shultz Belting Co., Philadelphia.

H. C. RICHARDS, Esq., representative of the Safety Insulated Wire & Cable Co., N. Y., says our Dec. 25 issue was a fine number, and congratulates us on the great advance made in the publication of the Electrical Age.

MR. C. P. GEDDES for a number of years has been treasurer of the Interior Conduit and Insulation Co., of New York. At a meeting of the directors of the Sprague Electric Co., of 20 and 22 Broad street, New York, last week, Mr. Geddes was elected assistant treasurer of the company. We are pleased to know that Mr. Geddes has received this high and responsible office, and we can congratulate the company upon the selection of so careful and conscientious a worker. We know that Mr. Geddes will keep a constant watch on the treasury of the company, and with the ability he has shown in the past, the treasury will never lack for funds.

ADAMS & BAGNALL ARC LAMPS, in Red and Blue Globes, were used in the illumination of the New York City Hall and Park on New Year's Eve during the Greater New York celebration.

The Electrical Age.

VOL. XXI—NO. 2 NEW YORK, JANUARY 8, 1898 WHOLE NO. 556

Fig. 1—General Electric Company's Locomotive, Hoboken Shore Road, Hoboken, N. J.

ELECTRICITY FOR SWITCHING PURPOSES ON THE HOBOKEN SHORE ROAD.

The use of electricity for switching purposes on the steam railroad, in place of the noisy drill steam engine, takes another step forward. This time on the Hoboken Shore Road, Hoboken, N. J. The full name of this road is the Hoboken Railroad Warehoase & Steamship Connecting Co. It runs from 17th street, Weehawken, to 4th street, Hoboken, along the water front, or from the Erie tracks at Weehawken to the docks of the North German Lloyd Steamship Co., Hoboken, a distance of about two miles.

This road was opened for traffic on September 20th, 1897. It was constructed to provide connecting facilities betweeu the tracks of the railroad companies entering Hoboken and the numerous warehouses and docks which line the west side of the North River from Hoboken to Weehauken. It is double track over a private right of way from 17th to 14th street, single track down Hudson street to 11th street and double track along that River Walk to 4th street, Hoboken.

The switching of the cars for the past three months has been effected by a repair car of the Hudson County Electric Railroad Company. The new locomotive was put into regular service on the 4th of January, 1898, hauling trains of loaded and empty freight cars between the docks and the Erie track. The difference in its operation from that of the common drill engine is immediately noticeable. The electric locomotive responds instantaneously to the movement of the controller handle and starts without jerk or noise, tightening up the couplings uniformly or coupling the cars together so gently that no blow is perceptible.

The locomotive was constructed in the shops of the General Electric Company, at Schenectady, N. Y., and somewhat resembles in appearance the electric locomotive in use on the Manufacturers' Railroad, which connects with the N. Y., N. H. & H. R. R. tracks at New Haven, Conn., and the giant locomotives now handling the entire freight traffic of the Baltimore & Ohio Railroad, through the Belt Line Tunnel at Baltimore. It is mounted on two four-wheel trucks, each axle carrying a G. E. 2000 motor, giving the locomotive a total of 540 rated H.P. The weight on the drivers is 57,200 pounds; the draw-bar pull is 10,000 lbs. The locomotive is driven through a single reduction gear of very low ratio. The speed is correspondingly low, and is rated at 8 miles an hour when hauling a heavy load.

At each end of the locomotive is an automatic coupler, and a small railed platform for the brakeman in charge of the trolley pole. The cab is of iron and resembles a double steam locomotive cab, with a sloping tender shield at each end. Drop windows are set around the four sides of the cab, affording an unobstructed view in all directions to the motorman. A sliding door on each side gives admission to the locomotive. The interior of the cab is lined with cherry and is a spacious and well lighted room. The fittings are all of polished brass or nickel. On each shield is a head-light; in addition one shield carries a bell, the other a chime whistle. Beneath one of the shields are four packed card resistances, two sand boxes, the compressed air tank and the equalizing air tank; beneather the other, eight resistances, two sand boxes and the engineer's tool box. At one end of the cab is placed a controller of the series parallel type known as the L-2. It contains, of course, the magnetic blow-out and is arranged to operate the motors either four in series or each two in series-multiple. Beside the controller is the air-brake handle and the two valves of the sanding arrangement, by means of which the sand is blown by the compressed air under the wheels.

In front of the motorman is an air-brake gauge and above it an ammeter reading to 500 amperes. Fastened to the roof of the cab is an L automatic circuit breaker set at 500 amperes. On the other side of the controller, from the motorman, is an M circuit breaker and an automatic governor switch for the air pump, placed at the other end of the cab. This is a single cylinder pump driven by a 3 H.-P. iron-clad bipolar slow speed motor.

Fig. 2—Interior of Cab.

The operation of this air pump is automatic. When the air in the tanks is at normal pressure the governor switch is opened. Blowing the whistle, applying the brakes or using the sander causes the pressure to fall. This closes the switch automatically and starts the motor and pump.

The cab is lighted by five standard Edison railway in-

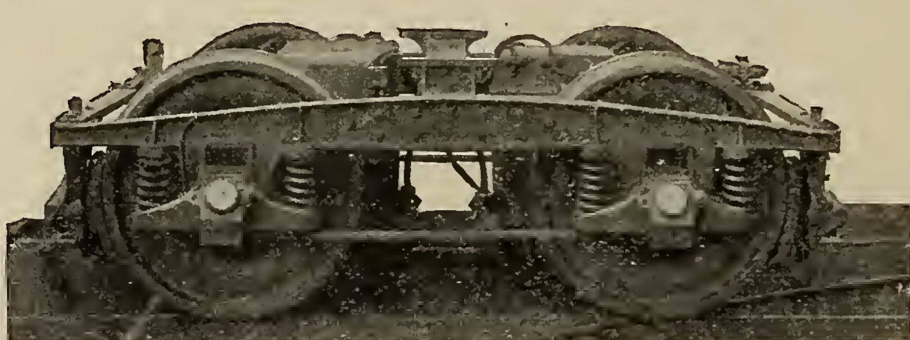


Fig. 3—Side View of One Truck.

candescent lamps.

The overhead wire is 00, suspended from wires strung between octagonal cedar poles, except at two or three points, where bracket construction is used. Where the locomotive turns in from Hudson avenue to the River

Fig. 4—End View of One Truck.

Walk, a peculiar condition has caused a special method of bracket construction. It was necessary for the overhead lie to be so set as not to infringe upon the limit of the next property. Thus at this point the overhead line is suspended from two bracket arms, one 6 ft. and the other 18 ft. long.

The current for the road is taken from the station of the Hudson Electric Light Co.

The Hudson Shore Road is one of the sub-companies of the Hudson Land & Improvement Company organized 52 years ago, under a special charter, by the Stevens family to consolidate their interests in their several Hoboken properties. The present head of the Stevens family, Col. Stevens, is president, and Robert L. and Richard Stevens are respectively first and second vice-presidents; the general manager and treasurer is Palmer Campbell, and the secretary, W. A. Macey.

Hamilton, Ont.—A gentleman has made a proposition to the city council to build an electric railway between this city and Caledonia.

The Hamilton, Chedoke and Ancaster Railway Company are making a vigorous effort to dispose of the balance of the stock, and hope to commence operations at an early date.

Lachute, Que.—The Atlantic and Lake Superior Railway Company, who own the Lachute and St. Andrews Railway, intend to convert it into an electric line and to extend it to Carillon.

HISTORICAL SKETCH OF THE FIRE ALARM TELEGRAPH.

(Continued from page 360.)

One of the most effective remedies proposed for preventing the interference of signals is the system of interlaced circuits, for which J. N. Gamewell received a patent in 1875. In carrying out this method the circuits are run in such a way that no two adjacent boxes are on the same circuit. This is most easy of accomplishment in cities occupying a long but narrow territory. In cities less favorably situated the great amount of wire required to fully carry out this principle has been a bar to its general adoption. An additional advantage derived from interlaced circuits is this, that in case of an open circuit no two adjacent boxes will be out of service at the same time.

If two signal boxes of the non-interference type are pulled about the same time, the one that has precedence by as much as the fraction of a second will transmit its signal while the other will be inoperative. To prevent the loss of this signal, John J. Ruddick invented a signal box in which this is accomplished in a very ingenious manner. With these boxes in circuit any number may be pulled at the same time, and all will respond successively. While this would be an advantage in the extremely rare cases where two boxes on the same circuit are pulled at the same time for two different fires, it would be a positive disadvantage in all other cases where a number of boxes are pulled for the same fire, to have the circuit occupied transmitting unnecessary signals, should the firemen upon their arrival at the fire find a special call or a second alarm necessary.

A problem which has not received an altogether satisfactory solution is how to make the signal boxes readily accessible to anyone in case of fire, and in a way that will not at the same time render it easy to give false alarms.

For this purpose a keyless door on fire-alarm boxes has been somewhat extensively used in the larger cities; these doors are simply closed by a latch and opened by a handle. On turning the handle to open the box, a concealed gong starts to ring loudly and thus attracts attention; this device answers very well for a densely populated section of a city, but in the sparsely populated portions its benefit is not so apparent. Many cases are also on record where persons who opened such doors with the intention of sending in an alarm, failed to pull the hook, being under the impression that the striking of the gong was an indication that the signal was being transmitted.

Other methods, such as placing the key in a small box with a glass front easily broken, and located conveniently to the signal box, or over the keyhole with the key permanently inserted therein, have been tried with more or less success.

A traplock on the doors of signal boxes with keys numbered and the holder's name registered, and where consequently a key in the hands of a malicious person can be used but once, has been found very effective in reducing the frequency of false alarms.

In one of the most original plans proposed, the boxes are placed inside of booths with mechanism so devised that, upon pulling the hook, the door of the booth will close and hold the person giving the alarm a prisoner until released by the proper authorities.

In another invention, for which a patent was issued, the booth was dispensed with, but instead, the box was provided with hidden mechanism which when released by pulling the hook would firmly clasp and hold the wrist of the person sending the alarm. For reasons obvious to everyone but the inventors neither of these inventions ever found its way into public use.

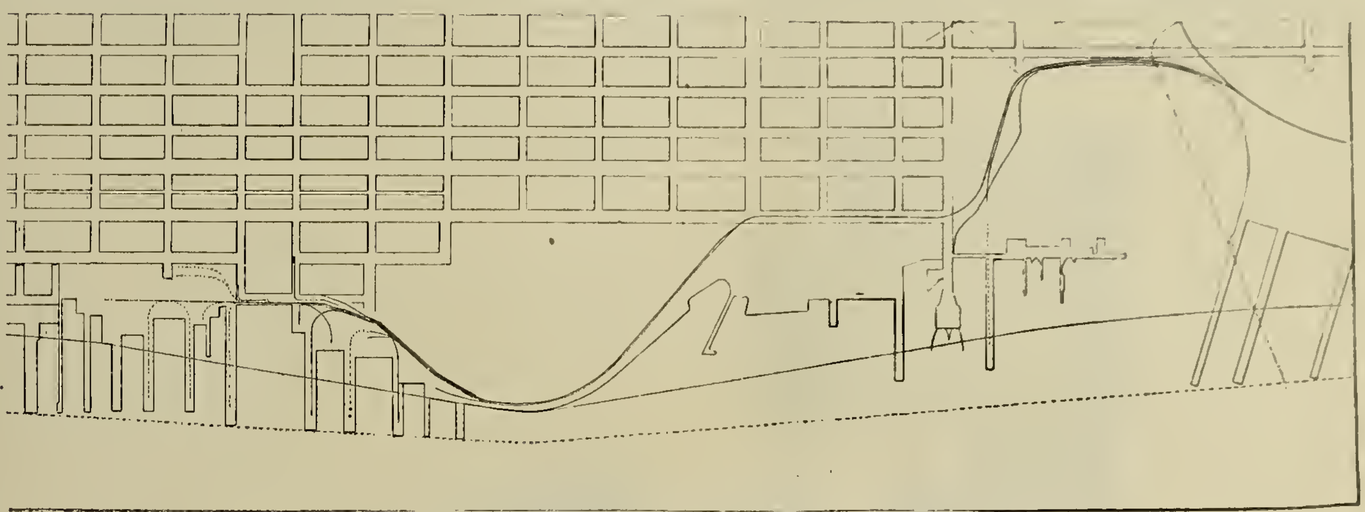


Fig. 5—Map of Hoboken Shore Road.

A not inconsiderable share of the unreliabilty of the fire-alarm telegraph in its earliest stages must be ascribed to the source which supplied the electrical energy. The Grove cell then used was not well adapted for service on a fire-alarm telegraph, where uniformity of current strength is such an essential requirement. The Daniel cell, by which it was succeeded, was much more satisfactory, and was generally employed up to the year 1871, when the Callaud or gravity cell was introduced. The superior merits of this cell were soon recognized, and in a very short time every fire-alarm telegraph was equipped with it. For over twenty years it was the only cell used for this service. Within the last two or three years, however, it has been superseded in a number of places by the storage battery, with very satisfactory results.

In one instance the gravity cell has been replaced by the dynamo. Superintendent Brown Flanders, of the Boston Fire-Alarm Telegraph, about five years ago applied the dynamo current to a single circuit. Its application was gradually extended, and at the present time the entire plant is operated by dynamos.

The automatic repeater invented by Edwin Rogers was gradually improved by him, as well as by the labors of J. N. Gamewell and Moses G. Crane, until it has become an apparatus of almost absolue reliability. While a signal from any one circuit attached to this repeater is being transmitted, all the other circuits are mechanically locked out, and thus confusion is prevented should a box on any other circuit be pulled at about the same time. It is also provided with a device whereby the armature of the operating electro-magnet is mechanically restored after each break of the circuit, and little more, therefore, is required of electricity than that it should hold the armature in position; consequently it will perform its functions successfully under greatly varying conditions of current strength, a very important consideration in an automatic system, where constant attention cannot be given to the care of the battery or the adjustment of the apparatus.

The electro-mechanical gongs have also been greatly improved, and nearly all are provided with armature-restoring devices, and for the use of fire departments, where the men are not permanently in their houses, they are provided with indicators which expose the number of the signal in large figures.

The general plan of a modern central office fire-alarm system still resembles that outlined by Dr. Channing, fifty-two years ago; but in the instruments and apparatus used most wonderful improvements have been made.

In the modern central office the Morse register has been replaced by the multiple pen register, which has the merit of greater compactness, and may accommodate both the signal and alarm circuits, with this advantage, that, as the records are printed in parallel lines on the same paper, their relative positions will indicate, to a second, the time elapsed between the reception of the signal from the box and its transmission to the engine-houses; it thus also incidentally serves as a record of the degree of promptness with which the operator has attended to his duties.

The old keyboard, at an early period, gave way to a dial transmitter still in use in several cities. In this apparatus there is a separate dial and index for every digit in the number to be transmitted. On receiving a signal from a box, the operator moves the indexes to the respective figures and starts the clockwork into action.

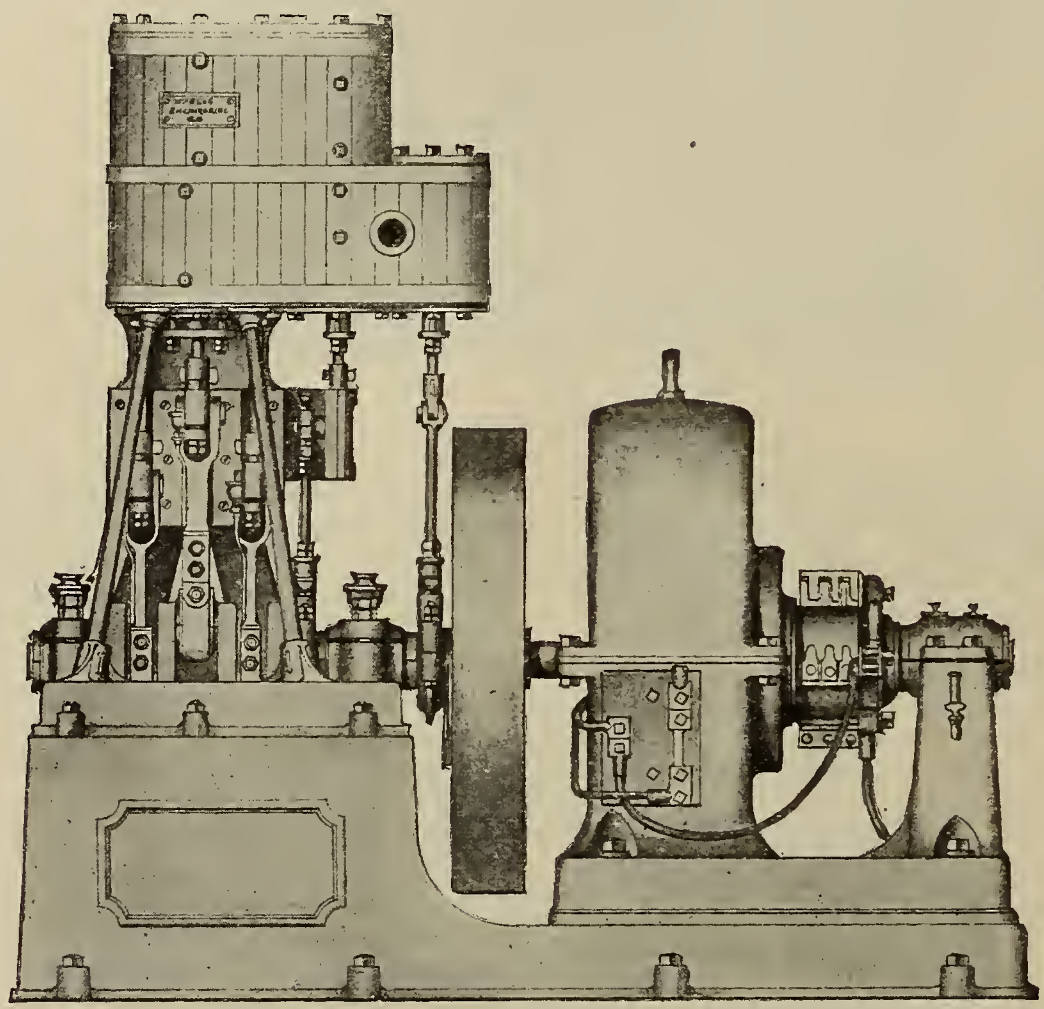
Another method, and one still in use in New York city, is to have a duplicate break-wheel for every signal-box number in the system. The operator, on receiving a signal of fire, selects the corresponding wheel and inserts it on the wheel shaft of the transmitter.

In one of the most improved modern transmitters the dials are all placed on the same shaft; the first dial on the shaft is stationary, and has engraved upon it the figures from one to nine, in as many series as there are movable dials; the other dials simply have apertures which in operation are turned so as to expose the numbers to be transmiited. This apparatus is manipulated with great rapidity, and as only the numbers to which the apparatus is set are exposed to view, the liability to error on the part of the operator is reduced to a minimum.

The testing clock of the original Boston central office has been succeeded by an automatic testing apparatus of excellent design and beautiful workmanship, which indicates and makes a record of the condition of the circuits at stated periods of time.

The best practice demands that there should be two separate circuits to communicate alarms from the central office to the engine houses, so that in case of trouble on one circuit the alarm may be received on the other.

In central offices equipped with new apparatus within the last few years every safeguard is provided to prevent mistakes in the transmission of alarms. With the first blow on the gong from a box signal a cylindrical indicator revolves and exposes the number of the circuit from which the signal is being received, as well as the number of every box on that circuit. The operator may, therefore, while counting the signal set the transmitter and, with one glance at the printed record of the register and another at the circuit indicator, verify its correctness and have the alarm in process of transmission within five seconds after the completion of the first round from the box.



Wells' Balanced Compound Engine and Bullock Generator.

WELLS' BALANCED COMPOUND AND QUADRUPLE EXPANSION ENGINE.

There is no field of desired improvement that has been more industriously worked within the past century than that of the steam engine. While its valve gear, material and workmanship have been vastly improved, the Wells system of the Wells Engine Company, 136 Liberty street, New York, represents the first and only improvement in its principle which justly entitles it to the distinction of being the most economical, durable and compact ever constructed. The important advantages derived from a balance of forces in the steam engine were practically unknown until demonstrated by this system, for the reason that all engines constructed with a "balance" in view embraced grave mechanical objections. Hence the single-acting "unbalanced reciprocating engine is the only system that has proved to be of any value. While the Wells engine embraces all of the desirable features of the most approved type in general use, it contains none of its objections. It is double-acting and so designed that all forces acting in the high-pressure cylinder are held in proper position by the forces acting in the low-pressure cylinder, producing a perfect balance around the crank-shaft, and preventing vibration and the escape or loss of power that in all other engines is thrown off through the frame into foundation.

An important feature is the balancing of steam pressures, which is not contained in any other engine. Steam is admitted to both cylinders simultaneously; during the first stroke the steam pressures upon the middle cylinder-head are exerted against each other; the force acting upward in the high-pressure cylinder becomes the support of the force acting downward in the low-pressure cylinder. In the return-stroke the pressures are exerted upon the top and bottom cylinder-heads in opposite directions, giving a balance of pressures within the cylinders—a condition that applies to no other type of engine, as no strains are communicated to the frame and bed-plate.

The high and low-pressure pistons, with their connections, being equal in weight and attached to opposite ends of the levers, moving in opposite directions in the same plane, the thrust of one is perfectly counteracted by the other, permitting any speed without vibration, with minimum wear.

The force of the steam applied to the high-pressure piston descending upon one side of the shaft is balanced by the force of the steam applied to the low-pressure piston ascending upon the other side, leaving only the weight of the crank-shaft and its connections to be carried by the main bearing-boxes.

Each motion in this engine has a corresponding opposite motion, producing a perfect balance at all angles of the cranks, at all speeds. By this arrangement no strains escape from the cylinders, and the connecting rods and cranks become the sole transmitters and controllers of all outside forces. It also transfers the fulcrum from the main bearing boxes to the centre of the shaft, where the two forces are united and meet the resistance of the load. The weight and forces being equally applied to opposite crank-pins moving in opposite directions in the same plane, the cranks become the beams, or levers of balance, and there being no weight of parts to be lifted and no friction due to steam pressure to overcome, the steam forces applied to the pistons and the momentum forces stored in its moving parts are all transformed into crank motion. Its absolute control of these forces for useful effect greatly increases the power of the engine. It also gives uniformity of motion, its forces being equal around the circuit of the shaft; they are given out in the crank-arms when the steam forces are diminishing as the pistons are approaching the end of the stroke, acting the same as an ordinary fly-wheel in carrying them over the centres, producing a rotary motion. While the weight and momentum of the reciprocating parts in all other engines retard the motion of the shaft and robs the engine of its power, by this method the motion of the shaft is accelerated.

Compared with the best "compound" engine in use, this principle shows in practice a gain of 25 per cent. in power, and as a simple "compound" it more than equals the economy of the best type of triple expansion.

Compared with the best type of compound engine in use it occupies one-half less space and is more simple, as it has one less frame, two main bearings in place of four, one-half less valve gear, and is one-third less weight; and compared to a triple expansion, which it more than equals in efficiency, the space occupied and its weight are still further reduced, while its simplicity is increased. Quadrupled it occupies no more space than the usual type of fore and aft compound, and is equally simple.

W. C. VOSBURGH MANUFACTURING CO., (Limited), manufacturers of gas and electric-light fixtures, 269 to 281 State street, Borough of Brooklyn, City of New York, N. Y., H. C. Beck, president. John Nix, vice-president; F. L. Strickland, treasurer; Chas. Chas. H. Littlefield, secretary. Western Branch: 114–116 Wabash avenue, Chicago, Ill., has been awarded the contract for the lighting fixtures required for the Hudson Building, 32 Broadway, Manhattan Borough.

THE BEST METHOD OF SETTLING DAMAGE CASES AND THE PREVENTION OF ACCIDENTS BY THE USE OF FENDERS OR OTHERWISE.

(Continued from page 14.)

3. Carefully drawn, explicit rules for operating cars made with due regard to the various local conditions should be rigidly enforced and intelligently observed.

4. Speed on various lines should be regulated according to the chances of accident presented.

5. Every car should be equipped with the best controlling apparatus, gong and headlight, and also be provided with such devices for the prevention of accidents as may seem practical.

By this last statement several good devices for the prevention of accidents are rather indefinitely referred to, among which the fender and the safety gate should be placed at the head. Experience has shown that the fender is seldom a nuisance and is frequently of great value. A simple type will be found to be very practical which, while it does not insure against injury, yet very often prevents serious results. The dropping or lowering of the fender is seldom of any benefit, as motormen are generally too much occupied in stopping their cars when a collision is imminent to pay attention to the fender. In many cases where the speed of cars has been reduced from a fast to a slow rate the fender will pick up with no harm resulting persons who without it would surely go under the car. Where the collision occurs while the car is under great speed, serious injury is not unlikely, but even in these cases loss of life and limb may frequently be prevented and money saved in the long run.

The safety gate, with which all motor cars in Minneapolis and St. Paul are equipped and which was not generally approved upon its introduction but a few seasons ago, has demonstrated its great value and practicability by almost annihilating those accidents which occur through boarding or alighting from cars. The danger of these accidents increases with the number of passengers carried and on nearly every road they cause a large part of the injury and damage expense. They present to the fakir the best opportunity for making a case, and always give the jury a good chance to give the plaintiff the benefit of a doubt. The safety gate is practical for any city. In fact, we have seen its best use when our road was earning over three times its ordinary receipts. With it the conductor has but one part of his car to watch while giving the starting bell, and in case there is reason for passing persons at crossings, there is no danger from their trying to board the moving car. It also affords protection to people standing on the rear platform in case of a car rounding a curve at high speed, or on other occasions, when a passenger through his own condition or carelessness, or the operation of the car, is liable to fall off.

As the gate is operated by the motorman it should never be opened until the car is at a standstill, and should always be closed just before the power is applied for starting. After the public becomes accustomed to the safety gate, its operation demands no change of running time from that used before its introduction. The most timid, whether old or young, will walk without fear to the gate while the car is stopping, and thus take but little time to alight. The gate is also of great service in handling large crowds at the parks where people seem to lose their common sense, as well as all ideas of propriety, and try to board and hang on to cars regardless of the danger involved. In such instances the value of but one entrance to the car is quite obvious, as at any moment the crowd may be checked by the closing of the gate and the car started.

The value of both fender and safety gate can best be understood by closely watching their use. Both are eminently useful and practical. Both have also a good moral and instructive influence; they caution both the public and the trainmen against accident, and also cause the community to realize that a soulless corporation has some regard for the life and property and sincerely desires to avert accident to them. They also give to the trainmen an assurance in operating the cars, which is of itself of considerable benefit.

Screens for the side of cars (when the trolley posts are between the trucks), sand boxes always filled with sand, and many other devices are also of considerable importance, and tend, each in its way, to reduce the number of accidents to the minimum. It is not possible, however, to operate cars entirely without accidents, and in studying the problem we should not look for perfect results.

The above presents roughly a few ideas suggested by long experience after trying nearly all the remedies known, and gives one the firm opinion that it is essential, so far as possible, to have the best equipment, including practical safety devices and the best men obtainable for operating the cars and for the claim and other departments, governed and aided by the best rules and supported by the best policy.

Wesson, Miss.—R. S. Purser has been awarded contract for electric light plant.

ELECTRICAL SHOW.

Interest in the next Electrical Show to be held in Madison Square Garden in May has already gone beyond the electrical into the kindred trades, and is surprisingly strong in oll branches of the railway business. Everybody remembers the splendid success of the show in 1896.

The exhibitors themselves were paid many times over in business for the cost of their respective exhibits, and the best evidence of this fact is in the early demand from former exhibitors for increased allotments of space. Contracts are already in for more than one-half of the total space sold in 1896.

Railway apparatus and supplies people will get their first real good chance in 1898 show to demonstrate what is being done in those lines. The changes in motive power now being made by street railways in and around the city, and interest taken in electric traction by short steam roads will have a double effect; they suggest to the trade that the active demand for apparatus and supplies will bring to the show great numbers of buyers. The second effect will be a stimulating of public interest in the new modes of generating and applying power to street railways.

From interest already taken in it by the trade, it is evident that the illustration of the various apparatus and supplies will be complete, varied and interesting, and public interest in those things will no doubt lead the

Madison Square Garden, Electrical Show, May, 1898.

The Electrical Age.

Established 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2 50
One Copy, six months,	1 25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

First Floor, World Building.

NEW YORK.

NEW YORK, JANUARY 8, 1898.

CONTENTS.

THE RAPID SPREAD OF ALTERNATING-CURRENT MACHINERY.

It is not so very many years since the use of electricity was limited to a few progressive and somewhat ambitious centres of civilization. It was regarded as a luxury of a doubtful nature, and its vast application and huge possibilities remained hidden until the inherent force of spontaneous development gradually unfolded its brilliant future. Since Jablochkoff lit Paris with his electric candle, fed by an alternating current, many widely separated attempts were made to give prominence, not only to this method of lighting, but to the machinery and system from which its power was derived. Those that have seen the twin growth of the two great and parallel systems of lighting and power distribution quickly realize that one would soon outstrip the other in the fight for precedence. But, although a temporary victory lay in the hands of those that had invested their capital and time in the interests of continuous-current machinery, it was soon evident that great attention was being given and earnest efforts made, to solve the new problem—the distribution of power by alternating current. The peculiarly flexible nature of an alternating-current system has appealed to the engineering instincts of many capable men, but the lack of means to properly develop mechanical energy at the end of a power circuit without the use of auxiliary appliances, set back the period of development a great many years.

Nikola Tesla in America, and Dobrowolsky in Europe produced their systems of two and three phase distribution, which in combination with the polyphase motor soon gave rise to a new spirit of enterprise and quickly brought the alternating current forward as an equally able and valuable means of distributing light and power.

The simplicity and ease with which the pressure is raised or lowered, the lack of complication and absence of a commutator in the alternator and the cheapness of construction of the alternating current motor undoubtedly proclaim the alternating current system one of enduring qualities.

The rapid spread of alternating current machinery has become very apparent in the closing years of this century. It leads us to anticipate a time when the application of alternating current will be made by traction companies for city and surburban use. Every available source of water power will perform its real function of sending some of its leaping force into the distant home, serving there as a willing servant, though unrestrained and free in the country hills. Some of the greatest of western mines owe their prosperity to the conjoint application of water power and the alternating current. A mine only becomes productive and valuable when labor is spent upon it, but when a fund of energy awaits the touch of a skilful hand and may be guided through a sinuous line to some adjacent mine, then the earth gives out its treasures without delay and yields to those that fathered such an enterprise munificent dividends, that pour in with undiminished regularity.

UNDERGROUND ELECTRICAL CONDUCTORS.

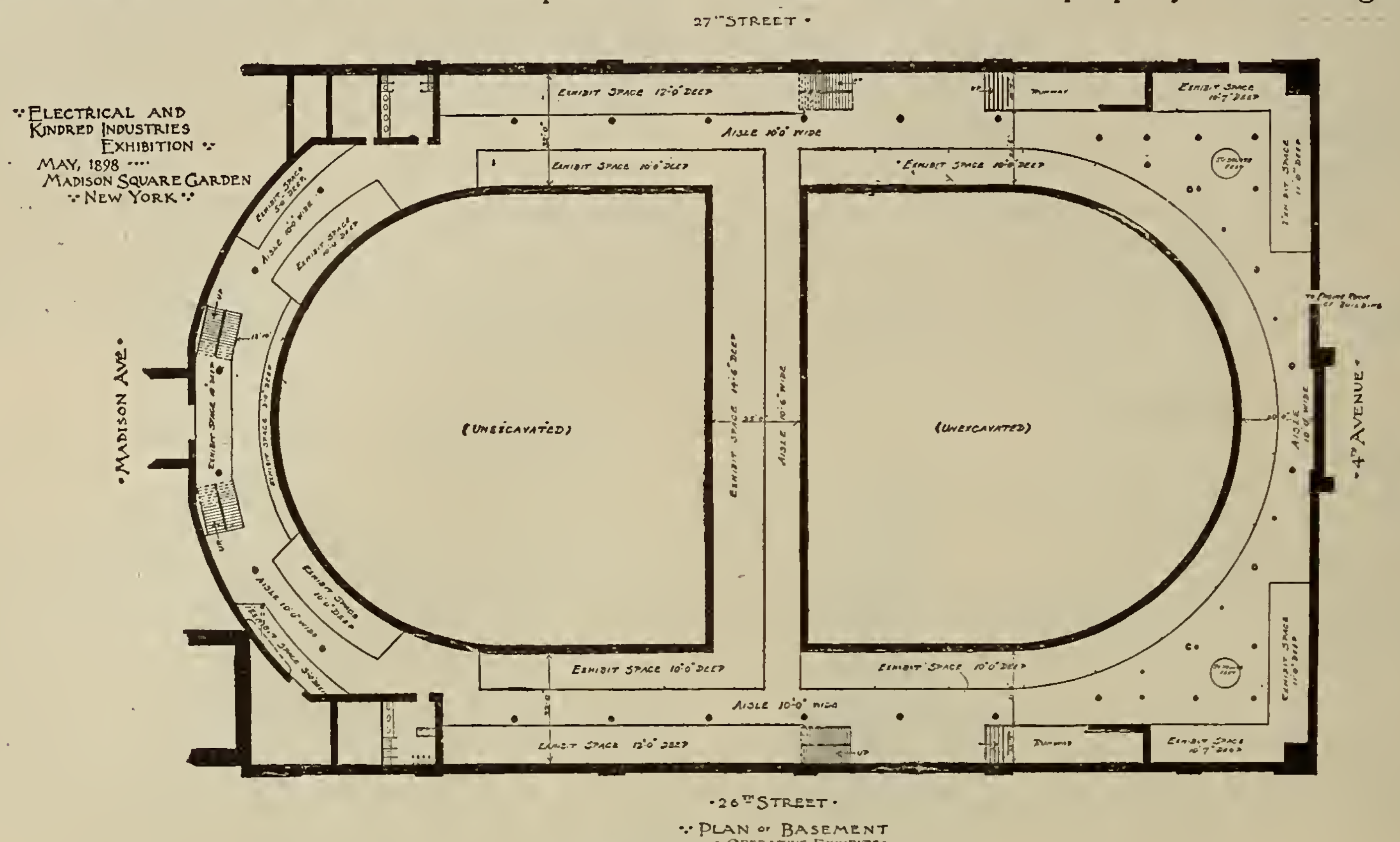
The new rules and regulations relating to the installation of wires in buildings or streets may be found in the charter of the City of New York. The statements there refer to the qualifications of an inspector of electric wiring, the removal of electric wires and underground electrical conductors. For the benefit of our readers we will insert section 582, relating to conductors placed underground: "Whenever the said Board of Public Improvement shall deem it desirable and practical after hearing all parties interested that the electrical conductors in any street, avenue, highway or public place, of the City of New York, lying within the boroughs of Brooklyn, Queens and Richmond, be placed underground, the said commissioner shall notify the owners or operators of the electrical conductors above ground in any such street, avenue, highway or public place that said electrical conductors shall be placed underground within a certain time, to be fixed by the said commissioner, which said time shall be sufficient for the proper construction of underground conduits or other channels in said street, avenue, highway or public place. Whenever any duly organized company, operating or intending to operate electrical conductors in any street, avenue, highway or public place, in that part of the City of New York which lies within the boroughs of Brooklyn, Queens and Richmond, shall desire to place its conductors or any of them underground, it shall be obligatory upon such company to file with the Commissioner of Public Buildings, Lighting and Supplies, a map or maps made to a scale, showing the streets or avenues or other highways or public places which are desired to be used for such purpose and giving the general location, dimension and cost of the underground conduit desired to be constructed. Before any such conduit shall be constructed it shall be necessary to obtain the approval by said commissioner of said plan of construction, so proposed by such company, and said commissioner shall have power to require that the work of removal and of constructing every such system of underground conductors shall be done according to such plan so approved."

The above facts will probably be of direct interest to electric light companies or such corporations as intend to place wires, extending through suburban districts, underground. We will add a short note regarding the duties of the consulting engineer, appointed by the mayor of Greater New York, as found in section 574: "the consulting engineer of lighting and electricity shall, when required by the commissioner of public buildings, lighting and supplies. examine problems arising from the use of gas and electricity and steam, affecting public interests in said city, from time to time, and shall report thereon to the said commissioner from time to time as he may be required. He shall recommend to the said commissioner proposed ordinances for the use and control of gas and electricity and steam, which the said commissioner may submit to the Board of Public Improvement and he shall perform such other duties as the said commissioner may from time to time require."

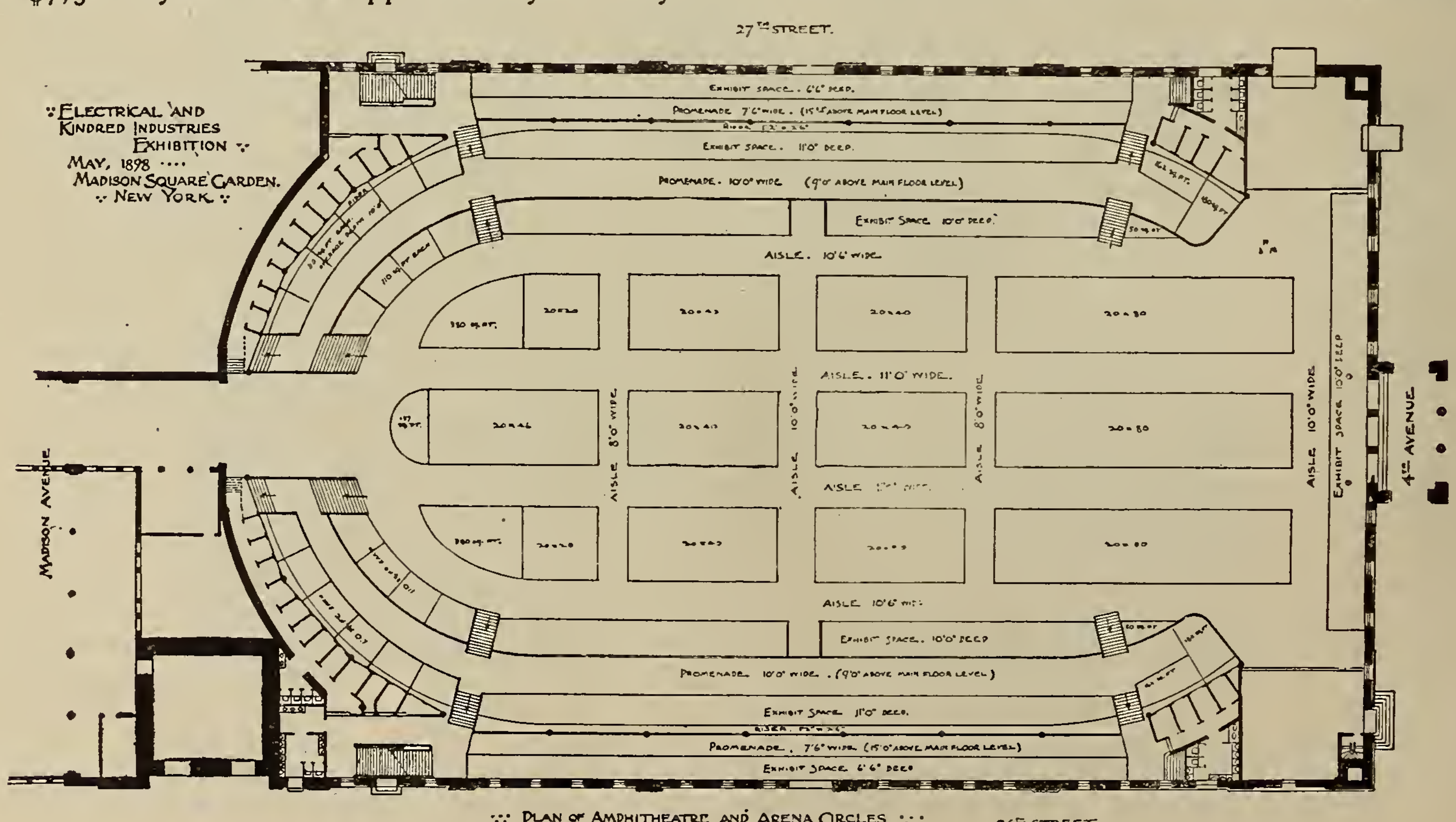
It may be interesting to some of our readers to become acquainted with the fact that the head of the department of public buildings, lighting and supplies receives a salary of $7,500 a year. He is appointed by the mayor.

teresting plant and only one entrance by an obscure stairway from the main hall, it proved to be a feature of public as well as trade interest.

Enough interested people found their way to it to make it profitable to the exhibitors. In Madison Square Garden not only the exhibit will be larger, more varied, more interesting, but it will be more accessilbe. There will be at least four entrances from three sides of the building, and the care and skill in placing the exhibits, pointing out the features and properly advertising them, which made the last operating exhibit successful, ought to make this one at least four or five times as successful.



Madison Square Garden.



Plan of Electrical Show.

ELECTRICAL SHOW—Cont. from page 20.

newspapers to give this feature of the show a great deal of notice.

The accompanying diagrams show a proposed arrangement of exhibits in the amphitheatre of the Garden where apparatus, supplies, etc, will be located, and the basement in which will be the generating exhibit and steam specialties.

It seems proper to say a word about this generating Exhibit. In the old building, with a smaller and less in-

THE MEASUREMENT OF CURRENT.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

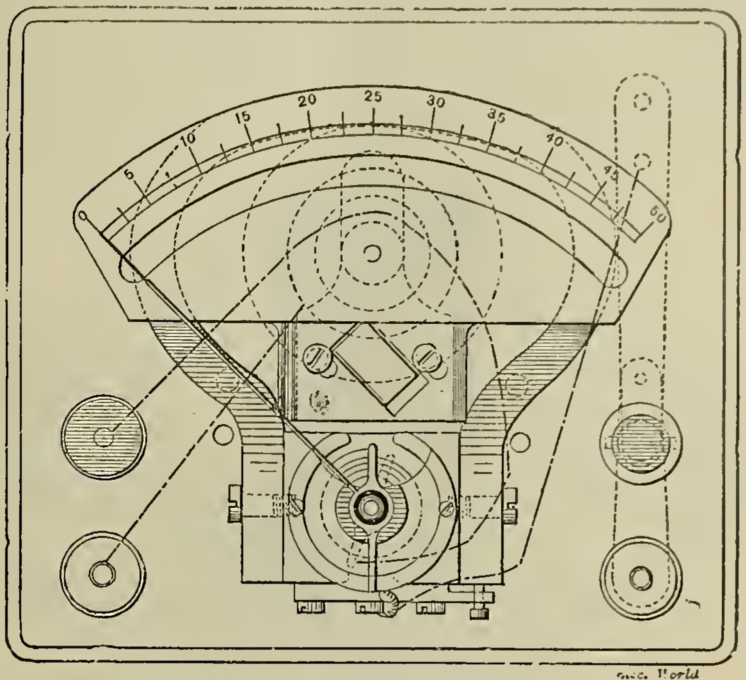
The flow of a current of electricity is directly due to the existence of an electric pressure in a wire. Although the evidence of its existence is not such as to give the same impression as would be received by viewing the steam gauge on a boiler, or the barometer of an air-pump, the reality of its presence soon becomes firmly established in the observant mind.

The forms of apparatus used for the purpose of measuring an electric pressure may be subdivided into three general groups,

Electro-Thermal,
Electro-Static,
Electro-Magnetic.

A spiral spring of high resistance material might be used; when the current had caused it to become perceptibly heated the elongation of the spring would become visible by its tendency to untwist. If one end be rigidly held the other could move a pointer, and thus perform the function required of it—the registration of different pressures.

The great object to be held in view in the construction of voltmeters should be their high resistance. The striking difference always noticeable between current and



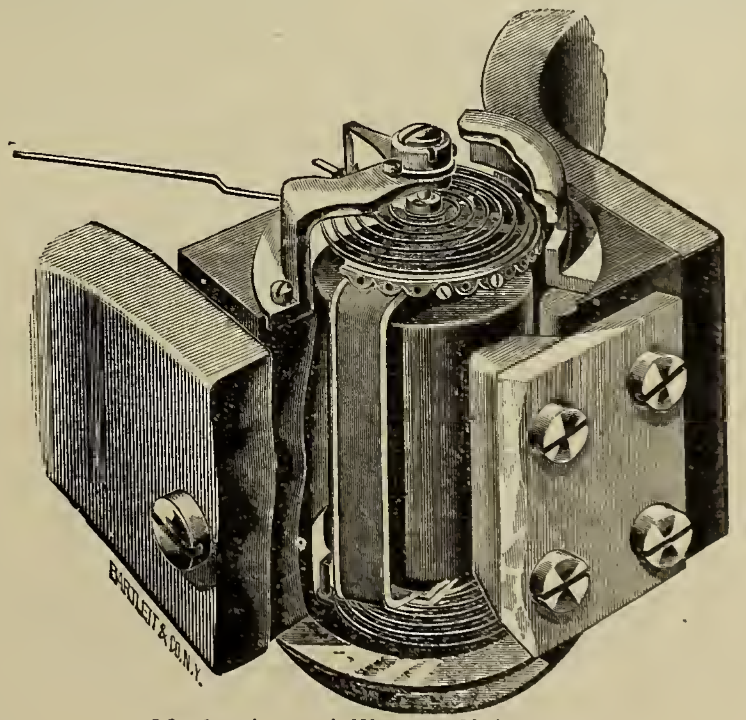
Connections of Weston Voltmeter.

The electro-thermal voltmeter is one in which the expansion and contraction of a metallic body causes a dial or pointer to move by the agency of some intermediate mechanism. The elongation of the wire is caused by the current, which can only increase or decrease when the pressure does likewise. Practically all current carrying voltmeters are of high resistance, and in this case there is no exception.

pressure measuring instruments is the very low resistance of the one and the extremely high resistance of the other.

Electrostatic instruments that measure volts do so without the consumption of any current.

If any electric circuit be broken and the extremities examined, they will be found individually to possess a positive and negative charge. These terms are merely relative expressions for the potentials existing between


Mechanism of Weston Voltmeter.

The best known type of instrument utilizing this principle is the Cardew voltmeter. A long wire of high resistance is strung between two pulleys, a pointer placed in front of a graduated dial is attached to one of them; when the wire stretches, due to the influence of the current, the little pulley over which the wire passes rotates and assumes different positions dependent upon the extent to which the wire has expanded.

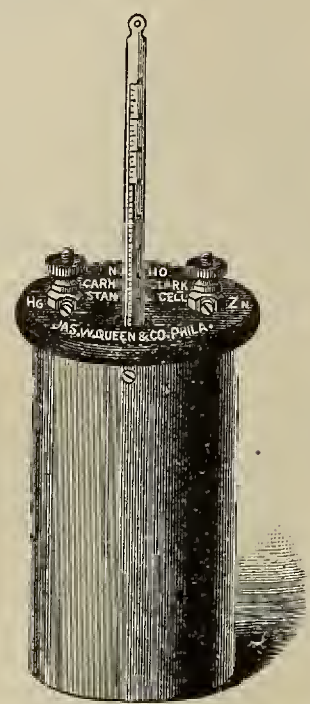
By sending in known currents of increasing strength the positions of the pointer may be permanently marked for future measurements; the voltmeter is then said to be calibrated.

two points. An electrostatic instrument therefore simply indicates this condition and measures the difference of potential.

The electrometer which serves the above purpose acts upon a very simple principle. If two oval-shaped pieces of metal be placed at right angles to each other, one insulated and tightly held and the other suspended above the first by a silken thread, the following will occur:

By charging one positively and the other negatively, the upper one will be attracted out of its position and try to assume a new one directly above the stationary plate. The greater the charge on each, the greater the attraction exerted between them. By attaching a light pointer to the movable plate, or a mirror throwing a beam of light on a scale, the deflection can be accurately observed.

The laboratory instrument is the quadrant electrometer, while that employed for practical pressure measurements is the electrostatic voltmeter. As both depend upon the same principle, the only difference lies in their respective delicacy of construction.

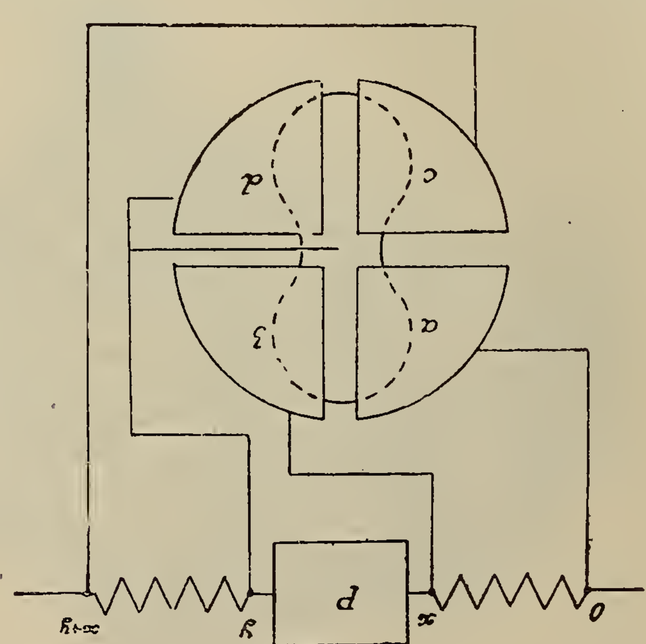


Standard Cell.

The quadrant electrometer consists of four quadrants lying in one plane and insulated from each other by supports of glass. A metal needle shaped like two opposite blades of a four-bladed fan is suspended above by a fine fibre. A mirror attached to the thread and a scale in front for observing the deflection complete the outfit. Two opposite quadrants and the needle are charged positively and the other two quadrants negatively from the circuit whose pressure is to be measured.

The electrometer was reduced to two long-shaped plates placed vertically, and between them on two light pivots swings the needle with a pointer attached. A small weight holds the needle at zero when readings are about to be taken, but do not prevent the two fixed plates from attracting it out of a perpendicular position where both they and it are oppositely charged. The weight can be changed, and thus increase or decrease the range of the instrument —a heavier weight requiring more difference of potential to move it than a light one. Thus the same scale can be used for hundreds or thousands of volts. The two fixed plates, though in a vertical plane, are inclined in position, the needle being held perpendicularly between them until acted upon by the electrostatic attraction of the two parallel plates.

A quadrant electrometer can measure a very small difference of potential, a fraction of a volt from $\frac{1}{10}$ to $\frac{1}{50}$ being accurately determined.



Connections of Electrometer.

The result is:

Volts = constant × square root of deflection.

The constant can be found very easily by applying a known number of volts and noting the deflection, because

$$\text{constant} = \frac{\text{volts}}{\text{square root of deflection,}}$$

thus giving it for future use.

The development of the electrometer into a direct reading voltmeter was effected by Lord Kelvin in an interesting manner.

An electrostatic voltmeter is used for very great pressures, their range including five or six thousand volts. An electrometer possesses the great advantage of being able to measure the pressure of an alternating current, although, to do so, the ordinary connections must be somewhat changed.

The electrostatic voltmeter can be immediately used for this purpose without change, as the reversals of potential do not destroy the attraction existing between plates and needle, whether the needle be positive and the two plates negative, or the needle negative and the two plates positive.

Electro-Magnetic.—A difference of potential can be measured by the electro-magnetic effects produced in a coil of wire, provided the general adjustment of parts be such as to enable the changes that occur to become evident. Those of the last named type have made use of the electrostatic force and do not depend upon a flow of electricity to produce readable effects; in this respect there exists an essential difference between them.

The simplest form of instrument by which an electric pressure can be measured consists of a coil of wire that attracts a soft iron core. The resistance of the coil is very high, being made of fine wire, and an additional resistance sometimes added in the form of a reel of german silver brings the resistance up to a very high point. A dial placed in front of an arm actuated by the moving core can be easily calibrated by the application of a series of known pressures, each being individually marked on the dial as the needle or pointer shifts, due to their influence.

A galvanometer can be used for the purpose of measuring great differences of potential by utilizing a shunt in connection with it.

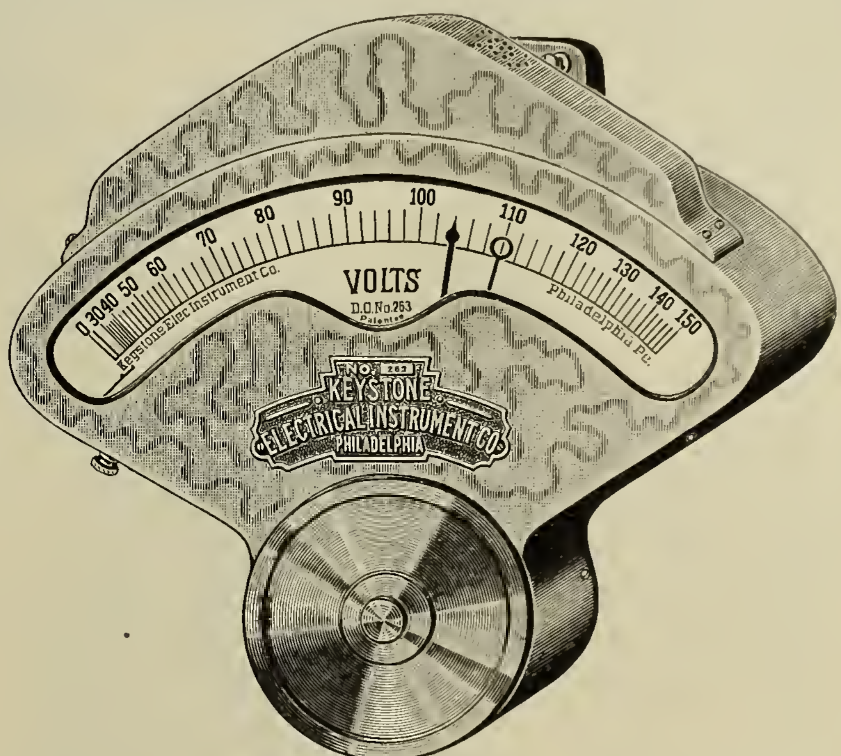
Great use of the standard cell has been made in test work of the finest kind. This is simply a very well made primary cell of constant E. M. F. at a certain temperature. The two generally known in laboratory practice are the Clark and Carhart cell. The deflection obtained on a galvanometer with one of these and a fixed resistance and shunt can, by comparison, be made the basis for further calculations with greater pressures under the same conditions.

Weston Voltmeter.—A voltmeter of well-known make is that invented by Edward Weston. It is built upon the principle of the D'Arsonval galvanometer, and for accuracy and reliability stands unequalled. It is inherently a galvanometer, but of so practical a construction that in spite of its delicacy it can suffer rough usage before becoming injured to a perceptible degree.

It is to be remembered that the ordinary type of galvanometer consists of a fixed coil and a movable magnetized needle. In the above instrument, however, these conditions are reversed. Instead of a small magnetic needle subject to the influence of a thousand disturbances, there is a heavy steel horseshoe magnet whose extremities are hollowed out to receive a small coil of fine wire mounted on pivots. Two watch springs convey the current to the coil, one being connected to each end of it, though insulated from each other. The current after traversing this coil passes through a series of finely-wound reels of german silver wire of exceedingly high resistance.

The metallic drum around which the coil rotates prevents any unsettled swing, thus rendering it dead beat. The magnet is rigid in this instrument, and the coil swings freely in contradistinction to the last and more familiar style of ordinary galvanometer.

A pressure can be measured by a system of comparison, as follows: A known high resistance is connected between two points, the difference of potential between which is to be measured. A standard cell and galvanometer are then connected to it so that their respective currents tend to flow in opposition. When a point in the high resistance is reached at which no deflection takes place, the pressure from the cell and the difference of potential between the extremities of that portion of the high resistance balance. Supposing the standard cell to be two volts and the resistance creating this equilibrium between its ends twenty ohms, there will then be as many times two volts in the wire as twenty ohms are contained in its entire resistance. Were the entire resistance of the wire one thousand ohms, the difference of potential existing between its ends would be one hundred volts.



Keystone Voltmeter.

Drop of potential is ascertained in a very simple manner worthy of notice.

When a known current is passed through a wire of known resistance, the fall of pressure throughout the wire can be at once calculated by the rule:

Drop of potential = current × resistance. The pressure at one end of the wire will vary from that of the other end by that difference. In order to make this method of avail an ammeter must be used and the resistance of the wire carefully determined.

In shop practice, where an ammeter is the only accessible instrument, a definite number of feet of copper wire will use up a pressure that is not great. The resistance of the wire per thousand feet is given in catalogues of wire manufacturers. The current passing through it will complete the data necessary, and the calculation can be made

with 1,000 feet No. 10 wire = 1 ohm,
with 30 amperes flowing.

$$\text{Drop of potential} = 1 \times 30 = 30 \text{ volts.}$$

Many interesting problems arise from a study of the drop of potential in a wire. The system of subway distribution, the network of circuits to be supplied to a house, are all built upon the basis of a certain estimated drop from point to point. And the illumination within depends entirely upon the care with which such considerations are made.

Thus the methods above outlined contains the essential principles depended upon for any reliable result in the measurement of pressure.

Electromotive force and difference of potential differ in this respect from each other. The inherent cause of electrical phenomena is due to the presence of a current or charge, but an electromotive force has given rise to the current by establishing a difference of potential between two points, thus allowing a flow of electricity to occur when the circuit is completed. In a cell of battery there are electromotive forces at work within the cell creating a difference of potential outside, by whose means a current can flow if permitted.

Thus electromotive force may be looked upon as the prime cause from which follow the subsequent effects of difference of potential and a current of electricity.

The volt is a unit of pressure. It will send a current of one ampere through a resistance of one ohm.

It is defined in other ways by reference to a magnetic system. The unit of electromotive force is that which is created in a conductor moving through a magnetic field at such a rate as to cut one unit line per second.

This definition has practically been adopted by all as the basis of the volt. The volt, such as considered in practice as a unit, would be equal to that electromotive force generated within a conductor cutting 100,000,000 lines of force per second.

Some molecular action within a wire sets up a disturbance whose effects are heat, magnetism and electricity; when the agitation becomes extreme, the heat accumulates with too great a rapidity for instant radiation and the phenomenon of light appears in all its gradations. The original cause of such effects is an electromotive force free to display its activity in so striking a manner.

QUESTIONS FOR REVIEW.

(1) The measurement of pressure is possible by what form of apparatus ?
(2) Describe the electro-thermal voltmeter ?
(3) Explain the action of the electro-static voltmeter ?
(4) What is a quadrant electrometer ?
(5) Upon what principle does the Weston voltmeter operate ?
(6) (a) What is meant by drop of potential ?
(b) What is a volt ?

E. P. MORRIS, the manufacturers' agent of electric light and railway supplies, 15 Cortlandt street, New York, is the selling agent for the Keystone Electrical Instrument used in the reading columns of the January 8 number.

MR. SEYMOUR, of PASS & SEYMOUR, manufacturers of porcelain, incandescent electric-light fittings, switches, cut-outs, etc., was in town this week at Mr. F. M. Hawkins' office, 39 Cortland street, their Eastern agent. Mr. Seymour is exhibiting a new porcelain socket made specially for Edison base lamps. The lamp can be inserted the same as in a Westinghouse or T. H. base and can be unscrewed or screwed in the same as an Edison socket, only the metal part is slotted as in the above sockets. The bottom of the socket contains a spiral spring, so that in case the lamp should loosen, as it sometimes does in an Edison socket, you will always have current and light.

THE HAZELTON BOILER COMPANY, 716 East 13th street, New York City, call their new catalogue "The Generation of Power," and justify the title by giving, in addition to the description of the boiler, a number of useful tables and articles on the combustion of coal, generation of steam, feed pipes, etc. The boiler and its features are clearly described and illustrated.

Many improvements have been made in this boiler, which not only increase its efficiency but also improve its appearance. The tubular matter in this book has been well selected and carefully edited, and is taken largely from the works of well-known authorities on this subject. It will be sent on request.

MESSRS. FOSTER & LOUIS, contractors, Fisher Building, Chicago, have sold their contract for the building of the Holland, Mich., electric railway and lighting plant to Messrs. H. B. Black, I. E. Cockran, Jr. and Mr. Powell, all Chester, Pa., capitalists. At a recent meeting in Chicago of the Holland & Lake Michigan Railway Company, Messrs. Humphrey, Larsons and Ferguson were succeeded by the election of new officers, as follows: Mr. H. B. Black, president; Mr. Powell, treasurer; I. E. Cockran, Jr., secretary, at which time the stock and bonds were also turned over to the new organization. The city of Holland has extended the franchise which expired January 1, 1898, to June, 1898. This road when completed will be seven miles in length and will operate between Holland at the head of Black Lake and Ottawa Beach and Mackatawa Park, well known Michigan summer resorts. The grading, bridges and power house are all completed, and the machinery is on the premises. It will take some four or five weeks to complete the road ready for operation.

THREE DIPLOMAS OF MERIT to one concern shows pretty well what the judges of the Tennessee Centennial Exposition (held at Nashville in November), think of the Robertson-Thompson Indicator, Lippincott Planimeter and Eureka Packing. Jas. L. Robertson & Sons, New York, entered these three articles and inform us they were awarded these prizes. They say if engineers and steam users would send for illustration, and descriptions of these goods, it would not only be of interest, but profit.

THE ONE HUNDRED AND EIGHTY-FOURTH MEETING of the New York Electrical Society, will be held at the College of the City of New York, 23d street, and Lexington avenue, on Wednesday, January 12th, at 8 P. M.

Mr. S. Dana Green will read a paper on "The Relations Between the Customer, the Consulting Engineer, and the Electric Manufacturer."

It will be the aim of Mr. Green, in this paper, to assist in bringing about that better understanding between these departments of the industry, on which much of its prosperity and welfare depends.

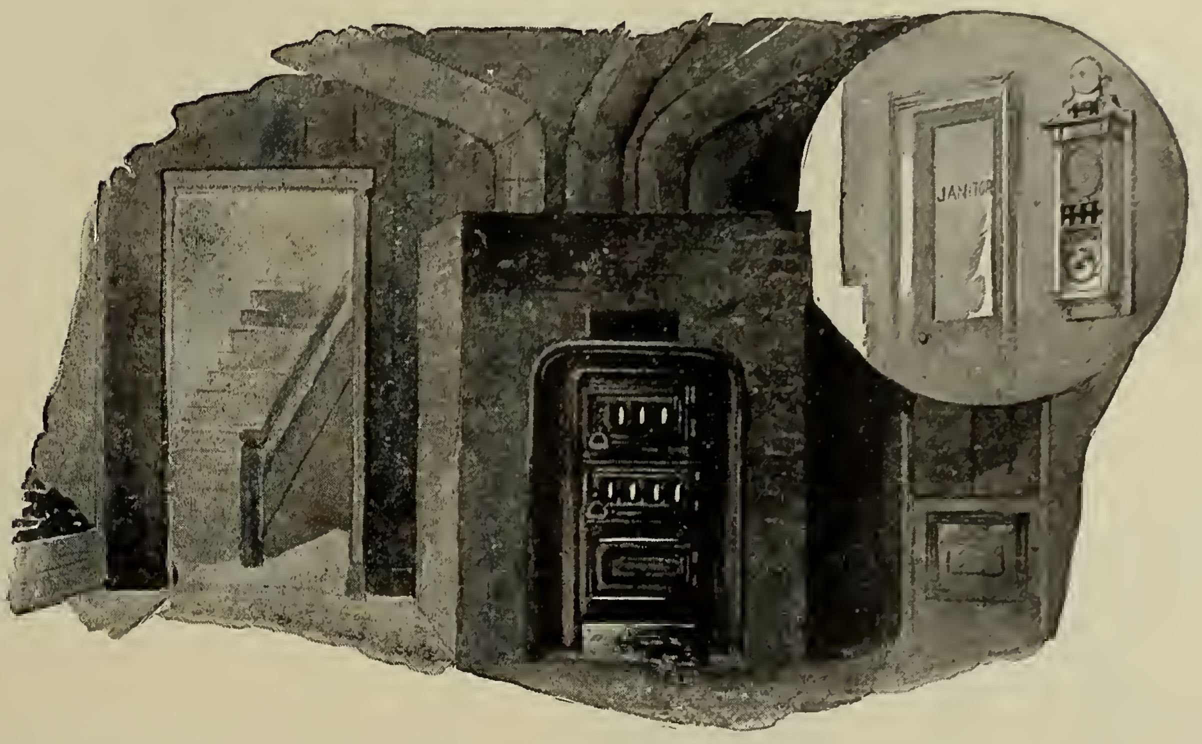
RUBBER WIRE COMPANIES meet January 6, at 115 Broadway, to determine the value of the propositions made to combine.

THE MANUFACTURERS AND SUPPLY DEALERS in electrical goods generally meet at Astor House to-day to decide upon some plan to make a living rate on all goods sold.

Blacksburg, Va.—S. A. Bross & Co. will install an electric light plant in flour mill now in course of erection.

The Electrical Age.

Vol. XXI—No. 3 NEW YORK, JANUARY 15, 1898 Whole No. 557



'Of wondrouse use is the might of flame
When man can watch and tame it,"—Schiller.

THE NEW MULTIPHASE CABLE—CONTINUOUSLY THERMOSTATIC.

One of the greatest objects of our lives is that of securing immunity from a multitude of dangers which threaten our homes and happiness. The instinct of self-preservation is manifested at an early age, and when developed to a high degree, by the growth of an inherent intelligence, it betrays itself in various ways, insurance against death, protection from accident and attempts to secure exemption from dangers which hang at times, like the sword of Damocles, above our heads.

While an indispensable factor in our business and home life, yet an ever present source of destruction and needless to say, cause of untold misery, is this same agent, "Fire."

In a crowded city the hoarse and thrilling cry of "fire" may arise at any hour of the night or day. A great flame of destruction swept Rome from the face of the earth, ravished London and left Chicago a mass of smoking ruins: At the close of this magnificent century, in which Man seems to have at his command all the strings of Nature, it would be strange indeed for us to see it die without having witnessed Fire's perfect enthrallment by man so that, when escaping from its normal environment, it of its own volition gives warning to him of its escape and dangerous presence.

Science has developed a way to meet all the causes of fire and now what are known as "Danger Lines," based upon insurance statistics for the past thirty years, enable one to so thoroughly equip and install that every incipient fire or dangerous heat, no matter what the cause, instantly gives warning of its deadly presence. The Montauk Multiphase Cable Company, by their new interior combined automatic fire and burglar multiphasic cable, and their hand book of "Danger Lines," meet all these conditions. The cable is infallible in action—continuously thermostatic.

Laid in a house it is like an ever-watchful eye or great nerve, ready at any instant to send its message of hidden danger to those that have foreseen the possibility of an accidental fire and used an efficient and rapid remedy. The Montauk Multiphase Fire Cable consists of an inner copper wire, surrounding which is a metal that fuses at a dangerous heat temperature. Around the second layer insulation is placed, and then a series of smaller wires upon which is drawn an outer covering of protecting material.

Combined in this cable with this great protection from loss by fire, are all of the necessary wires for giving every kind of electric service that is needed for all interior electrical installations.

This new idea and the problem solved through the perfection of this marvellous invention is the making of all electric wires employed in every interior electrical installation, and for whatever service to be rendered, capable of discovering incipient fire from every infinitesimal point of its length and giving warning thereof—locally and centrally.

These local adaptations are innumerable, and should you desire central station connection it can be had by use of the multiphase controller, which is operated in conjunction with the cable, and is aptly termed the head of the cable; wherein it voices to the central station exactly what the trouble is—whether fire, burglars, trouble or aught else that may be desired.

This feature must undoubtedly render the cable a valuable auxiliary to telephone, district service or fire alarm systems, or any other independent central station system, and when automatically operating is in all respects to the circuit as any other subscriber. The receiver is never disturbed.

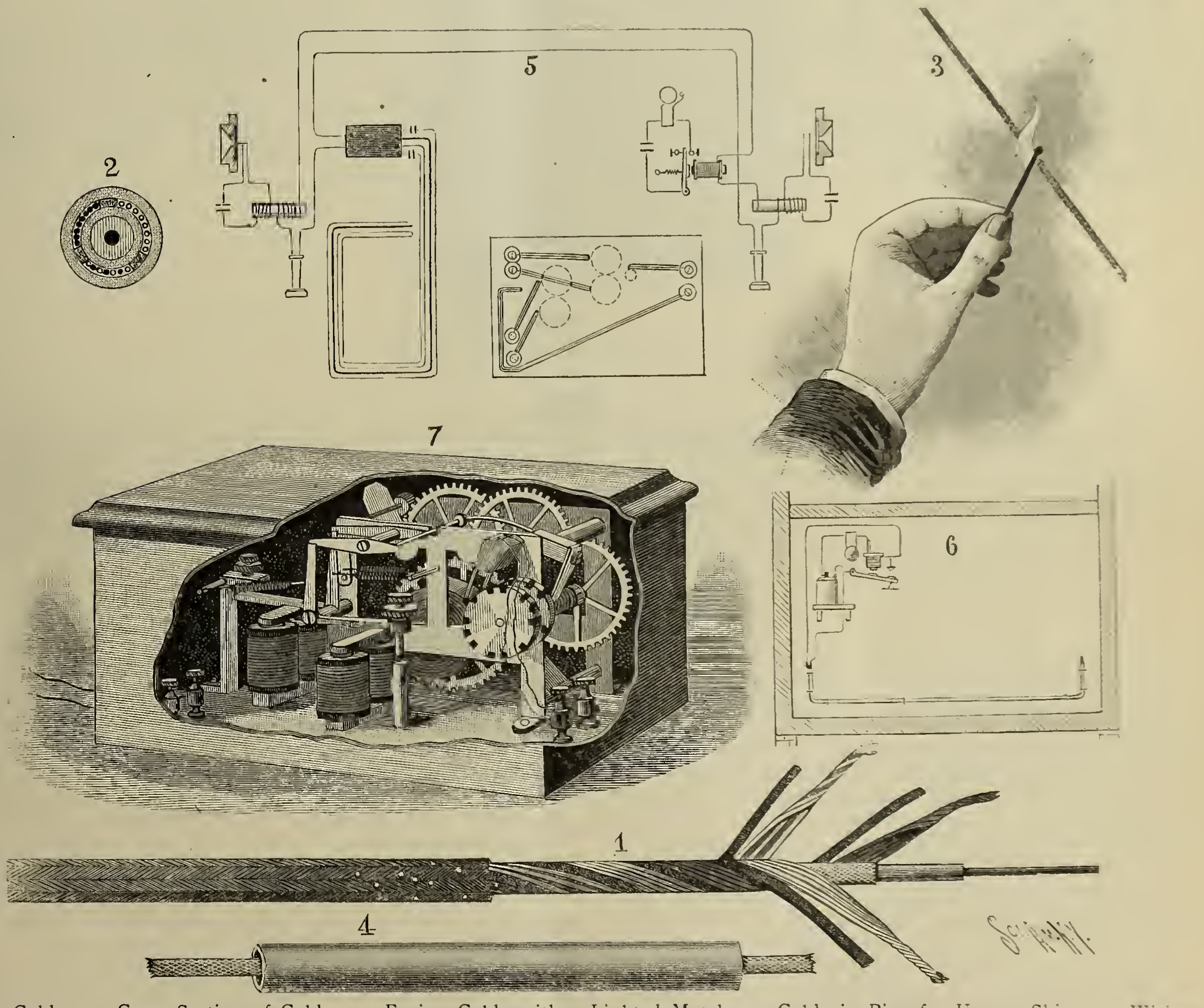
These cables have the same conductivity, the same insulation resistance, and the conductors are of the same standard gauges as required by the trade.

The cable performs its duty as follows: Suppose a fire breaks out along the line of the cable; the inner fusible coating melts and connects with the outer conductor, which immediately rings an alarm. The illustrations used in conjunction with this article were kindly loaned by the "Scientific American," and show, in perspective, and sketch, details of the automatic multiphase fire alarm cable. One of the outer conductors of the cable may be connected to an automatic circuit controller, through the medium of which an alarm is rung off in the central station. If the fire is severe enough the circuit, being automatically closed, is certain to operate any signalling device properly connected. If a cable is installed near enough to the window to arouse the suspicions of a midnight marauder, his efforts to cut the cable will close the circuit between the fusible coating and outer couductor and alarm the house. For the convenience of contractors the return conductors on the outside of the cable are made distinguishable from each other by tinning one set, used for burglar alarm, another used for the fire alarm being plain copper, and a third, fourth, fifth, etc., similarly treated or colored. The obvious benefits are so great that those living in fear of the dangers of fire can now offer no excuse should they suffer the consequences which inevitably result from a poorly protected building.

Alarm Given by Burglar Cutting Wires.

Fire Alarm Given by Wires Strung Along Cornice.

The ease with which this cable can be strung along points susceptible to injury from fire gives it the nature of an exceedingly flexible and readily installed protective system. A vessel at sea takes tremendous chances unless it uses every available method of protecting itself from fire. In total, the conclusion may be reached that any fire can be instantly suppressed if the Montauk Multiphase Fire Cable is installed along the "Danger Lines" which the history of fires have so clearly demonstrated. The address of the company is 100 Broadway, New York.



1. The Cable. 2. Cross Section of Cable. 3. Fusing Cable with a Lighted Match. 4. Cable in Pipe for Use on Ships. 5. Wiring for House Fire Alarm Connected with Central Station. 6. Wiring of Room and Alarm Connections. 7. Interior of Controller.

SPARKING, ITS CAUSE AND EFFECTS.*

BY THORNBURN REID.

Present theories in regard to the operation of commutation and the nature of sparking, show considerable progress beyond those of a few years ago. The most important step forward was taken when the reactance of the coil under commutation was recognized as the greatest obstacle to perfect commutation, and the duty of overcoming this reactance was assigned to the E. M. F. set up by the cutting of the lines from the field by the coil under commutation. It was also recognized that this must be limited by the available reversal E. M. F.

This was a long step forward, but it stopped just short of a complete explanation of the phenomena involved. This failure was due to an erroneous idea, which has fastened itself on the theory from the start, that injurious sparking was due to the current sparking across the gap between the brush and the receding segment, by reason either of incomplete reversal of the current, or of over-reversal.

I shall attempt to show, in what follows, that sparking from either of these causes may be harmless, and that the real injury is done before the segment leaves the brush.

Taking first the simplest case of commutation, that of a coil of *n* turns with its ends connected to adjacent commutator segments, we may state the operation of perfect commutation thus:

First, consider a coil which is approaching a brush through which the current is entering the armature from the outside circuit. The brush covers the segment connected to one end of this coil, and half of the brush current is passing through the coil from segment 3 to segment 2 (Fig. 1), the other half from segment 3 to segment 4.

Second, consider this coil receding from the brush, which now covers segment 2, as shown in Fig. 5. Half of the brush current is now passing through the coil from segment 2 to segment 1, the other half passing through the next adjacent coil from segment 2 to segment 3. The current in the coil 3–2 now has the same value under the conditions shown in Fig. 5 as it had before in Fig. 1, but its direction of flow through the coil has been reversed. Between these two positions of the coil with reference to the brush, the whole operation of commuta-

* A paper presented at the 120th Meeting of the American Institute of Electrical Institute of American Engineers, New York, December 15, 1897.

tion has taken place, requiring generally but a very small fraction of a second.

Fig. 2 shows the first operation in commutation. The two ends of the coil are now connected through the brush, and the current passing around the left-hand circuit of the armature has two possible paths, the one through segment 2; the other through segment 3. The amount of current which will flow from the brush direct to segment 2 depends on the difference of potential between the brush and segment 2, and on the resistance of contact area of segment 2.

Since the difference of potential of any two points in a circuit is the same through whatever path the current flows, this D P is equal to the algebraic sum of the potentials reckoned from the point of contact of the brush with segment 2 to the point of contact of the brush with segment 3, across this contact and through the coil to segment 2. The D. P. in the commutator segment need not be considered, as it is negligible. The D. P. in the brush itself is also negligible.

The D. P. across the area of contact of segment 3 varies directly with the current flowing across it, and inversely with the area of contact. The D. P. in the coil 3–2 depends on three factors—the C R drop in the coil, the counter E. M. F. of self-induction due to change in the value of the current and the E. M. F. due to cutting the lines of force of the field. This last we call "reversal E."

The CR drop varies with the current flowing in the coil. The counter E. M. F., or inductance drop, varies with the rate of change of the current in the coil. Reversal E varies with the rate of cutting of the field lines.

The CR drop at the contact area and the CR drop in the coil both oppose the current, and the inductance drop aids it as long as the current is decreasing. The reversal E may act in either direction, but is usually opposed to the inductance E. Therefore, the D. P. between the brush and segment 2 equals the CR between the brush and segment 3 plus the CR in the coil 3–2 minus the inductance drop in the coil, plus reversal E. It is seen that, as the brush moves over from the position of Fig. 2 to that of Fig. 3, the area of contact of segment 2 increases, while that of segment 3 decreases. Thus the resistance of the current path from the brush to segment 3 and through the coil to segment 2 is continually increasing, while the resistance from the brush to segment 2 direct is decreasing. Therefore the CR drop across the contact area of segment 3 will increase or decrease according as the contact area of current decreases more rapidly.

Thus throughout the period of commutation there is an increasing opposition to the passage of the current through the segment 3, and an increasing faciliity for its passage through segment 2 due merely to the changes of the areas of contact of tbe brush with the two segments, and to the consequent changes of resistance.

For perfect commutation, which is the case we are considering at present, the impedance of the coil E should always be equal and opposite to the reversal E, as will appear later.

The next period in commutation is that during which the current in the coil is increasing to its final value after having passed through zero.

When the current in the coil is zero, one-half of the brush current is passing through each of the two segments under the brush on the proper assumption that the current divides equally between the two halves of the armature. The CR drop at the contact surfaces of the two segments will then be inversely proportional to the area of the contact surfaces, and the difference between the impedance E and the reversal E will then, as before, be equal and opposite to the difference between the two CR drops at the contact surfaces. It should be noted here that, although the current in the coil is zero, its rate of change may be considerable, and thus cause considerable inductance E.

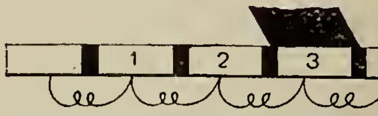


Fig. 1

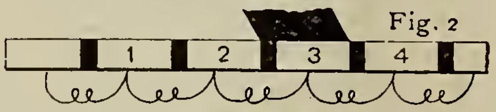


Fig. 2

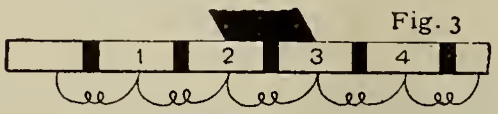


Fig. 3

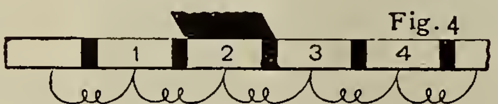


Fig. 4

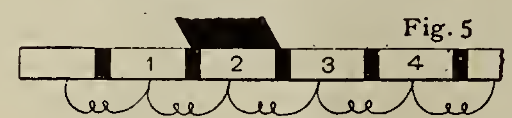


Fig. 5

While the current in the coil is increasing, the inductance E is in opposition to the current, while the reversal E is in the same direction with the current. Thus while in the first period of commutation the induction E prevented the decrease of the current, in this period it prevents its increase. The reversal E, on the other hand, aids the decrease of the current in the first period, as well as its increase in the second. The increase of the contact surface of segment two, and the decrease of that of segment 3 still continue to aid the flow of the current from segment 2 through the coil to segment 3, so that the effect of all these varying E. M. F.'s is just the same throughout this period as throughout the first period, but the resistance of the coil itself, which in the first period aided the decrease of the current, in this period opposes its increase.

Finally, just as segment 3 leaves the brush (Figure 4) the current in the coil becomes equal to one-half the brush current and no current passes through from the brush to segment 3, and the segment leaves the brush without any difference of potential between it and the brush.

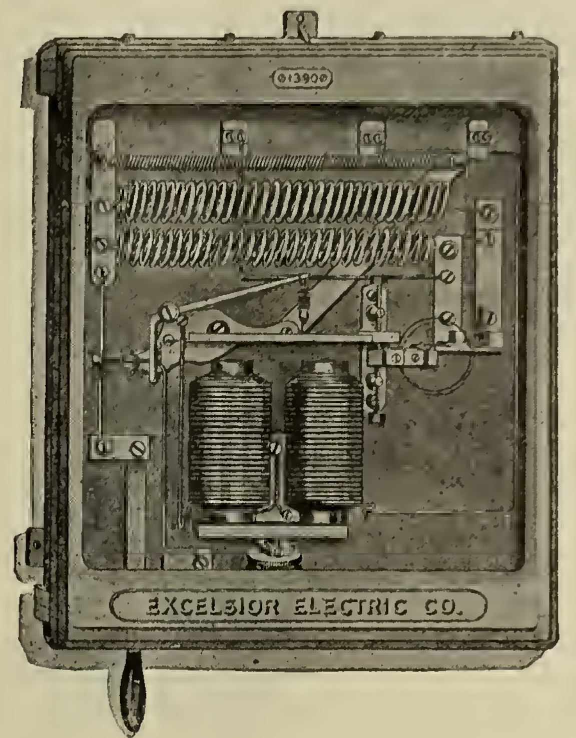
(To Be Continued.)

St. Thomas, Ont.—The by-law to confirm an agreement between the city council and the Street Railway Company for the electrification of the street railway was passed by the ratepayers. The company agrees to build six and one-half miles of track and to strengthen Wilson Bridge.

Kerrville, Tex.—The Kerrville Electric Light, Heat & Power Company has been incorporated by Charles Schreiner, A. C. Schreiner, and L. A. Schreiner, to furnish electric light and heat for private and public use. Capital stock, $10,000.

"EXCELSIOR" CONSTANT-CURRENT GENERATORS.

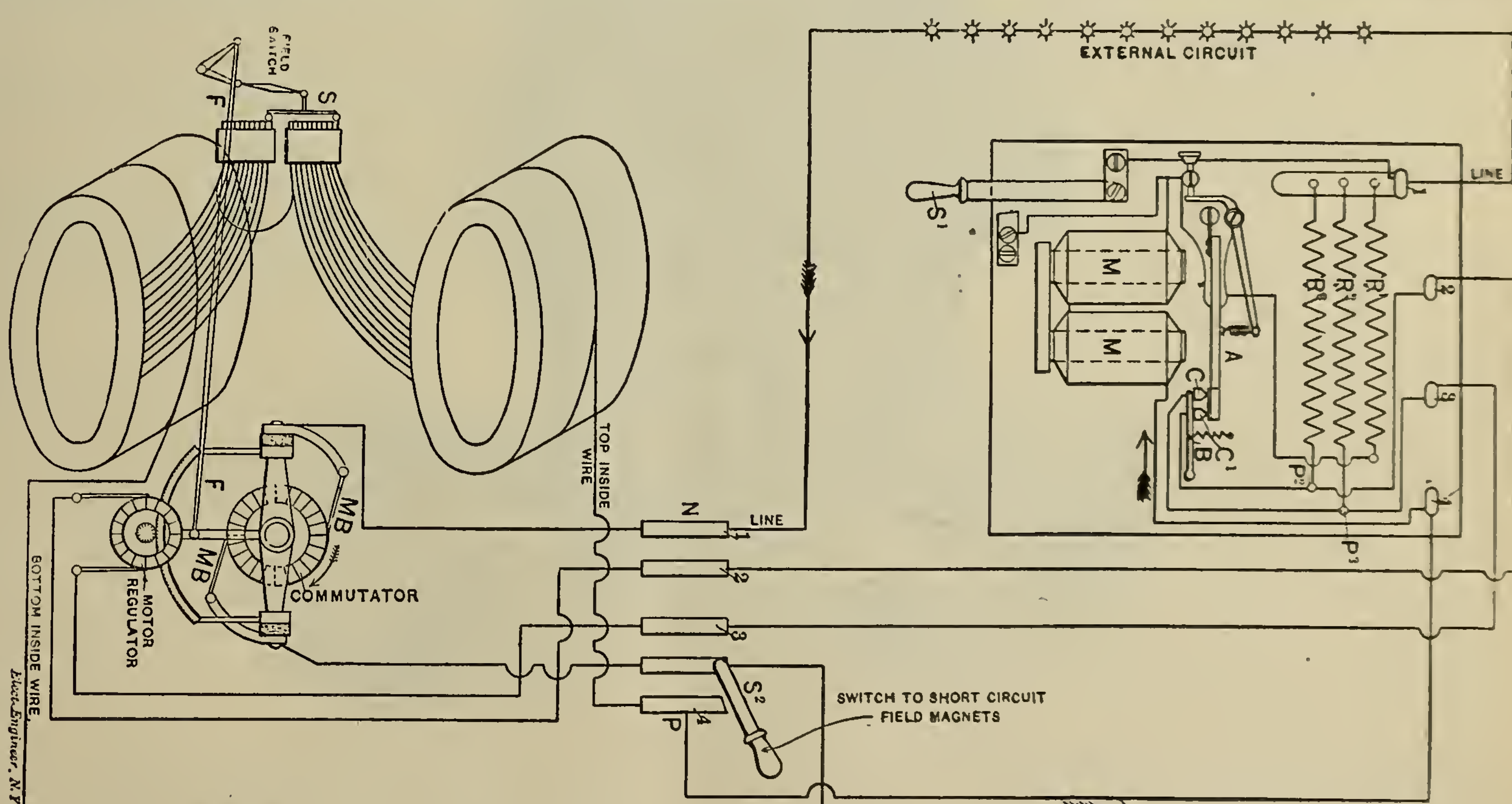
Of all systems of distribution of electric energy in small units over a large area, the constant-current is the least expensive.



A. G. 1. Automatic Regulator Controller.

Arc lamps, series incandescent lamps, and motors can be operated on a single circuit of light copper wire, usually No. 6 gauge.

If all parts of the installation are properly insulated, the higo electromotive force employed cannot be objected to.



A. G. 2. Illustration of Method of Automatic Regulation.

Early in 1889, realizing that the capacity of the then existing constant-current generators was entirely too small to produce economical results, the Excelsior Electric Company, of 115 Broadway, designed and placed on the market a 50-kilowatt generator, which maintained 100 arc lights in series, using a current of 9.6 amperes. A generator the same size, wound for a current of 6.8 amperes, maintained 125 arc lights in series.

Later on, when the demand for still larger units arose, they placed on the market a 75-kilowatt generator of the same design, which maintained 150 arc lights in series, using a current of 9.6 amperes. A generator the same size, wound for a current of 6.8 amperes, maintained 200 arc lights in series. The commercial efficiency of these generators is very high.

Features of Construction.—By referring to the two illustrations, "A. 9," it will be seen that this generator consists of two field-cores connected by a cast-iron yoke at one end, and provided with pole-pieces at the other, which encircle the armature on three sides. The armature, it will be noted, ls so placed that its shaft rests in bearings which are on the interior of the machine, so that the armature can be entirely exposed. This is facilitated by the pole-pieces, which are hinged, as shown, and which can be turned out so as to expose the armature completely, and allow it to be drawn out a sufficient distance for thorough repair, if necessary, without removing the shaft from the journal-bearings.

The armature core is built up of iron wire, the wire being wound on a cast-iron frame or skeleton having a T section, which divides the core into two parts. The arms of the spider which holds the armature are insulated from the core and frame, and fit into notches which are cut tapering from both sides toward the centre, so as to keep the whole concentric.

The insulation between the armature core and the coils is composed of volcabeston and mica.

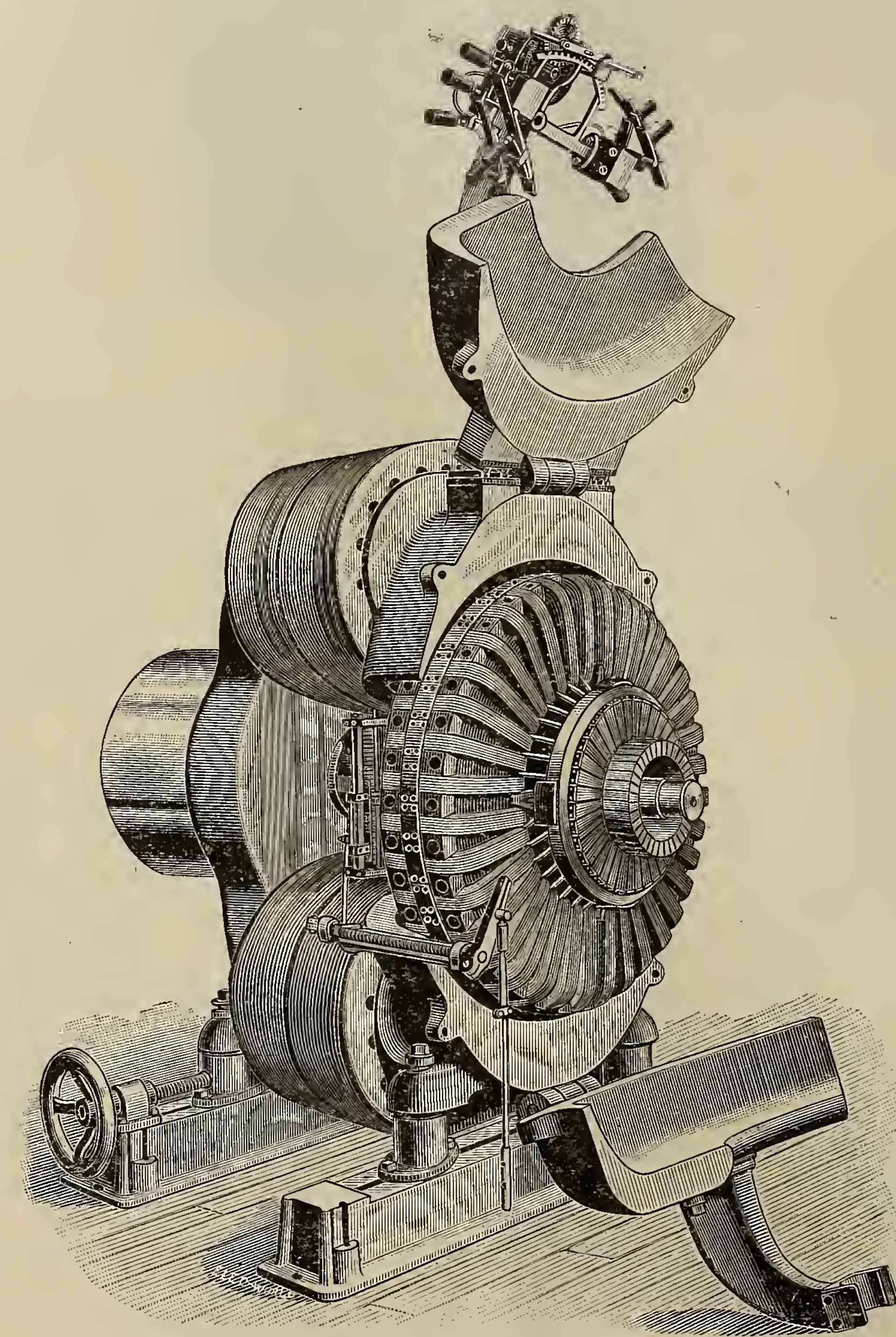
Automatic Regulation.—The regulation of this generator is a development of the methods heretofore employed by the Excelsior Electric Company, and is effected by shifting the brushes in conjunction with a regulating resistance, both of which are simultaneously operated by a small auxiliary motor. This motor, which is entirely hidden from view, is situated in the hub-like projection bearing on the arms which span the two pole-pieces beside the end of the armature shaft, and which might be mistaken, except on closer scrutiny, for the bearing of the shaft. This small motor is fixed in a magnetic field, which is produced by attaching the cast-iron arms shown to each pole-piece and bringing them together so as to surround the armature of the small motor. It might be thought for an instant that such a bridging of the magnetic circuit would take a large number of the magnetic lines of force away from the armature, but this has been provided for by mounting the cast-iron arms, not directly on the pole-pieces but by separating the two iron surfaces by a good thickness of hard rubber, so as to make a considerable break in the magnetic circuit. The magnetism passing through the arms, therefore, is very weak, but, nevertheless, sufficiently strong to produce a field for the small regulating motor, which acts with the greatest promptness.

This regulating motor is controlled by means of a wall regulator shown in illustration "A. G. 1." The method employed is very clearly shown in the illustration "A.G. 2." Here, it will be seen, M B are the main brushes mounted upon a rocker arm, which is provided with a circular rack which meshes with a pinion attached to the end of the shaft of the small motor regulator.

Starting from the positive terminal of the machine, P, the current is led to the binding post, 4, on the controller, and from there passes into the controller magnets M, M. After traversing these magnets the current enters the armature A, and after passing through the resistance R^1, goes to line, and the external circuit to the negative terminal N and main brush of the machine.

It will be noted, however, that the end of the controller armature, A, bears against two contact points C, C^1, which are connected through points 2 and 3 to the brushes of the small regulating motor on the machine. At the same time the two latter circuits are tapped at points P^2 and P^3, and connected through German-silver resistances R^3 and R^2 to the terminal 1.

Now, the regulating magnets M M are so adjusted that when the normal current passes over the line the armature A stands horizontal and makes contact with both points C, C^1, which are fixed at the end of the lever B. The current entering the armature A from the magnets M, M, therefore besides passing to line through the resistance R^1, has two other paths open to it—through contacts C, C^1 to the brushes of the small regulating motor via points 2 and 3. But it will be remarked that the currents in these two circuits are in the same direction, and when they meet at the regulating motor, oppose each other, with the result that they have no effect



A. 9. With Hinged Pole-Pieces Turned Out, Exposing Armature.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:
One Copy, one year, - - - $2.50
One Copy, six months, - - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, JANUARY 15, 1898.

CONTENTS.

A GREAT PROBLEM IN RAILROADING.

Thousands of miles of electric road have been installed in the United States; villages are connecting with towns and towns with large cities with such rapidity that at present the north-eastern coast of the United States looks like a network of trolley lines stretching far and wide on every side.

Railroad construction is being carried on at a rapid rate in spite of the fact that certain difficulties present themselves, some of which have been removed and others still appear as glaring faults. Railway bonding may be considered as one of the greatest sources of worriment to the manager of an electric road because of the fact that it represents perfection in the beginning but usually deterioration in the end. The manufacturers of rail bonds have implicit faith in the good qualities of the article they sell, and the superior merits of their methods of applying the bond.

There may be twenty-five different kinds of railroad bonds in use, yet a traction company installing a new road is forced to choose from among this number, trusting to experience in making a selection or possibly to luck or even selecting indiscriminately. In an article on railway bonding, by Walter E. Harrington, read before the Franklin Institute, of Philadelphia, the subject of railway bonds is treated without any frills or formula, clearly, quickly and ably. The writer is thoroughly convinced that a good bond in one case might be a poor bond in another case, and the fact seems to be true. Many cases might be brought forward showing the untrustworthiness of bonds that have been successfully used on other roads. The cavity or hole drilled in the web of a rail should be smooth and true so that upon the insertion of the bond an intimate contact is secured between it and the rail, thus securing immunity from the entrance of moisture and subsequent corrosion of bond and rail.

Mr. Walter E. Harrington, in speaking of the use of amalgam to improve the contact between copper bond and rail, mentions the fact that a decrease of twenty-four per cent. in resistance was secured by amalgamating. The conclusions of the writer on the subject of bonds are of a general nature and take into consideration mechanical defects as well as loosening, strength and conductivity.

The following statements may be of value to certain of our readers interested in electric railroading, and are given entirely with this object in view.

(1) The Edison-Brown plastic cork bond gives the best results.

(2) The standard bond under fish-plate is excellent, but is difficult to place.

(3) The Bryan bond is the best round fish-plate type of bond, both electrically and mechanically, provided however, that the bond is thoroughly amalgamated with the Edison-Brown alloy.

(4) The Crown and Columbia types of bonds would not be so objectionable if they were stranded and the strands protected from electrolysis.

(5) The Crown type of bond is rendered materially efficient by the use of the Edison-Brown alloy, while the Columbia type is only benefitted slightly. In both instances the Columbia is the better bond.

(6) Iron wire bonds are highly inefficient.

The above conclusions clearly show that certain combinations may be duly effected that will lead to good results; certainly better results than those obtained by using a single element. From the standpoint of resistance, some bonds test up better than others, yet engineers should certainly understand that a bond must be durable as well as a good conductor, cheap and inexpensive to apply.

In the course of time, experience will teach us how to choose and what combination it is best to make; by this means removing one of the most objectionable features in railroad construction, namely, the loss of power in poor bonds and the expense their renewal invites.

MR. S. DANA GREENE'S TRIPLE ALLIANCE.

A very interesting article was read before the New York Electrical Society, January 12th, 1898, on "The Relations Between the Consumer, Consulting Engineer and the Electrical Manufacturer." The discussion was participated in by Messrs. Osterberg, Dunn, Mailloux, Dr. C. E. Emery, Prof. Crocker, H. B. Coho and others.

We quote an extract from Mr. Greene's paper, as follows: "The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two. . . . . Broadly speaking, his function is to see that his client, who buys apparatus and installs it, selects, first, that system best suited his particular local condition and then, in purchasing, secures the best, not necessarily the most, for his money."

The common sense of Mr. Greene's statements, as well as his broad experience, entitle him to the profoundest respect. It is needless to say that the relations between the customer, consulting engineer and electrical manufacturer are frequently of a strained nature. The one that suffers between them is the one producing the cash, namely, the customer.

A meeting of the powers would certainly bring about, from a co-operative standpoint, direct benefit to all three.

Laurel, Md.—George W. Waters, Jr., town treasurer, may be addressed concerning contemplated purchase of electric light plant.

on the little motor, the armature of which remains stationary. It will also be noted that a part of the regulating current passes to line through R^2 and R^3.

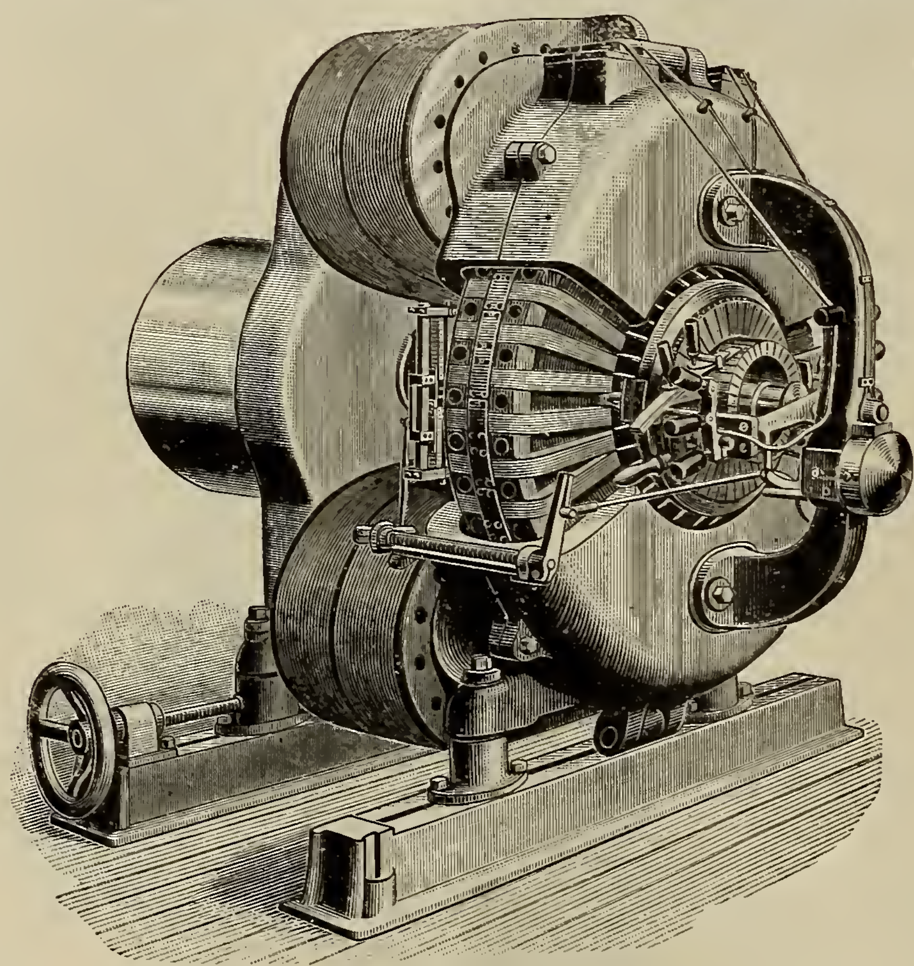
Now, if from any cause an increase of current takes place above the normal, the armature A of the controller is drawn down out of its horizontal position, by which action the contact at C is broken, while that at C^1 is still maintained. The regulating current now has only one path open to it, from C^1 to 2 2, etc,, to the left-hand brush of the motor regulator, thence through the armature to the other brush, to points 3 3, P^3, and out to line through the resistance R^2. This affords a complete and continuous path for the regulating current, and the motor armature at one starts to revolve and to turn the brushes of the machine in the corresponding direction for cutting down the current; at the same time the rod F F acts upon the field switch S, which assists the brushes in reducing the current by cutting out sections of the field magnets.

When the normal current has again been established, the controller armature re-establishes contact C, and the regulating motor stops. A diminution of the current from the normal causes the breaking of the contact C^1, which sends the regulating current through the motor in the direction opposite to that just described, and with a corresponding effect. It will be evident that at all times the resistances R^1, R^2 and R^3 are in circuit; and, as the last two points from constant shunts to the points C and C^1, no sparking whatever takes place when contact is broken at either of those points.

The result of this is that, upon any variation in the current, not only are the brushes revolved in a corresponding direction by the regulating motor, but, as will be noted, the field switch S is operated, to cut sections in or out, by the means of the connecting arm F F; both these methods of regulation acting in conjunction serve to bring the machine instantly into its normal state.

The switch S^1 is provided for the purpose of cutting out the regulating motor when adjusting the position of the magnets M, M, while the switch S^2 is employed for short-circuiting the field magnets when shutting down the machine.

The general appearance of the generator, it will be noted, is exceedingly compact, and the open construction adopted allows of ready access to every part for examination and repair, if necessary.



A. 9. 100-Light, 2000 C. P. Generator.

MEASUREMENT OF CAPACITY.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

One of the most curious phenomenon is that of the charge and discharge of a Leyden jar. Under certain conditions a body, especially if it be made of metal, possesses the power of absorbing a charge of electricity. The quantity of electricity it retains in any given case is entirely dependent upon the surroundings. An ordinary sphere of brass exercises an inductive effect upon all objects around it. When the adjacent objects are placed in nearer proximity, the ability of the brass sphere to absorb a greater charge increases.

A Leyden jar is simply a pair of metallic plates separated from each other by an insulating material of either air, glass, ebonite or their equivalent. Without referring, at present, to the insulating material, let attention be called to the conditions which determine the amount of charge a condenser or Leyden jar is capable of receiving.

From a simple review of the situation it seems more than likely that the capacity of a body to receive a charge of electricity would depend upon certain geometrical as well as electrical conditions.

The question of importance, therefore, is one that brings them into prominence.

The larger a body is, the greater its area, the more competent it becomes to accumulate a great charge. And furthermore, not only, as previously remarked, will its nearness to another conducting body accentuate this property, but the fact that if the air were replaced by some other material it is more than likely that the effect would be further increased and the charge aggravated.

Thus from a glance so brief it is seen that the

Size,
Distance,
and Insulator

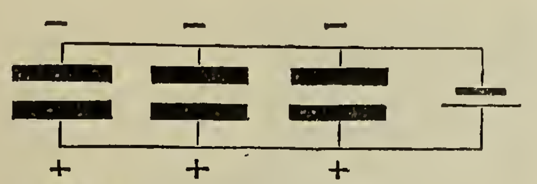
have a very noticeable effect upon the charge a body can accrete and hold.

A comparison can very aptly be made between a condenser and a room.

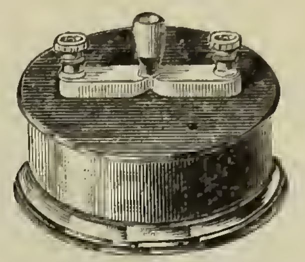
The amount of air a room can hold depends upon its size and the pressure at which the air is driven in. The number of cubic inches of air are therefore solely determined by this. In speaking of the capacity of a room the number of cubic feet would designate this idea, but the geometrical conditions, the very dimensions are thus

The number of coulombs or the amount of charge a body is capable of receiving, taking the past facts also into consideration, is dependent upon two factors—

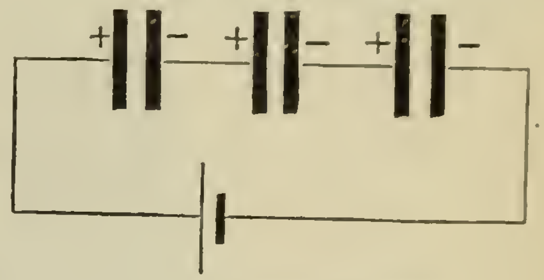
The capacity of the condenser and the pressure. The amount of air in a room or closed tank would depend upon the size of either and the pressure applied; likewise



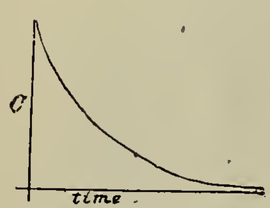
—Condensers in Multiple Arc.



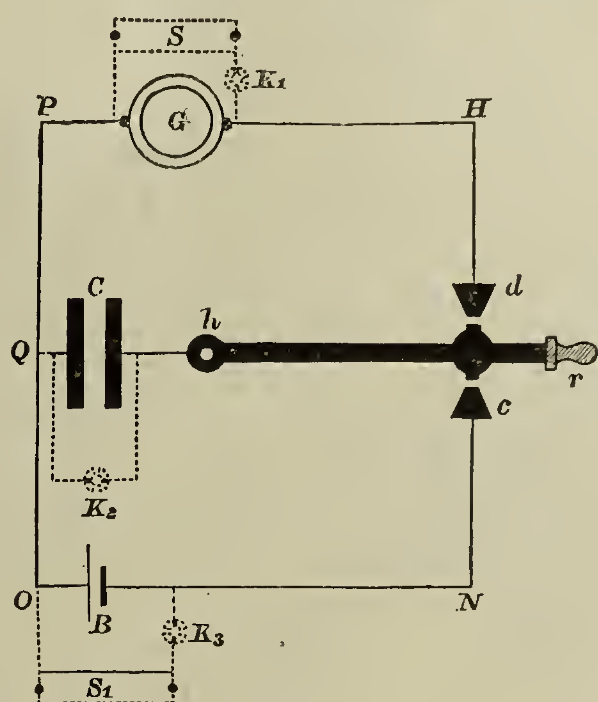
Laboratory Condenser



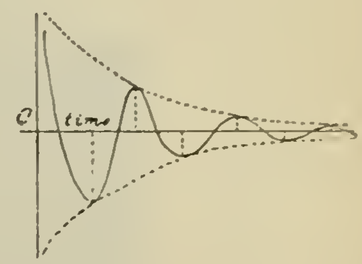
—Condensers in Series.



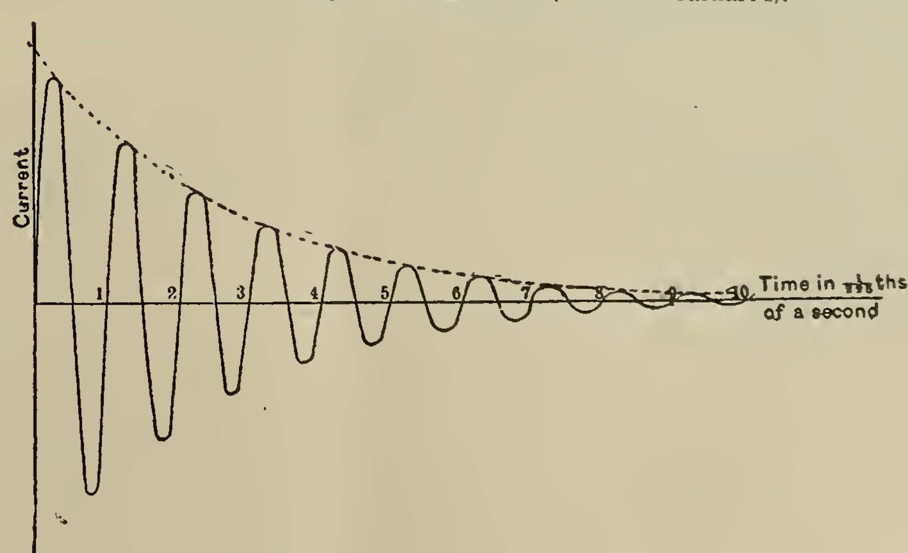
Discharge Through High Resistance.



S and S1—Shunt Circuits.
C—Condenser.
hr—Lever of Discharge Key,
c—Lower stop of Key.
d—Upper Stop of Key.
H. P. Q. O. N.—Main Connections.
G—Ballistic Galvanometer.
K1, K2, K3—Simple Keys.
B—Battery of Standard Make (Clark's or Carhart's).



Discharge Through Low Resistance.



Oscillatory Discharge from a Condenser.

referred to. A condenser has no fixed capacity. It may be compared with another condenser by charging both with the same pressure, but otherwise the comparison fails.

The meaning of capacity when a condenser is considered is spoken of in Farads.

Unfortunately, a Farad is so large a unit that it could not be considered in a practical sense. The unit used in daily practice is the microfarad, the one-millionth part of a farad.

The quantity of electricity is spoken of in coulombs.

a condenser.

The rule, therefore, illustrating these facts is as follows:

Charge = Pressure × Capacity,
$Q = E \times F.$
where Q = Coulombs,
E = Electromotive force,
F = Farads capacity.

It must be understood that the area of the plates, the distance between them, and the nature of the material separating them, will directly affect the capacity in all cases.

Definition of Capacity.—The capacity of a condenser is determined by the number of coulombs which will raise its pressure to one volt.

A Farad is the capacity of a body which is raised to one volt pressure by a charge of one coulomb.

Specific Inductive Capacity.

Air	1
Rubber	2.3
Paraffine	2.3
Gutta-Percha	2.5
Mica	6.6
Glass	10.0

Large City Central Station Fire Alarm Office.

Specific inductive capacity is an expression defining the extent to which an insulator will allow a charge to affect another body by induction.

It may be understood that air, glass, hard rubber, etc., retard the inductive effect of one body upon another to different extents.

Air is usually referred to as a standard, the induction occurring through it being very slight; the others are rated accordingly.

Glass and insulators made of materials likely to vary in quantity have a specific inductive capacity dependent upon their purity. The power of glass changes with the amount of lead, etc., it contains.

(To be continued.)

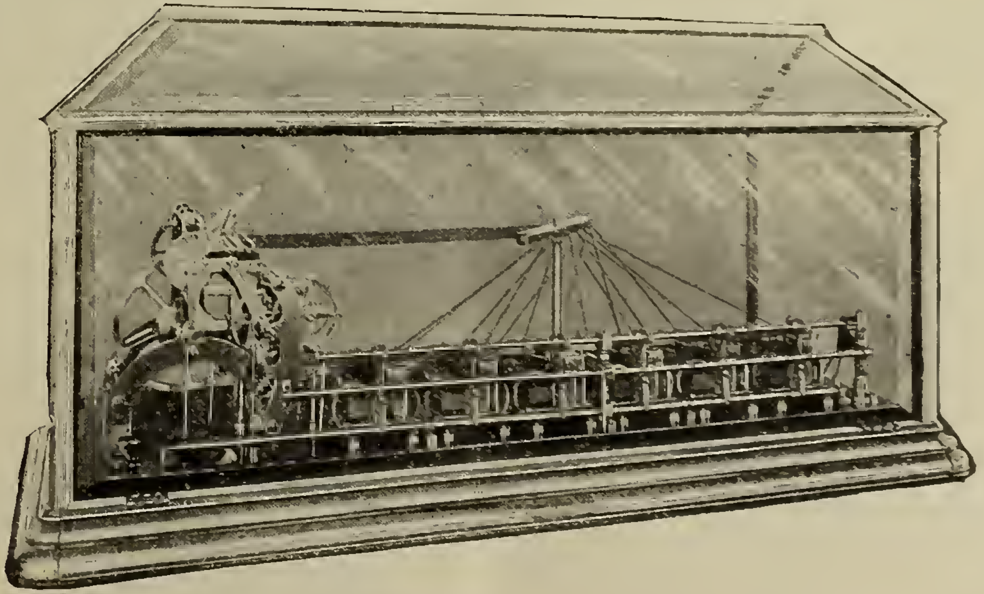
Belleville, Ont.—An English syndicate is negotiating for the control of the Belleville Street Railway, with a view of extending it to Tweed.

THE AGENCY THAT PROTECTS LARGE CITIES.

In reviewing the daily newspapers the number of great fires which occur annually will be found, in proportion to the number of buildings and the population, to be on the decrease. The various causes giving rise to a conflagration are too numerous to mention here. The object of this brief article is merely to refer to the benignant influence exerted by electricity in affording protection to the multitude, housed closely together, in crowded city centres. "Fire and Water," of New York, January 8, 1898, speaks of certain destructive fires in Chicago, a week or so ago, the losses from which amounted to $1,500,000.00; that referred to particularly being the Coliseum Building, in which an X-ray exhibit was under way. In New York, Philadelphia, Boston, San Francisco and other large cities fires occurred amounting to hundreds of thousands of dollars. By stopping to consider, however, how great the destruction would have been had no efficient means of safety been employed, it is certainly probable that ten times the damage would have resulted, with a loss of life appalling in its extent.

The function that electricity plays in excluding the chances of fire is so applied that it is impossible for a conflagration to occur, only in the case of inexcusible neglect. The use of fire alarm telegraphs, employed by large city central station fire alarm offices and many private homes, as well as large office buildings, without forgetting the street corner alarms, have so eased the mind of the public that even a country visitor becomes rapidly acquainted with the fact that every citizen is supposed to operate the signal box at the first sight of smoke or flame.

The Gamewell Fire Alarm Company, of 19 Barclay street, New York, have installed throughout the United States, in town and city, their unexcelled apparatus. The perfected fire alarm service of today is an evolution, the outcome of the combined inventive genius and mechanical skill of many, whose valuable services the Gamewell Company has from time to time been able to secure in its steady and continuous efforts for improvements and to meet the requirements of the various conditions existing in different localities. The policy of the Gamewell Company has always been, not only to extend and promote

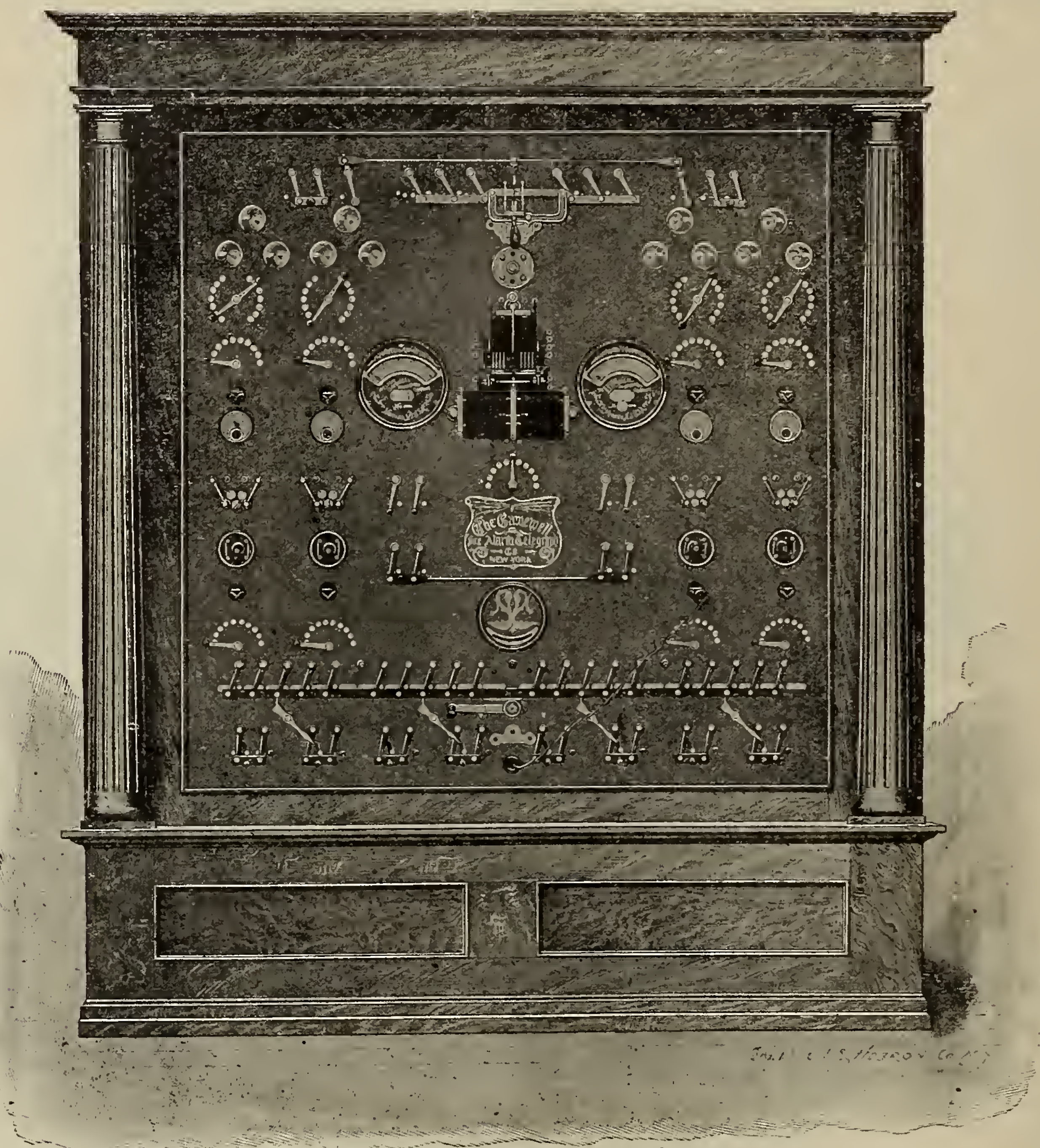


Automotic Repeater No. 127.

the introduction of fire alarm and police telegraphs, but to improve their service. They have not only regarded the scriptural injunction to "prove all things and hold fast to that which is good," but they have always been ready to adopt any invention which experience has demonstrated to be an addition to the safety and reliability of these systems.

The catalogue of the Gamewell Fire Alarm Telegraph Company is a beautiful exposition of the various devices used for the protection of a city of any size. Due to their great success, which the certainty of the mechanism of their apparatus has secured for them, the supremacy of the Gamewell Company in fire alarm telegraphy, and the fact that no other concern has ever been able to make a commercial success in this field, is easily accounted for.

One of the most wonderful and, to say the least, most desirable policies followed out by the Gamewell Company is their perpetual guarantee to replace, without cost, anything which fails to work satisfactorily; on account of imperfect workmanship or material, even though years of time elapse. The efficiency of the municipal police and fire alarm service is rendered doubly effective by the accordance of action secured through the flexibility of this system. It establishes telegraphic connections between the police stations, fire alarm centres and all policemen on duty, both night and day. It gives to every citizen and patrolman, however remote from headquarters, a means of summoning police assistance. It insures discipline and attention to duty on the part of firemen and policemen, and secures for the public a freedom from danger that neither the ancient body guard nor the largest bucket brigade could ever offer.



Combination Storage Battery and Repeater Switchboard.

Middletown, Ohio.—The Middletown Gas and Electric Light Co. has been incorporated by Charles E. Denny, W. F. Simpson, W. C. Barnitz, T. E. Reed and J. J. Gallagher, for the production of electricity for power and lighting purposes, etc. Capital stock, $50,000.

Sherbrooke, Que.—It is rumored that the Sherbrooke Street Railway Company will extend their line to Little Magog Lake next summer.

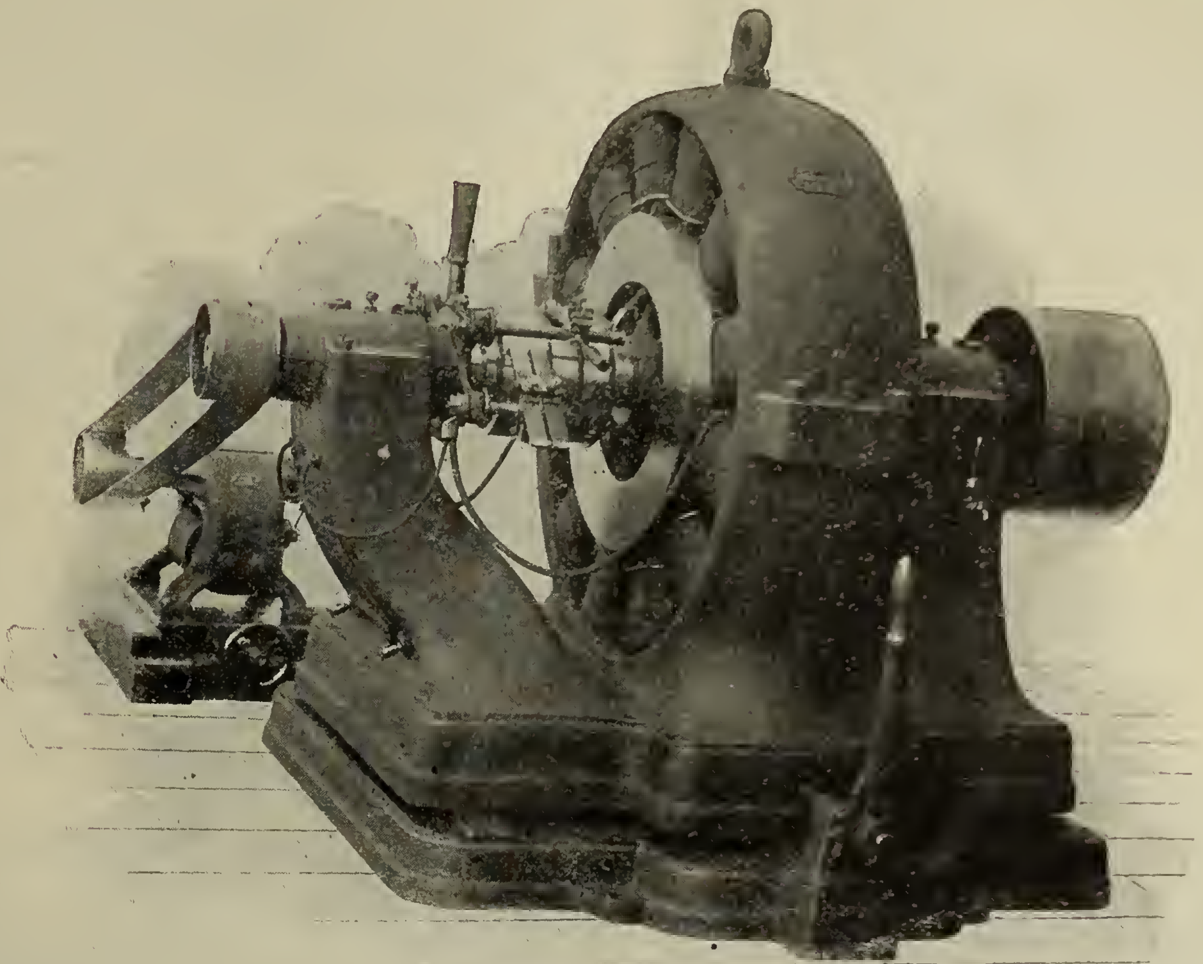
Nicholasville, Ky.—The Nicholasville Telephone Co. has been incorporated by R. B. Lancaster and others. Capital stock, $10,000.

Vol. XXI—No. 4

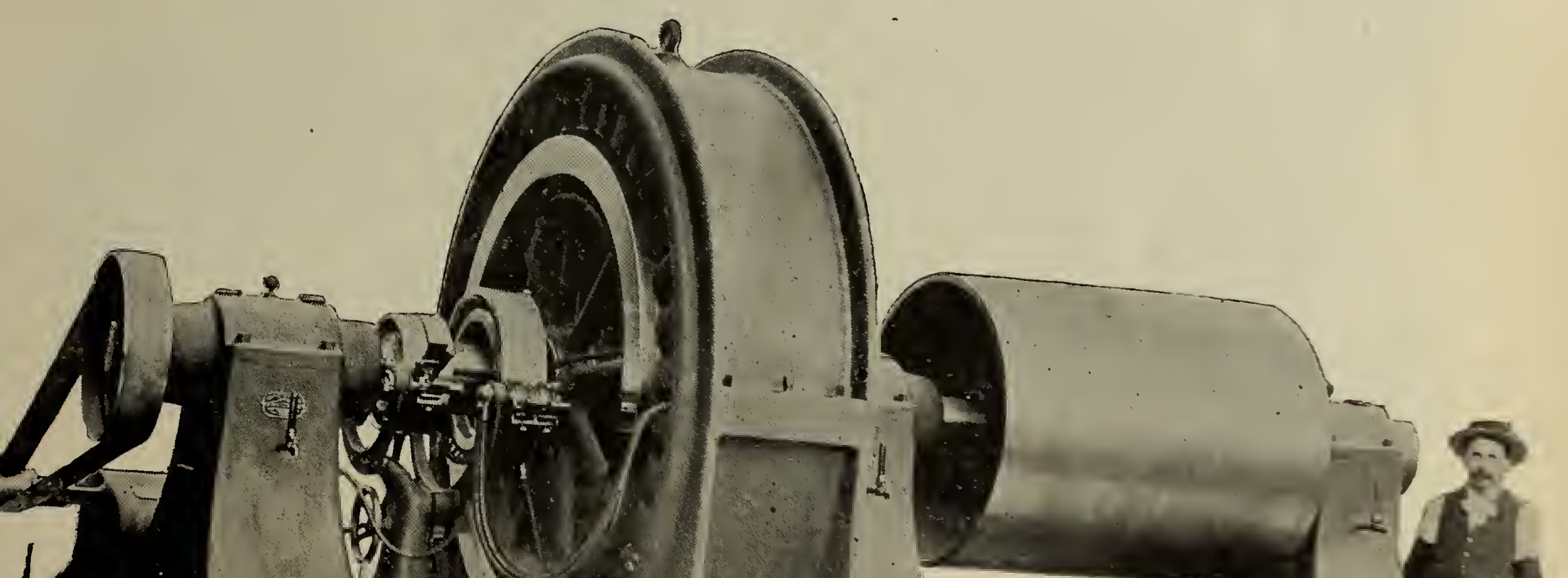
The Electrical Age.

NEW YORK, JANUARY 22, 1898

Whole No. 558



100 Kilowatts, 140 Cycles.



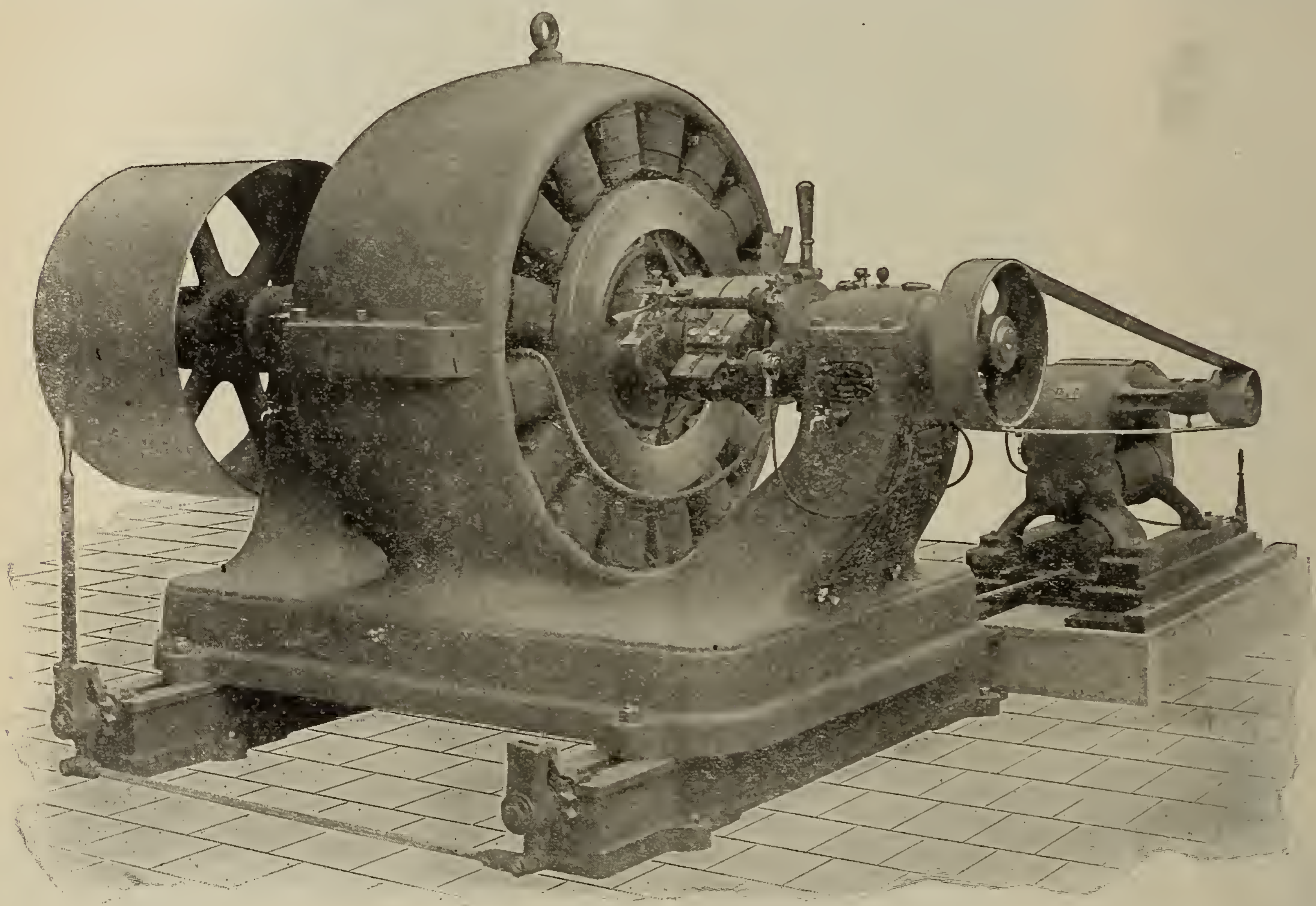
400 Kilowatts, 140 Cycles.

UP-TO-DATE ELECTRICAL ENGINEERING.

y papers have commented on the above subject t fully realizing that they had but to turn their the proper direction to see what up-to-date elec- engineering really consisted of. The question is not one requiring abstract discussion, because it is fully represented at present in types of apparatus and methods of construction that clearly show what up-to-date electrical engineering has been and is doing. It is truly said that the man of energy works and says little. Nothing is more true of the manufacturing concern whose object is clearly kept in mind and who, without self-approbation, quietly and deliberately succeeds in accomplishing what others fail in; brings before other manufacturers and a host of increasing customers the labor of their hands, the perfected devices that reason and art have enabled them to construct. People say, alternating-current apparatus has become popular. This is a tardy recognition of the labors of the firm that has made it so. The Fort Wayne Electric Corporation, of Fort Wayne, Ind., have gradually increased the field of their efforts and expanded into a concern whose stability and reputation is the result of years of experience. The "Wood" compound-wound alternators for high and low frequency, manufactured by them, are certainly the leaders of their class. They possess a composite field circuit, with laminated poles cast into the yoke, thus saving a great percentage of the copper formerly used and increasing the output of the alternator to a large degree. In the armature the spiders and clamping rings are so ventilated that the temperature of field coils, pole-pieces and armatures is effectively reduced. The use of an improved commutator, closed at both ends, and thus kept free from deposits of foreign matter, represents a final touch that will favorably impress the electrical engineer. Each part of the machine is tested with eight thousand volts before placing upon the market.

The Fort Wayne Electric Corporation have perfected to a high degree a new line of alternators, specially designed for low frequencies, the advantage and benefits of which are low speed, low temperature and high commercial efficiency. The sixty-cycle machines referred to are wound for 1100 or 2200 volts at full load, respectively. The illustrations included in this article are those of a hundred k.w. and 140 cycle machine; 150 k.w.; 60 cycles, and 400 k.w., 140 cycles. The alternators, as seen, are separately excited, but being compound wound, regulate perfectly for all changes of load. The capacity of any generator may be measured by its power to radiate heat.

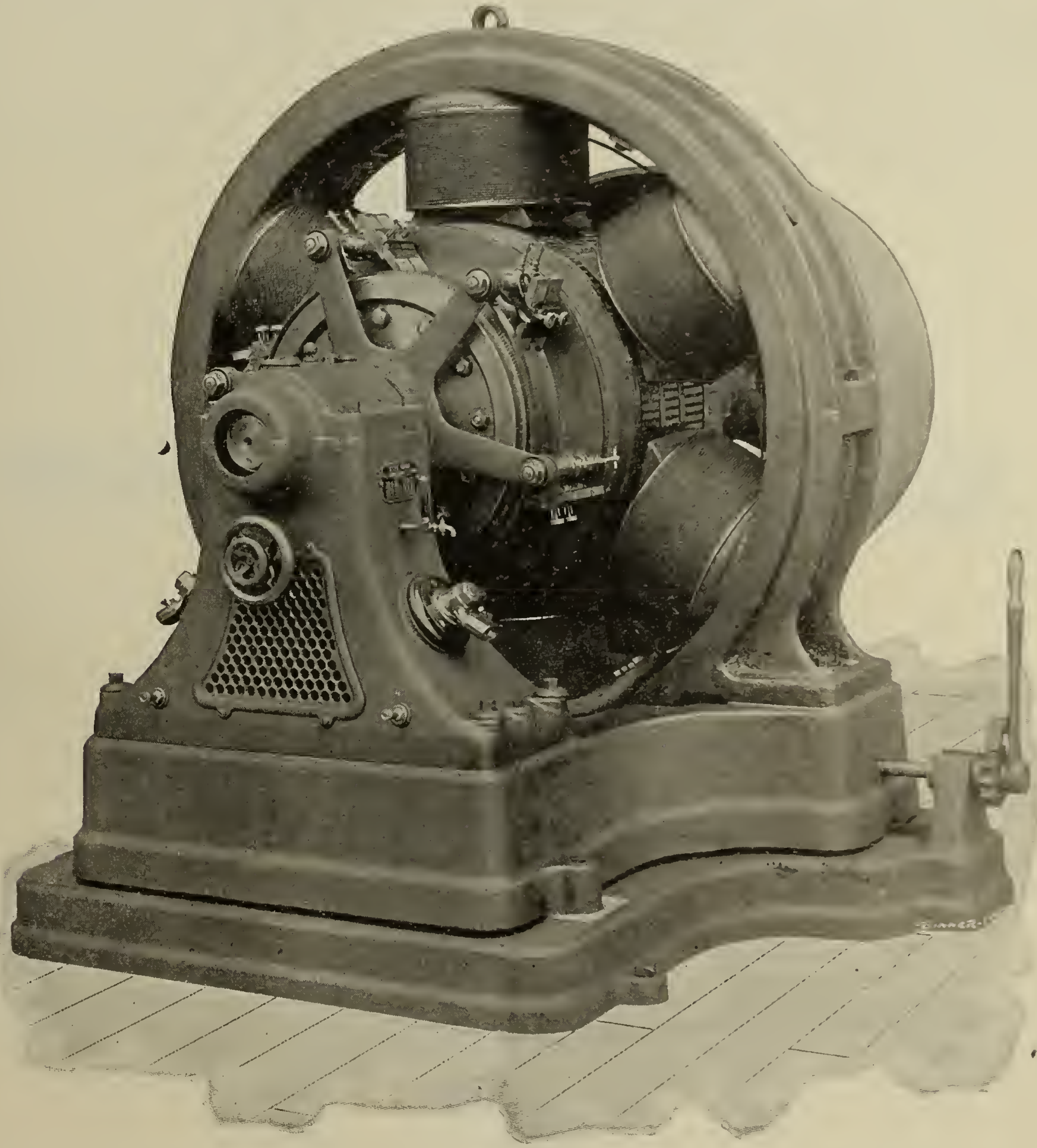
It is therefore evident that the wholesome design of these solidly built machines, their power of rapidly dissipating the C^2R loss, perfect magnetic circuit, high permeability, improved commutator construction and general mechanical excellence, will make them capable of withstanding the heaviest strains of service. The 100 k.w. alternator runs at 1,050 revolutions a minute, has 16 poles, is 62 inches high, covering a floor space of 83 in. x 70 in.; its armature weighs 1,350 pounds and the alternator, complete, 7,500 pounds. The 400 k.w. alternator has 36 poles, runs at 467 revolutions per minute, is 98 inches high, occupies a floor space of 185 in. x 96 in., its armature weighs 7,900 pounds, and the alternator, complete, 36,600. The low frequency, 150 k.w. alternator has 16 poles, runs at 450 revolutions per minute, is 69 inches high, occupies a floor space of 115 in. x 77 in., its armature weighs 3,450 pounds, and the alternator, complete, 15,400 pounds. The 400 k.w. alternator uses a pulley 40 inches in diameter with a 50-inch face.



150 Kilowatts, 60 Cycles.

The Fort Wayne Electric Corporation have designed and constructed on the basis of the "Wood" system direct-current dynamos for light and power, for either belting or direct connection. The armature of a 75 k.w. generator is shown, which runs at 275 revolutions. The assembled machine, whose guaranteed output is the same at full load, weighs but 7,825 pounds, delivers 600 amperes, 125 volts pressure, requires 113 horse-power at full load. The weight of this machine averages up for the direct driven type about seventy pounds per horse-power. The efficiency is high, its smoothness of operation, sparklessness at all loads and low speed are among its most valuable features. Its safety factor is so large that its good points would be preserved even with a twenty-five per cent. overload. When sold for direct connection the field crown, armature, front pedestal and the field regulating rheostat only, are furnished. If the generator is to be belt driven, the rear pedestal base and sub-base, as shown, form part of the equipment. These dynamos are compound wound for 125, 250 or 500 volts, and may be used and will be delivered when so ordered, for direct connection or belt driving.

The above multipolar generators are made with cast steel frames, which is considered the best of practice in modern machinery, its high permeability and the ease with which it is moulded have made it a pronounced success. The designers of Fort Wayne machinery thoroughly understand the meaning of up-to-date electrical engineering as shown by the perfect proportions of their dynamos and the world-wide reputation they have secured.



15 Kilowatts, 275 Revolutions.

SPARKING, ITS CAUSE AND EFFECTS.

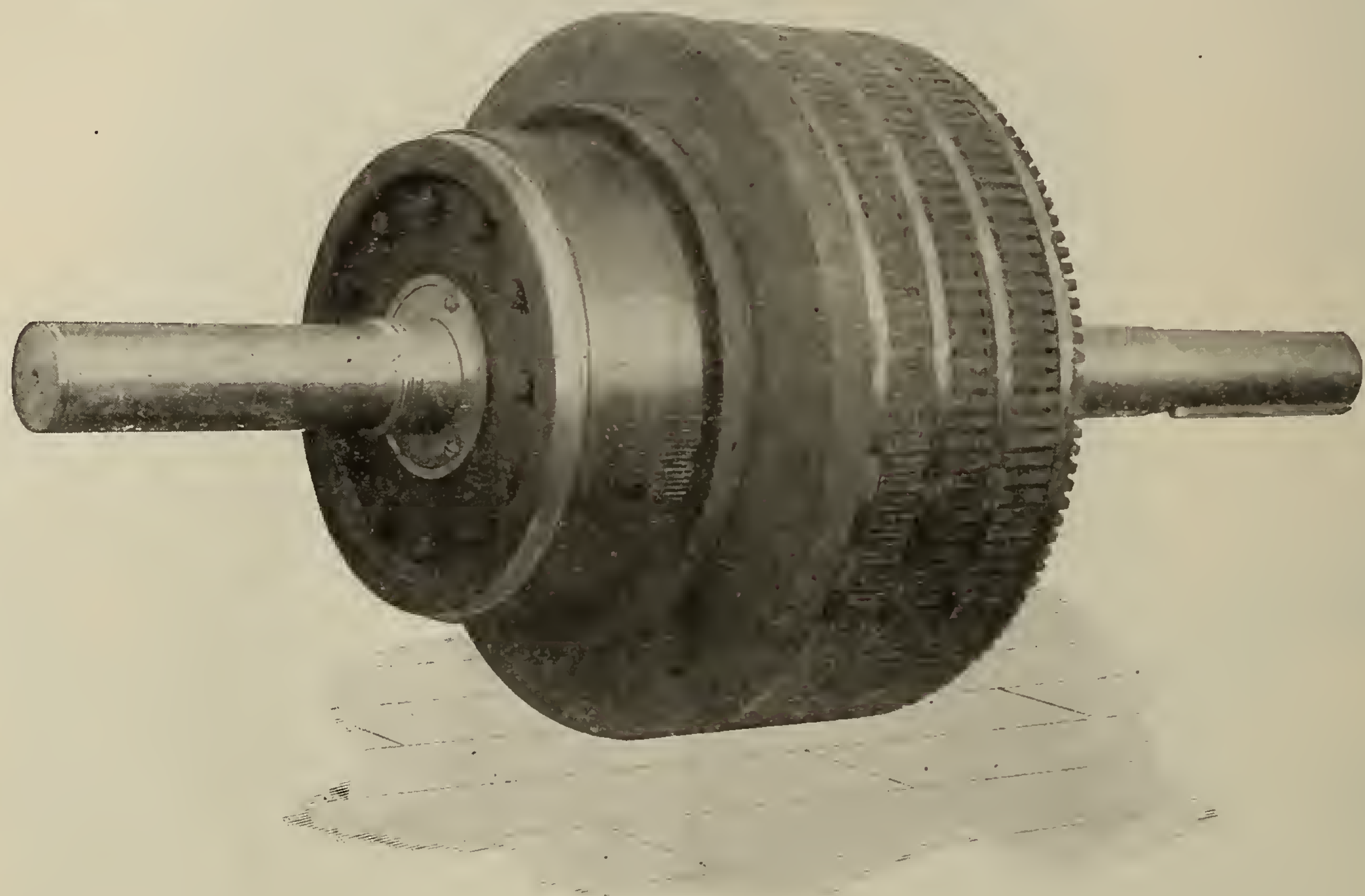
(Continued from page 32.)

Following are some of the various ways in which imperfect commutation may occur, and the manner in which this imperfect commutation causes injury to the commutator.

First. Suppose that the current flowing across the contact surface of the receding segment does not decrease as rapidly as the contact surface of that segment decreases. The current density then increases and is a maximum at the last part of the segment that touches the brush. More energy is thus concentrated at that point than at any other, and owing to the fact that time is required to conduct that energy to other parts of the segment, that part will be raised to the highest temperature. This temperature may be high enough to melt, or even volatilize the copper of the segment, therefore when the brush leaves the segment, the current continues to flow through the film of melted copper, volatilizes it and draws an arc. This arc constitutes the injurious or "vicious" spark. The removal of the volatilized copper from the receding edge gradually wears that edge away. Reduction of the contact surface thus continually increases the current density, and the arc is formed at an earlier stage of the commutation when the current to be broken is greater, and thus the spark increases in viciousness until the commutator has to be turned down before the machine will run at all.

Again the energy developed at the receding edge of the segment may not be sufficient to melt the copper. In this case the current to be broken when the segment leaves the brush will jump across from the brush to the segment. This spark has no deleterious effect, since most of its energy is developed in the space between the segment and the receding brush, instead of being concentrated at the edge of the receding segment. This spark is of the same bluish color as that of the Ruhmkorff coil, by which it may be distinguished from the injurious spark, which is yellow.

Second. Suppose that the current flowing across the contact area of the entering segment increases more rapidly than the contact surface increases. The current intensity in that part of the segment then increases, and more energy is concentrated at this point than at other parts of the segment and it will accordingly be raised to a higher temperature. If this temperature is not high enough to melt the copper, no harm results and there is no spark, since the contact is not broken at that point. If, however, the temperature produced is high enough to melt the copper, the melted copper may be carried along by the brush, and the entering edge of the segment is thus gradually eaten away. This will not show by any sparking immediately, but it will eventually cause a spark to appear in the following manner: The eating away of the entering edge of the segment gradually reduces the area of the entering segment, and thus increases the resistance of that segment. This delays the decrease of current in the receding segment, and the current density in both segments increases until the temperature gets high enough to produce a spark as described in the first case of imperfect commutation. Another incidental injury that may occur is the deposition of the melted copper at the back of the segment, thus raising the surface of the segment at that point, and this, together with the depression of the surface at the front of the segment would cause the brush to jump and chatter, which of itself would cause deleterious sparking.



Armature 75 Kilowatts, 275 Revs.

This would explain the cases where a machine runs perfectly sparkless when first set up, but after a time commences to spark, the spark increasing in intensity and deleterious effect and disappearing when the commutator surface has been turned up, only to reappear after sufficient time has elapsed. The wearing away of the front edge of the segment is hardly likely to be noticed, since no injury would be looked for until the spark appeared, and then the cutting of the back edge would be much more prominent, because that, being produced by an arc, would have a roughened appearance, while the surface of the front edge wonld be left smooth by the rubbing off of the melted copper.

Third. The reversal E may be large enough not only to reverse the current in the coil under commutation, but even to increase it beyond the value of half the brush current. In this case the extra current would flow through both segment furnaces, but owing to the fact that this current would be increasing while the receding segment was reducing its contact area, that segment would get hottest, and as soon as it reached the melting point an arc would be drawn and destructive sparking would ensue.

The problem that the designer of the modern machine has before him is to design a machine that will run from no load to 25 per cent. above full load without sparking, and without movement of the brushes.

In the case of machines intended for lighting, the conditions of no shifting of the brushes is not generally required, but most of our modern lighting machines are made to fill that requirement.

The current to be reversed, therefore, varies from the exciting current of the machine up to 25 per cent. above its full load current. The inductance E and the CR drop in the coil also vary in this proportion, and for perfect commutation through all these varying loads it would be necessary for the reversal E also to vary in the same proportion, and may even decrease with increase of load, on account of distortion of the flux coming from the field by the armature ampere turns.

(To be continued.)

THE ONE-HUNDRED AND EIGHTY-FOURTH meeting of the New York Electrical Society was held at the College of the City of New York, 23d street and Lexington avenue, on Wednesday, January 12, at 8 p. m. Mr. S. Dana Greene read a paper on "The Relations Between the Customer, the Consulting Engineer, and the Electric Manufacturer."

It was the aim of Mr. Greene, in this paper, to assist in bringing about that better understanding between those departments of the industry on which so much of its welfare and prosperity depends.

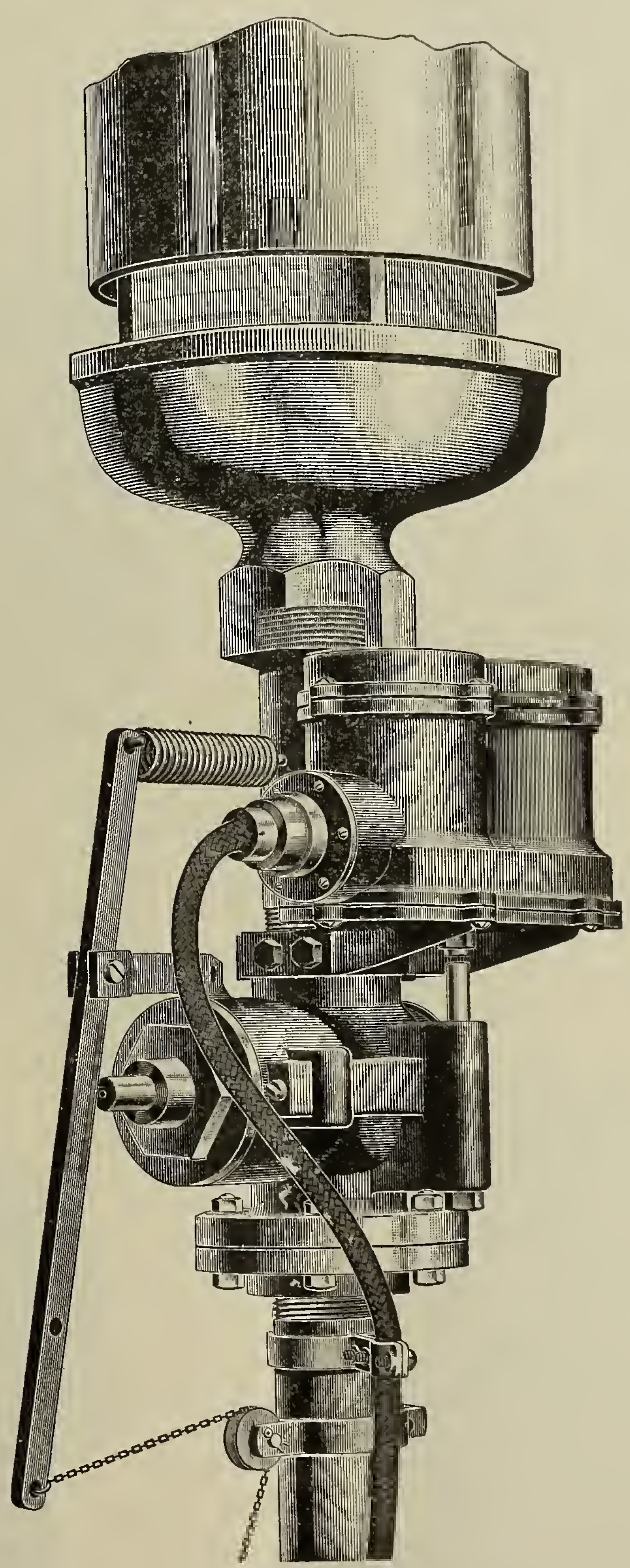
GEORGE H. KIMBER, representing Clifton Conduit, made by the Clifton Manufacturing Company, Boston, Mass., the Bibber, White Company, and the Crefeld Electric Works, manufacturers of magnet, office and annunciator insulated wire, has moved to 15 Cortlandt street, New York.

Philadelphia, Pa.—The Collegeville Electric Railway have entered into an agreement with the Reading Railway Co. whereby they will cross the Perkiomen Railroad at grade in Collegeville.

THE ELECTRIC AUTOMATIC WHISTLE OPERATOR.

An interesting and ingenious device is being manufactured and sold by the Signal & Control Company, 45–47 York st., Brooklyn, N. Y. It is a device for electrically controlling a whistle valve, operating it automatically at given periods of time, so that the whistle will signal regularly when vessel is under way, or if at anchor, will ring ship's bell five seconds every minute as required by rules of the road at sea. The electric valve is placed between the hand-pull valve and the whistle. The switch is connected to the valve by means of a weatherproof and certainly waterproof cable. It requires but little current to operate the valve, which may be obtained from a few cells, primary or storage battery, or the dynamo current. The great advantage of the electric automatic whistle operator can be readily understood when the reader realizes that the law requires a series of systematic signals in foggy weather. The automatic valve issues these signals with perfect regularity at given intervals.

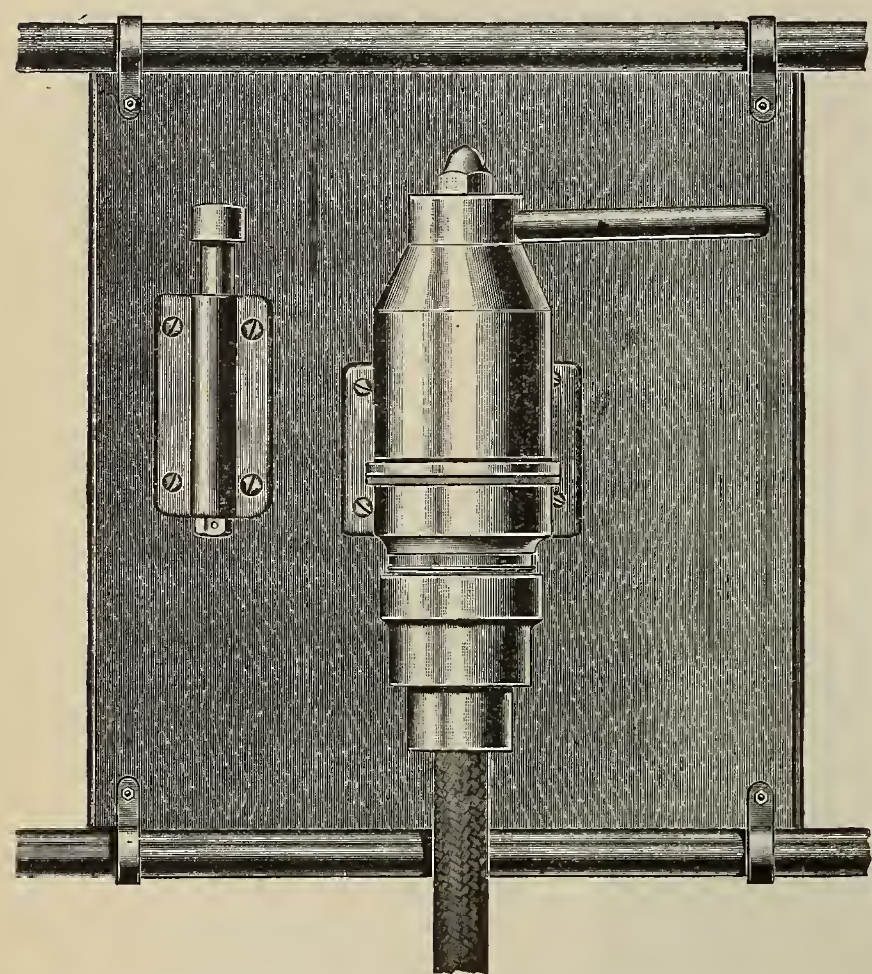
There are many occasions when collisions occur and sea accidents of a most horrible nature, entirely due to some fault in signalling, either presumed or having actually occurred. Such questions cannot arise with this device, because its absolute reliability is one of its most pronounced features. The captain may have his mind at rest or occupy himself with other important duties when fog settles upon the ship and the view becomes obstructed. He can still control the whistle-switch and stop the fog signal, at the same time remain in the pilot-house and exercise the fullest control over his vessel. The electric automatic whistle operator is being used by the United States Navy Department for all cruisers, monitors and battleships. The principal steam yachts, Ward Line, Red Cross Line, Boston Fruit Co.



Electrically Controlled Whistle Valve—For 3-inch Pipe.

The Light-House Board and Revenue Cutter Service have adopted it, and the Cunard, American, White Star, North German Lloyd, Hamburg-American, Red Star and Atlantic Transport Lines, the Old Dominion, Providence, and Stonington, Montauk Steamship Company and the Northern Steamship Company use it exclusively. The heads of the merchant marine and the marine departments of the United States have endorsed its use, and all of such experience that their opinion possesses any value will understand and appreciate the great benefits to humanity derived from the use of this important device.

Marine Telegraph System.—Steamships desiring the full and perfect equipment of apparatus of the above nature use, in conjunction with the operator, the marine telegraph system, as manufactured by the Signal & Control Company. The illustrations show a multiple switch with telegraph key, ocean marine multiple switch, and improved United States Navy standard. By means of the multiple switch and telegraph key, the captain can com-



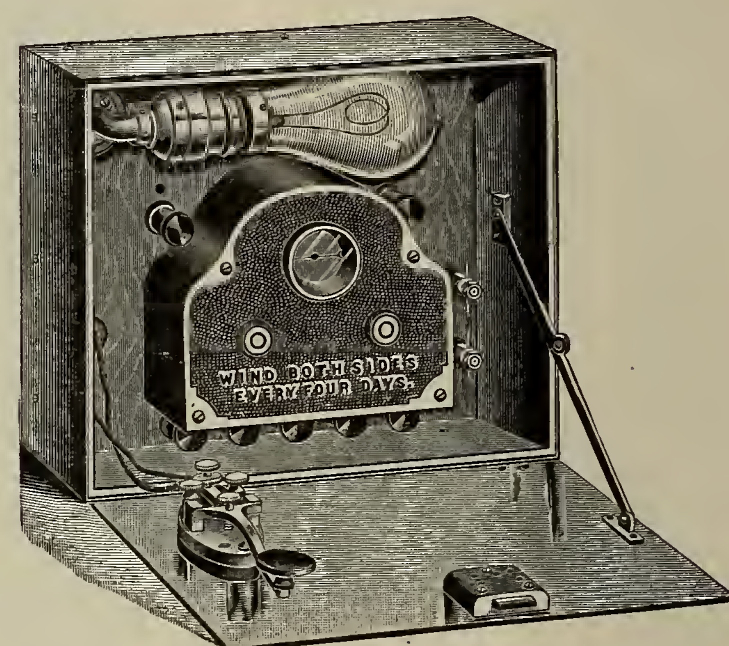
Whistle Switch.—Located convenient to officer in charge, at different points of the bridge, or pilot-house.

municate with other vessels by simply following the dots and dashes of the Morse code. It is not a difficult matter to discriminate between the length of a long and short signal, and the captain may easily occupy the position of an operator, provided he follows a card having the Morse code

Multiple Switch, with Telegraph Key.—Size 10x15x5 inches, when closed.

printed upon it. Life saving stations provided with telegraphic instruments of this nature can readily communicate with vessels at sea. As compared with the primitive method of signalling with flags, this scheme takes but one one-hundredth of the time and possesses the additional advantage of being available at night. If the distance is too great between the points of communication, escaping steam, which is visible a distance of many miles, can be used instead. By the use of the whistle telegraph, a message of mercy can go speeding on its way night or day, in calm or in storm.

Mr. Hillis, of Bagnall & Hillis, of Yokohama, arrived January 15, and will make his office at 15 Cortlandt st., New York, Room 62.



Improved U. S. Navy Standard.—Size 9x10x5 inches, when closed.

Cleveland, O.—An electric railroad will probably be constructed from this city to Milford and Terrace Park.

New York, N. Y.—The Manhattan Elevated Railroad Company is about to equip its road with an electric system.

Ocean Marine Multiple Switch.—Size, 13x13x6 inches.

Toronto, Ont.—Ritchie, Ludwig & Ballantyne, solicitors, give notice that application will be made at the next session of the Legislature to incorporate the Toronto and York Radial Railway Company, with the power to purchase the franchise and property of the Metropolitan Street-Railway, Toronto Belt-Line Railway, Toronto-Munico Railway and others.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy. six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, JANUARY 22, 1898.

CONTENTS.

THE INEVITABLE OUTLETS OF AMERICAN INDUSTRY.

A book may some day be written entitled "The Rise and Fall of European Manufacturers." It is not with the vain spirit of spread-eagleism that American manufacturers may look forward to the day when many of the industries of Europe will have succumbed to competition and acknowledged by their decease that American manufacturers know how to produce better machinery at a cheaper price than they themselves.

The reports reaching Washington, from the different consuls scattered over Germany, France, England, Italy and Switzerland have indicated the presence of a competing force, perfectly evident in each industrial centre of these countries. The time is not so remote since Americans bought their China plates from Europe and as to any manufactured article in the line of simple machinery, the early Americans acknowledged without hesitation that they were unable to even contemplate other than the crudest methods of manufacture. But since this comparatively short span has passed, since America has grown from the Atlantic to the Pacific and made use of her own natural resources, her ability to produce and manufacture has been so greatly augmented that now, in the face of some of the greatest and most firmly established European manufacturers, she has presumed to set her goods in competition and has found, in spite of ancient prejudices and time-worn notions, a ready sale for them.

The great steel works of the United States are not only supplying the people of this country, but sending tons of this most precious metal to various European and particularly English ports.

One of the proofs that American ingenuity is more awake and comes more quickly to a focus than the same genius in Europeans is found in the rapid sale of American bicycles all over Europe, and the only hope of those engaged in that industry is to compete with the influx of American wheels by the use of American machines and American methods. Bridge building has become a matter of international competition, with the result that Americans have successfully competed with European engineers in this field and secured large and paying contracts. The elevator equipment of the underground road in London was secured by a well-known American firm of electrical engineers and manufacturers. Electric cars completely equipped are being exported from American to English shores and in Germany motors and generators and sundry supplies have found a quick sale and a ready market.

It is evident that the tide is changing and that, unless tariffs are raised for the protection of each mother country, the time is not far off when Americans will transport their goods across the water as systematically and in as large quantities as our European friends formerly did to our own shores.

The problem presented to the student of industrial conditions is a strange one. Why can American manufacturers compete so ably with Europeans when their wage rate is higher? A clew as to the real reason may possibly be found in the absolute system prevailing in all methods employed by the American manufacturer.

Whether this be so or not we leave to others to decide, but the fact is still clearly evident that the drift of manufactured products and particularly the sale of American-made machinery is to be found annually increasing in lands as well equipped as our own for the same work.

THE IMPROVEMENT OF CANALS.

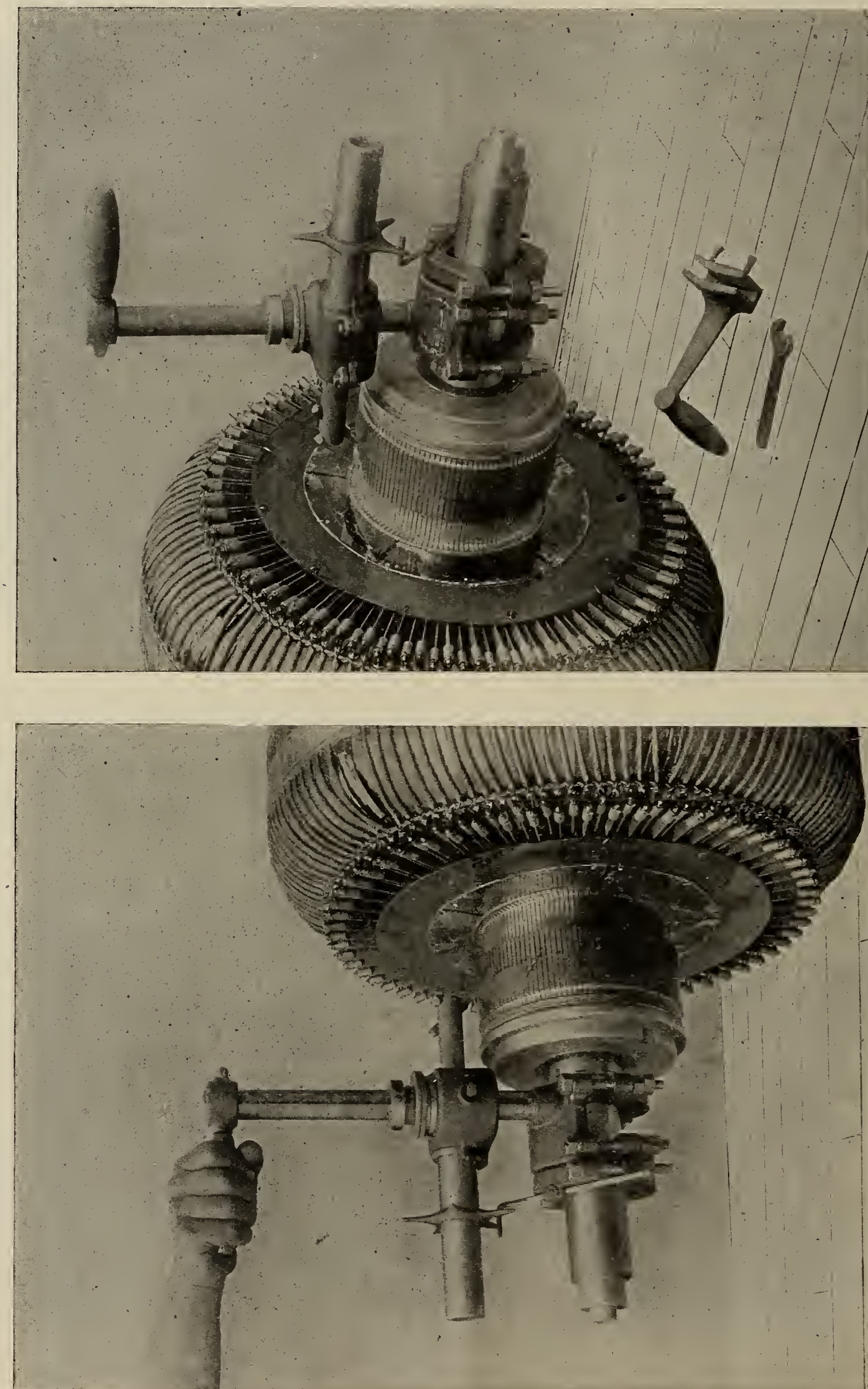
The organization founded for the improvement of canals in this state has as its president George Clinton, of Buffalo, whose grandfather was the founder of the Erie Canal. The organization over which he presided was known as the Union for the Improvement of the Canals of the State of New York. Their work in connection with the improvement of the Erie Canal was of considerable importance, and the influence they exercised is felt today stronger than ever. In 1894, on the Seymour plan, it was proposed to spend $12,000,000 on canal improvement. Unfortunately the legislature of 1894 vetoed the scheme. The Executive Canal Committee was formed in the same year with Chairman Balch as its representative, and a measure was brought forward with the same purpose in view. As far as these bills, propositions and schemes are concerned we have but this to say, the legislature does not seem to thoroughly appreciate the value of improvement in the nature of quicker transportation along the route of a canal. The state has been completely deaf to all that refers to the use of an electric system of propelling canal boats. If improvements are to be made, let them be of a radical nature, not merely with reference to the width of a canal or the depth of its locks, but having some bearing upon the question of speed and improved facilities for transporting freight or merchandise quickly from point to point. Let the canals be regarded not only as an outlet of some importance, but as an artery of trade of the greatest importance from which the state could reap an enormous revenue by providing for its people a new and effective means of transportation. We have the canals; what we need now is an electric traction system running along its banks. Let the mule assist ancient civilization, not the new. Let its backwardness make way for the forwardness and promise of the swiftly travelling current.

Newberry, N. C.—The construction of a telephone system is contemplated.

COMMUTER TRUING DEVICE.

One of the most valuable parts of a dynamo is the commutator. It requires great skill and perfect machinery to make a good commutator and it has always been a matter of trouble and expense to repair it when out of order. It sometimes becomes ridged with grooves or develops lumpy segments. When in this condition, it must be trued or turned down. The B. & B. Commutator Truing Device of the Fort Wayne Electric Corporation, Fort Wayne, Ind., is the invention of one of their foremen and assistant superintendents. As will be seen from the illustration, it is intended for connection by a clamp to the armature shaft, around which it is revolved by hand power.

The tool is fed automatically forward with each rotation of the device around the shaft, facing the commutator perfectly true with the bearings. The crank shown in the figure is intended for use when it is desirable to true off the commutator without removing the armature from the machine. The crank is then attached to the pulley and the armature and commutator rotated instead of the tool.



Commutator Truing Device.—Patent Applied for.

This apparatus was especially designed to meet the requirements of the Fort Wayne dynamos, but is also applicable to any dynamo having commutators within the capacity of the device. It is especially adaptable to the truing off of railway motor commutators and does this work much better than is possible in a lathe, as it leaves the commutator surface perfectly true with the bearings, a very important consideration when carbon brushes are used.

The machine is neatly designed and substantially built and is practically inexpensive when its advantages are considered. In fact, no power or lighting station should be without one, as it saves not only the expense of a lathe but also the expense of cartage to the nearest repair shop.

The engineer will frequently argue against the use of a practical device by claiming that the dynamo under his care never sparks. The possession of a commutator truing device is certainly a ready means of obviating the difficulty as soon as it presents itself. It has been endorsed by the best men in the country, and on account of its ready adjustment and independent action is certainly the best device of its kind on the market.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

On January 12th, the New York Electrical Society had its 184th meeting at the College of the City of New York, where most of its this season's meetings will be held.

Mr. S. Dana Greene read a valuable and interesting paper on: "The Relations Between the Customer, the Consulting Engineer, and the Electric Manufacturer."

The aim of Mr. Greene, of this paper, was to assist in bringing about that better understanding between those departments of the industry on which so much of its welfare and prosperity depends.

Messrs. Max. Osterberg, Gano S. Dunn, C. O. Mailloux, H. B. Coho, and Drs. C. E. Emery and F. B. Crocker, took part in the discussion. The following resolution was duly presented and adopted:

Standardization.

Resolved, That in view of the excellent suggestions and recommendations on standardizing apparatus embodied in Mr. S. Dana Greene's paper, the society hereby expresses its approval of efforts in that direction, and invites the American Institute of Electrical Engineers to consider some comprehensive plan for such standardization of American apparatus for electric light and power.

The members elected were:

Otto Rothenstein, Otto Electric Co., Times Building, New York City.

F. K. Vreeland, 228 Orange Road, Montclair, N. J.

F. V. Henshaw, 79 State street, Brooklyn, N. Y.

S. L. Griswold Knox, Crocker-Wheeler Electric Co., Ampere, Newark, N. J.

John Neilson, Supt., Larchmont Electric Co., Larchmont, N. Y.

Putnam A. Bates, 113 W. 72nd street, New York City.

E. B. Higgins, 26 Cortlandt street, New York City.

Thomas A. Edison, 96 Broadway, New York City.

At the request of the president the secretary read the following announcement:

Announcement of Agreement Between the New York Electrical Society and the Electrical Exhibition.

For some time past the New York Electrical Society has been considering means for enlarging its scope of usefulness, and addressing a larger clientage among the citizens of New York, so as to bring the public into more intimate relations with the scientific aspect of all classes of electrical work. The proposition to hold an Electrical Exhibition at Madison Square Garden, next May, appeared to the society to afford it the needed opportunity for putting itself prominently before the public as the oldest electrical body in the country, and the recognized local society, aiming by papers and discussions to diffuse the best electrical information.

The electrical exhibition has very promptly and generously met the views of the New York Electrical society, and has not only apportioned it space in the exhibition hall, for a booth and rendezvous for its members and friends, but has also placed at its disposal a contribution of funds for its educational work. This amount will be increased by a percentage of the admission receipts of the exhibition, which is to be held "under the auspices of the New York Electrical Society." Members of the society will be admitted to the exhibition at half price.

It is believed, from what is already known, that this exhibition will surpass anything of the kind ever done in this city, and will, during the continuance of a month, not only do much to promote electric interest, but enable the society to reach a great many thousand people who should know of its work, and many hundreds who would unquestionably be in its membership.

The Electrical Society is now organizing committees and laying plans for a hearty and active co-operation in the work of the Exhibition and looking, of course, to its own increase of membership and its fuller recognition as an authoritative, influential body.

It is hoped and expected that this will mark the beginning of one of the most successful moves ever undertaken by the Society, and approving comments of friends and members encourage the executive committee to believe that they will be enthusiastically supported in the programme, the sole object of which is to increase and extend the Society's usefulness. The officers would therefore not only urge the members of the Society, individually and collectively, to assist in making the Exhibition as brilliant a success as possible, for the direct benefit that such success will confer on the Society, but also wish to impress on members the desirability of active co-operation with a view of increasing the membership—a membership which, standing now at four hundred, should be at least a thousand before the year is out.

It has been suggested that the Advisory Committee of the Society, representing its interests with the officers of the Exhibition, and for other exhibition purposes, should consist of the present officers and all the living ex-presidents, namely:

Frank W. Jones,
John M. Pendleton,
Dr. Francis B. Crocker,
Joseph Wetzler,
C. O. Mailloux,
John W. Lieb, Jr.,
Dr. C. E. Emery,

all of whom, it is understood, will gladly co-operate in this movement to develop work, to which they themselves have so actively contributed in past years.

The following resolution was put to the meeting and adopted:

ELECTRICAL EXHIBITION.

RESOLVED: That having heard the report of the officers of the Society in regard to the arrangement effected for co-operation with the approaching Electrical Exhibition in this city, the members hereby express their hearty approval and pledge themselves to active work, that shall make the most of this opportunity for promoting the interests of electricity and the welfare of the society.

HENRY ELECTRICAL SOCIETY.

Rooms Nos. 111-115 West 38th street, New York.

The next meeting of the Henry Electrical Society will be held at Columbia University, Engineering Building, Room 302, on January 21, 1898, when Mr. D. R. Lovejoy will deliver a lecture on "The Induction Coil and High Potential Discharges."

The lecture will treat of the practical design of the induction coil and will be illustrated by many experiments showing the various effects obtainable.

A D'ARSONVAL GALVANOMETER.

In an article written by Edward E. Sheldon for the American Electrician, entitled "Construction of a Galvanometer," some valuable detailed matter was given in connection with the appended illustrations, that related exclusively to the construction of a D'Arsonval galvanometer.

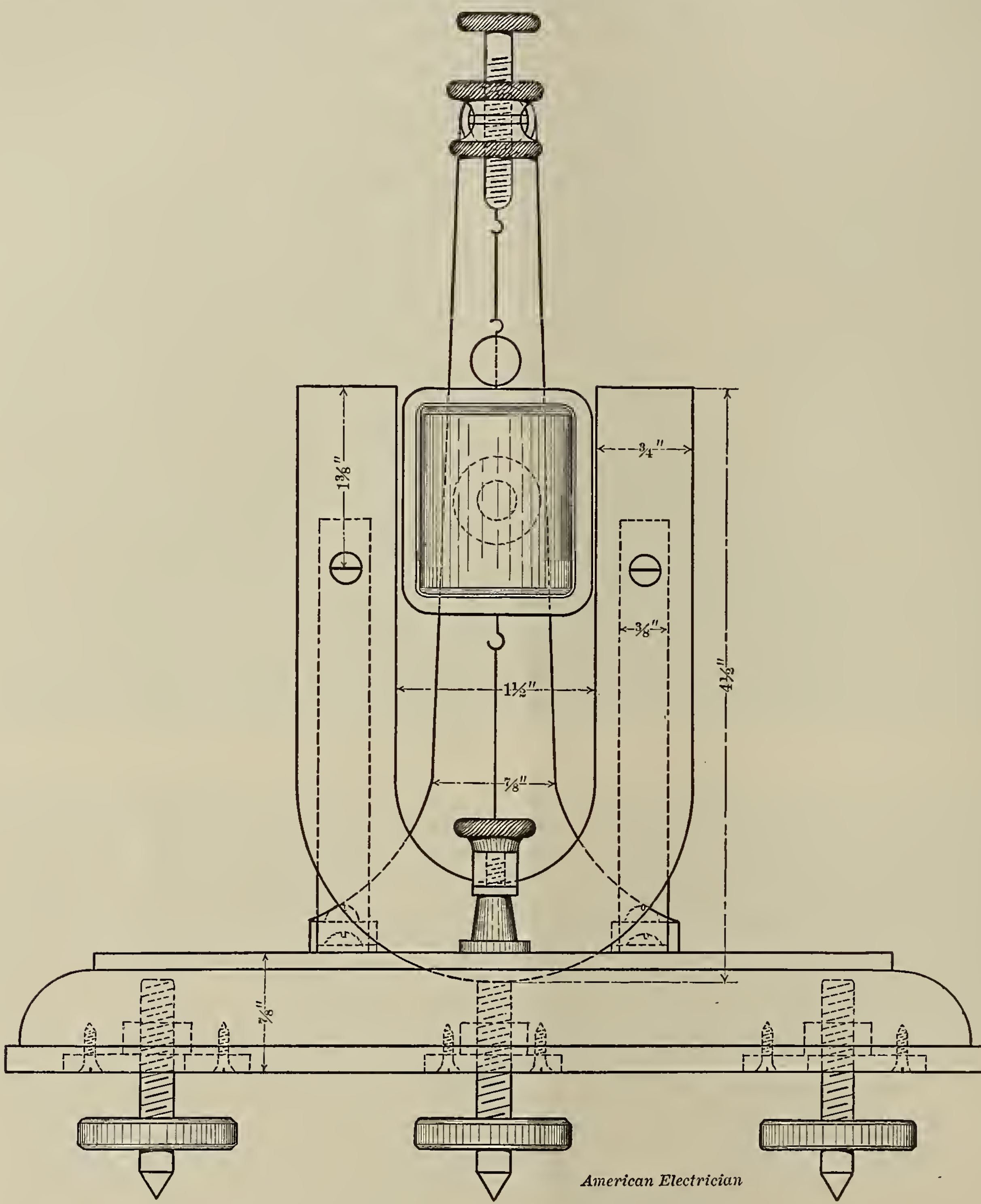


Fig. 1—D'Arsonval Galvanometer—Front View.

It may be interesting to some of our readers, not well versed in the technical side of this subject, to know that the Weston Electrical Instrument Company, of Newark, N. J., have made a success of the application of the D'Arsonval galvanometer, in the construction of volt and ampere meters. The working drawings of a galvanometer that will prove to be very serviceable are represented in the foregoing illustrations.

The base of the galvanometer, shown in figures 1 and 3, is made of hard wood or rubber. The supporting piece, shown in figure 2, is finished from a brass casting. The shape and dimensions of the same are given in both figures 1 and 2. The cylinder of soft iron supported between the poles of the magnet is attached to the standard as shown in figure 2, and the adjusting screw above which raises or lowers the coil surrounding this soft iron cylinder can be observed in figures 1 and 2. The coil is wound upon a framework of metal or fibre, the size of wire being No. 36, B. & S. A small mirror is attached, as shown in figure 1, above the coil.

Further details of value to the student desirous of constructing this instrument complete, may be found in full in the May, 1897, issue of the American Electrician.

Keokuk, Ia.—The Ottumwa Electric Railway—Judge Woolson has signed and filed a decree in the federal court ordering the sale of the electric road.

MEASUREMENT OF CAPACITY.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Condensers in Series.—When a set of condensers of equal capacity are connected in series the capacity of the group is reduced, but the pressure increased.

With Capacities Equal.—When the condensers are of equal capacity, the capacity of all connected in series is equal to the capacity of one divided by the number.

With Capacities. Unequal.—When the condensers have different capacities and are connected in series, the capacity of the whole is equal to the reciprocal of the sum of the reciprocals.

Represented in symbols

$$K = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} + \text{etc.}},$$

where K = total capacity
K_1 = capacity of first condenser
K_2 = " second "
K_3 = " third "

Condensers in Parallel.—When condensers are connected in parallel the entire capacity is equal to the sum of the capacities.

Method of Direct Deflection.—The capacity of a condenser can be ascertained by reference to another condenser in a very simple manner.

In order that two charges may be compared, a galvanometer must be used whose deflection depends upon the amount of the charge sent through it.

A ballastic galvanometer serves this purpose to perfection. It does not differ in principle essentially from a reflecting galvanometer, except in regard to its swing. It swings very slowly when subjected to a sudden discharge from a condenser.

Method.—If two condensers of unequal capacity are to be compared, one must be known.

Instead of a condenser, the other may be a section of submarine cable, etc.

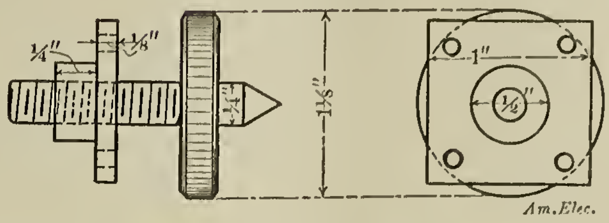


Fig. 4, Leveling Screw.

Both are charged by a constant E. M. F.—a standard cell, for instance.

When the condenser of known capacity is charged, it is discharged through the galvanometer and the deflection noted.

The other conductor or condenser of unknown capacity is likewise connected and discharged through the galvanometer. The charges are compared by means of the deflections, and the capacities correspond likewise.

Supposing a condenser of one-half a microfarad is charged by a standard Clark cell, when discharged the deflection

$$d_1 = 80;$$

with the condenser to be measured the deflection

$$d_2 = 200.$$

The rule states as follows: Capacity of the first : ca-

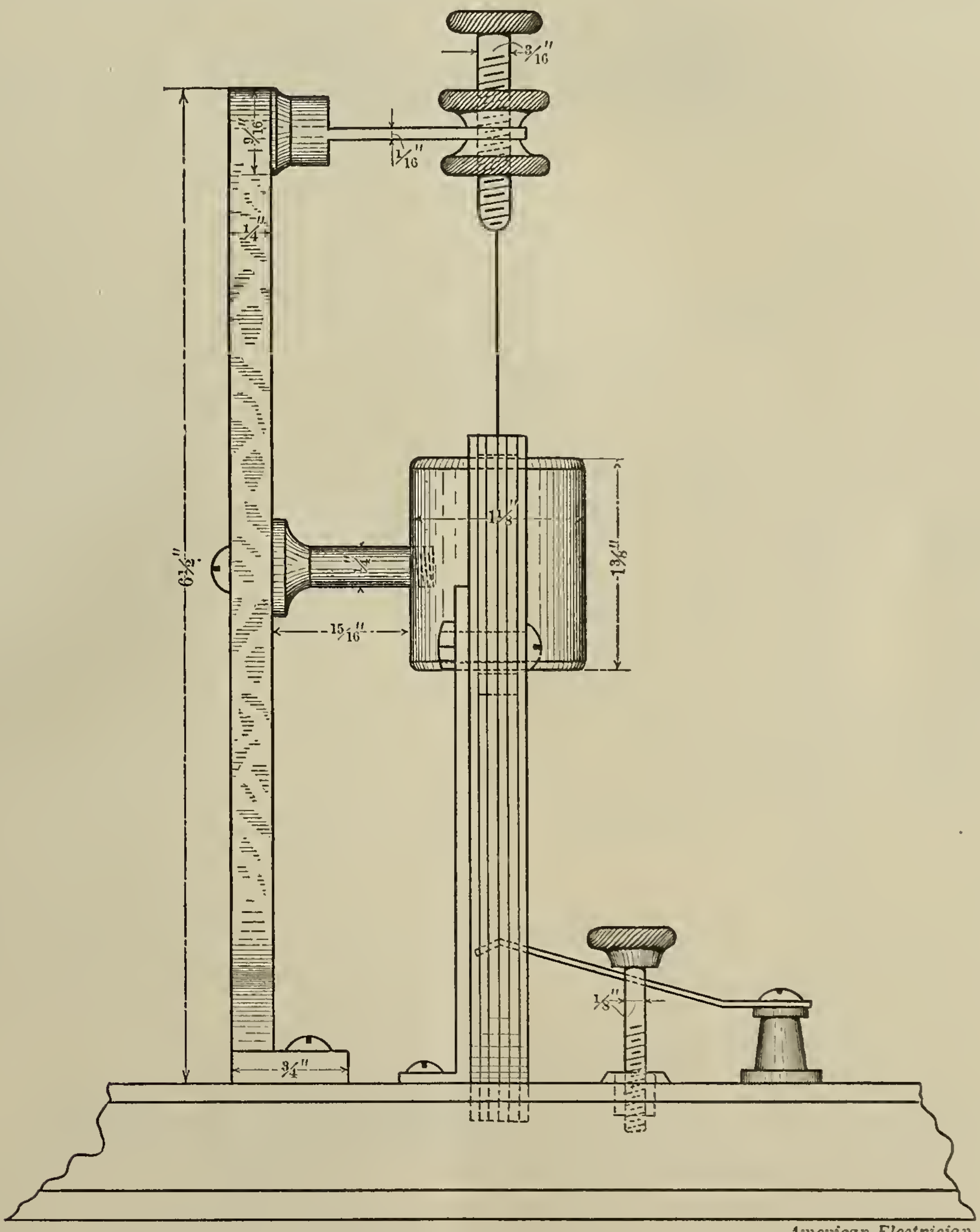


Fig. 2—D'Arsonval Galvanometer—Side View.

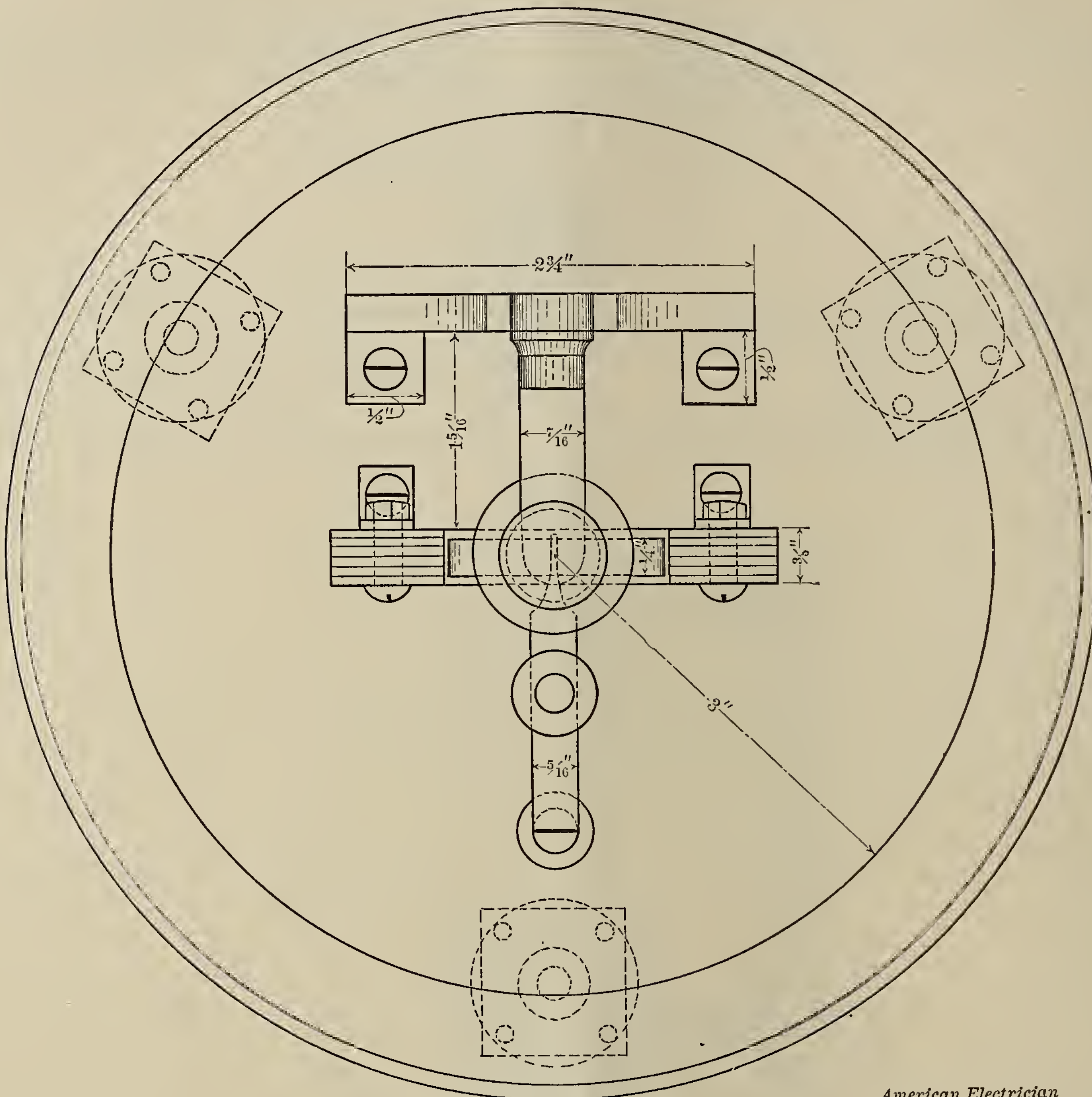
pacity of the second = first deflection : second deflection.

In symbols

$$F_1 : F_2 : = d_1 : d_2$$

F_1 = capacity of first condenser = ½ M. F.
F_2 = " to be determined.

There being no practical limit to the capacity of a body, the greater the pressure the greater the charge it will hold. In telephone practice the wire is surrounded by crinkled paper, and the insulation over that, to surround it with air if possible—air having a specific inductive capacity equal to unity—thus reducing the induction and consequent charge.



American Electrician

Fig. 3—D'Arsonval Galvanometer—Plan View.

d_1 = deflection due to ½ M. F.
d_2 = " " unknown capacity;

therefore,

$$F_1 = F_2 \times \frac{d_2}{d_1}$$

$$= \frac{1}{2} \times \frac{200}{80}$$

$$= 1.25 \text{ micro-farads.}$$

Condensers are generally made of alternate layers of tinfoil and mica, or tinfoil and paraffined paper.

A knot of cable about $1\frac{1}{6}$ miles equals $\frac{1}{3}$ microfarad capacity.

A condenser in many respects resembles a battery of very high internal resistance.

It has been discovered that condensers when exposed to a rapidly alternating electric current become heated. The paper if paraffined may dissolve the wax. This effect is due to dielectric hysteresis.

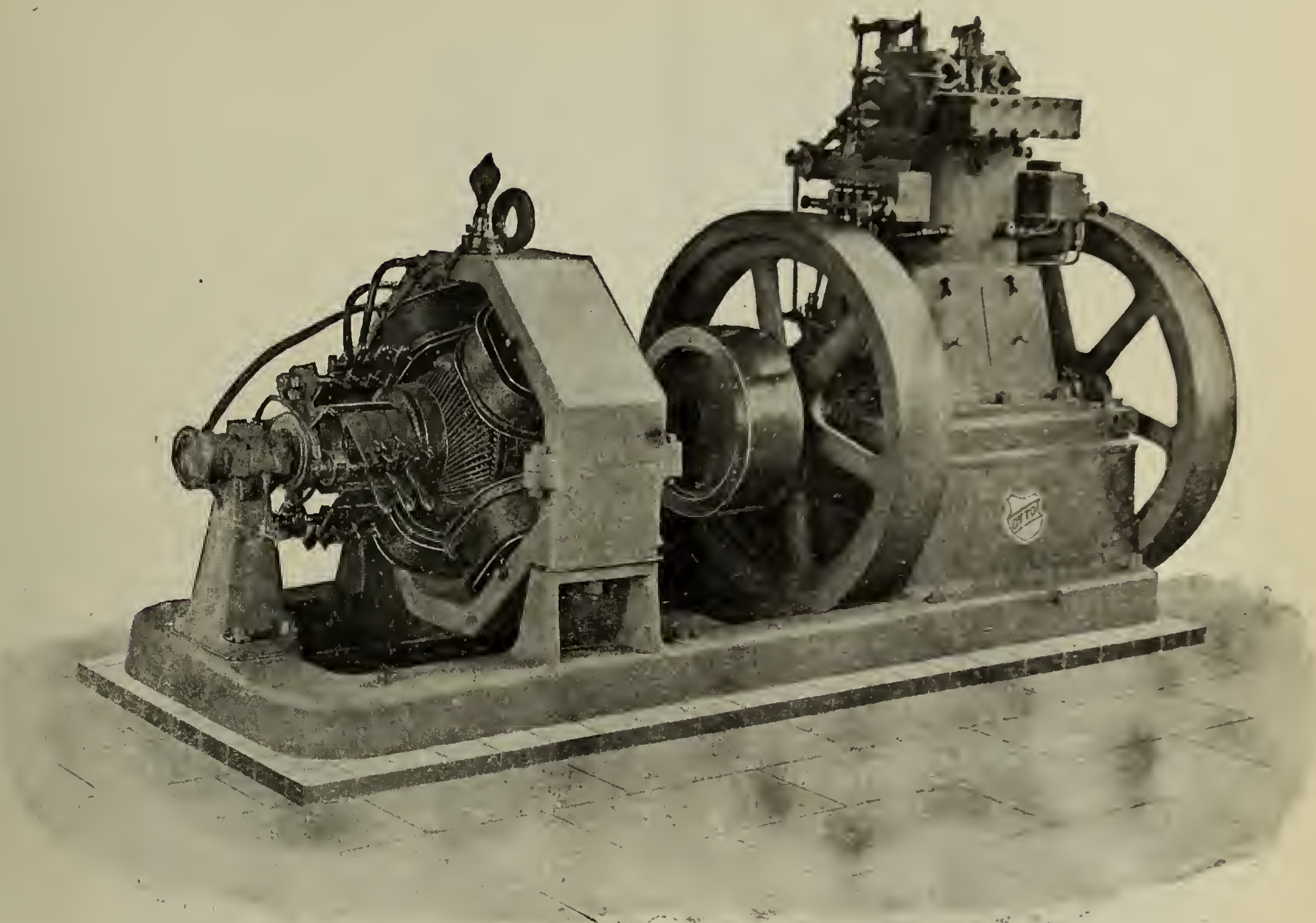
If the capacity of the great Atlantic cable could be reduced the passage of signals would be greatly accelerated. At present the cable must first be charged before a signal reaches the other end.

When alternating or interrupted currents are used a condenser prevents rapid communication; a coil of wire, if properly arranged in circuit, will in such a case neutralize its effect.

H. B. Crouse, of Crouse-Hinds Electric Co., of Syracuse, N. Y., makers of switches, switchboards, panelboards, etc., was in town January 15, closing up some big orders needing his personal attention. Mr. Crouse and Mr. F. M. Hawkins, of 39 Cortlandt street, N. Y., their Greater New York agent, were together doing Greater New York on important business. Mr. Crouse left for home early in the evening.

The Electrical Age.

VOL. XXI—NO. 5 NEW YORK, JANUARY 29, 1898 WHOLE NO. 559



Gas Engine Plant. Otto Gas Engine and Electro Dynamic Company's Machine.

THE ELECTRO DYNAMIC COMPANY.

It has often been said that the greatest inventions are generally the simplest ones. A highly ingenious device is being manufactured and sold by the Electro Dynamic Company, of 224 Chestnut street, Philadelphia, that will probably give rise to the remark on the part of electricians indicative of an immediate appreciation of its good qualities. The device is included among a list of marine specialties and is called an electric speed indicator. It is built upon a very simple principle, as follows: a permanent field is produced by a pair of steel magnets. An ironclad armature rotates in this field, being driven by the engine, whose speed it is to record. It is evident to the reader that electromotive force is directly proportional to speed in a field of constant intensity; therefore, by using a voltmeter or electric revolution indicator upon whose dial speed is marked instead of volts, the revolutions per minute of any piece of machinery, steam engine or otherwise, may be brought to the attention of more than one individual widely separated from each other at the same time.

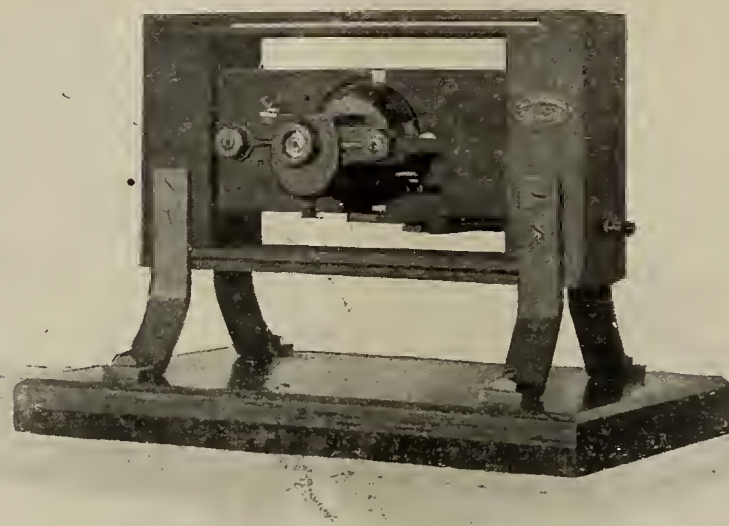
The above device not only shows revolutions but also direction of rotation. The pointer rests normally at the middle of the scale and moves to the right or left according to the direction of rotation. For steamers using twin screws, it is possible to keep a record and have in constant view the revolutions of each engine. When both screws rotate at the same speed the rudder may be kept in its normal position between the two, and thus save an element of delay which in the aggregate may affect the vessel's time of landing. The indicators are enclosed in waterproof cases and may have their dials illuminated at night.

As an instance of the benefit of the helm angle indicator we would state that it has been found that on one of the record-breaking transatlantic liners, that by adjusting the speed of engines so that the helm could be maintained amidships, the lessening of friction resulted in a saving of two hours' time on a trip across.

Edco Dynamos.

The Electro Dynamic Company manufacture the well-known Edco dynamo, which has met with great success since the time of its introduction. They are economical, well designed and are capable of extended runs without heating or sparking or deterioration in any respect. They are built for either belt drive or direct connection. The field yokes are made of mild steel of very high permeability. The bearings are ring oilers. The important principle which should underlie the construction of all armatures has not been neglected by this company, but observed in their ironclad cool-running armatures; the rapid radiation of heat from the armature, to which we refer, has been so successfully accomplished that the safety factor is unusually large, thus enabling the consumer to call upon the machine without danger for high percentages of overload. The commutators are made of tempered copper, with high-grade mica insulation. The machines are of multipolar design, varying from ten amperes in a 115 volts through a series of 12 sizes to a six pole, 500 ampere, 115 volt generator.

An illustration is given of a direct-connected gas engine plant, consisting of a No. 26 "Otto" gas engine, running at 300 revolutions per minute, of 22-brake horse-power. The height from centre of shaft 40⅝ ins.; fly-wheel, 32 ins. in diameter; weight, 2400 pounds. The generator is a 300-light machine, delivering 150 amperes, at 115 volts, of 17¼ k.w. at the normal of 400 revolutions per minute. The plant was installed in the home



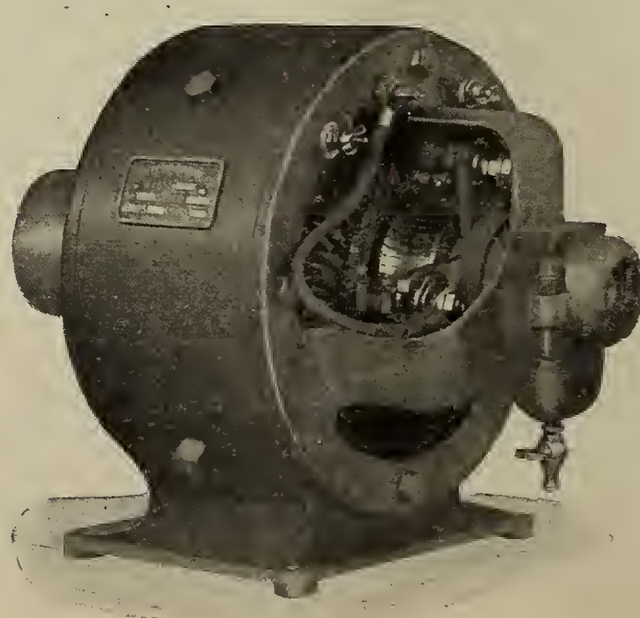
Generator of Electric Speed Indicator.

of Frank K. Thomson, president of the Pennsylvania Railroad, Philadelphia.

The Electro Dynamic Company built and sold electrical machinery in 1880, and is therefore familiar with

Electric Speed Indicator.

every detail of construction, and is up to the times in the latest electrical and mechanical developments.



Closed Type (Dust Proof) Multipolar Generator.

Electric Drill Motors.

They have been particularly successful with their portable electric drill motors with flexible shaft Its use means of 60 per cent. saving in labor, and its advantageous application for drilling in shipyards, boiler shops, and erecting shops of all kinds is substantiated by the nature of the communications received approving of its use and speaking highly of its benefits. The following letter speaks for itself:

NAVY DEPARTMENT, Bureau of Construction and Repair.

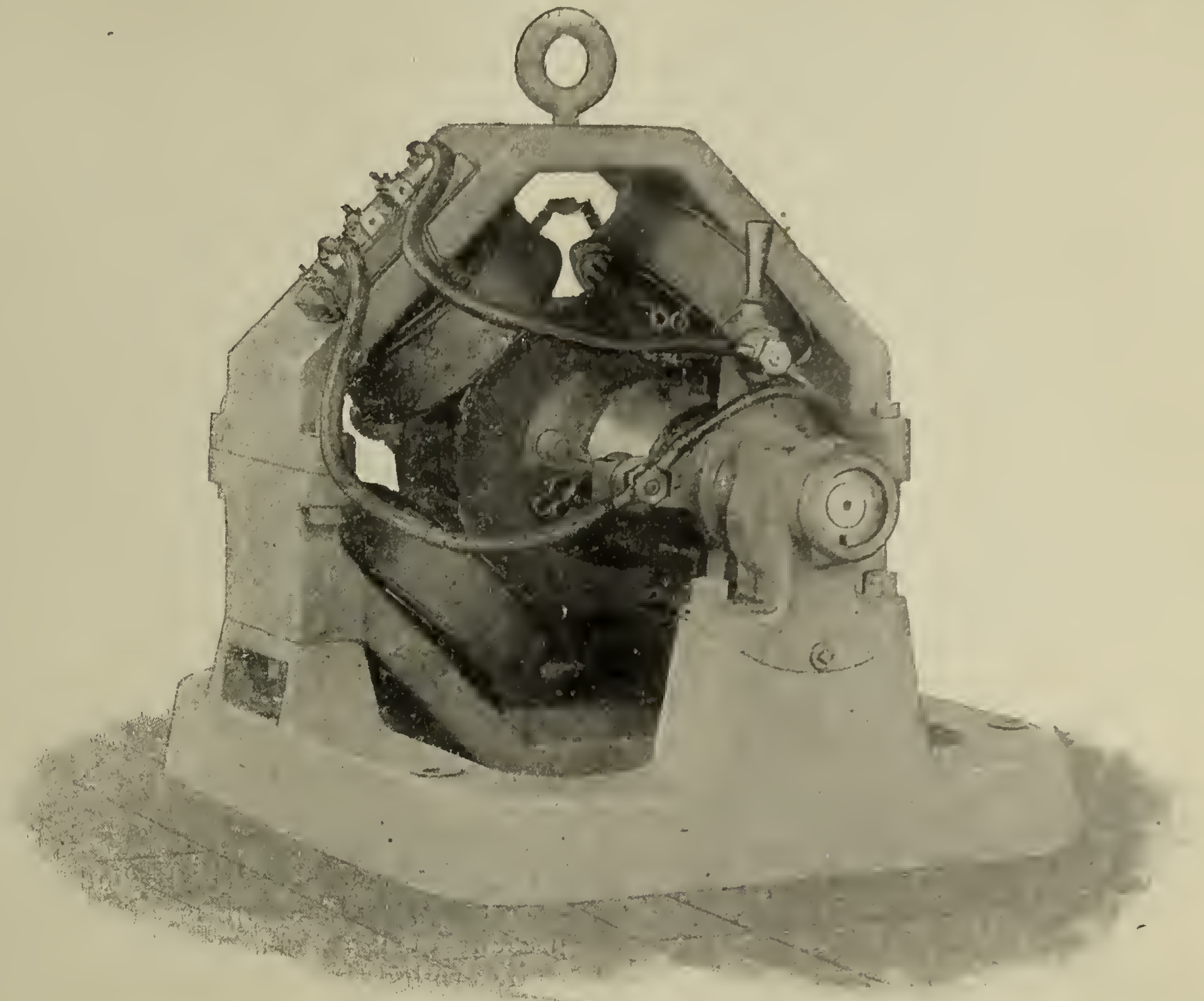
Electric Rudder Telltale.

Washington, D. C., February 11, 1892.

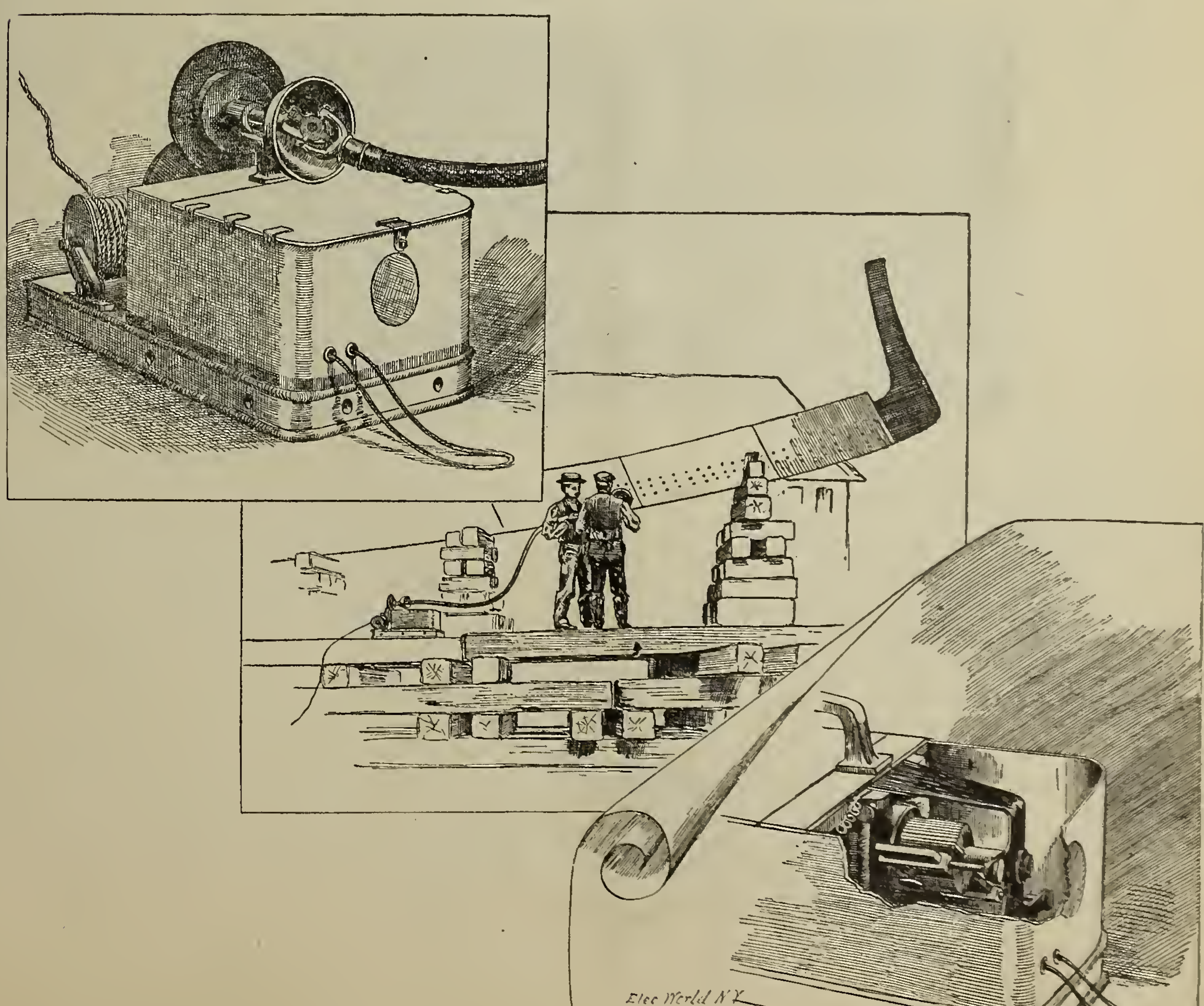
Electro Dynamic Company,

224 Chestnut street, Philadelphia, Pa.

Gentlemen:—Replying to your letter of the 6th instant, relative to the electric drill motors furnished by you to the Brooklyn Navy Yard, I would say that the motors gave entire satisfaction while I was stationed at the yard, and during the visits I have made there during the past year I have always found them at work, and heard the desirability of having more of them repeatedly expressed. In all heavy drilling required in naval vessels, the motors are particularly serviceable, and I believe there will be a large field for their use in drilling for side armor bolts of armored ships.



Open Type Multipolar Generator--Electro Dynamic Co.

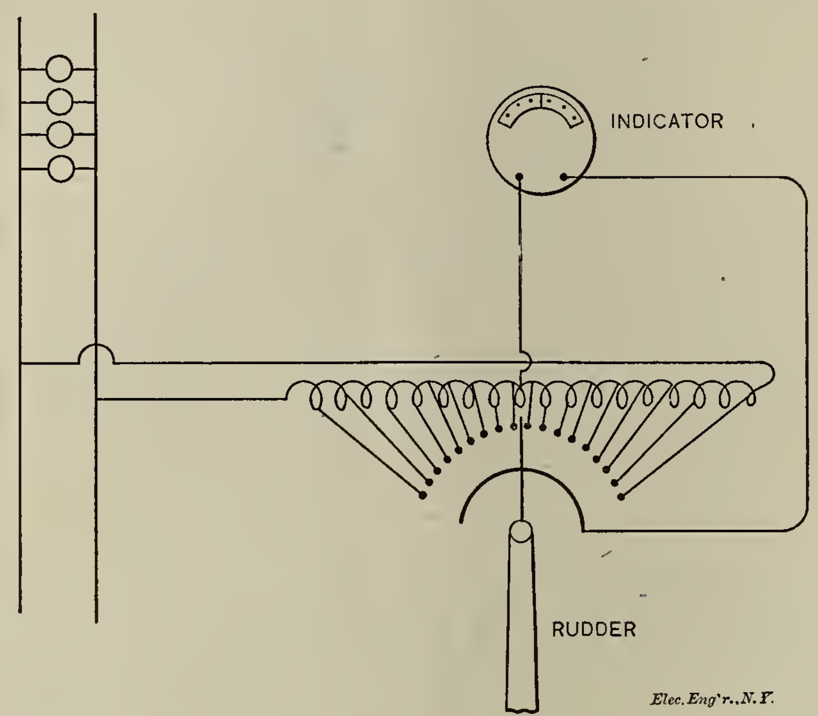


Electric Drilling Machine.—Electro Dynamic Co.

I believe the 2 h.-p. type of motor, similar in its general features to that you built for the New York Navy Yard in 1888, is most suitable for general work, and that it will be seldom desirable to build the smaller sizes of motors, since the 2 h.-p. motor is light enough for all practical purposes of transportation in a ship yard.

Very respectfully,

J. J. WOODWARD,
Naval Constructor, U. S. N.



Electric Dynamic Co.

LAMP INSPECTOR'S INDICATING WATT-METER.

The successful operation of an incandescent lighting system depends largely upon the use of lamps of proper efficiency. To secure the most satisfactory service and highest economy, the efficiency of the lamps should be as high as the fluctuation of voltage on the circuits will permit. The selection of lamps for a particular installation should, therefore, be made with regard to the regulation obtained with the transformers in use. Efficiency is also the true basis for renewal of lamps, for it is manifestly uneconomical to continue a lamp in service when it has so deteriorated that the current it unnecessarily consumes costs more than a new lamp.

A portable instrument to determine accurately and rapidly the watts per candle-power required by a lamp, is of great value in selecting new lamps and in testing lamps in service. The General Electric Company has recently designed and introduced the Thomson Inclined Coil Portable Indicating Watt-Meter to meet an increasing demand for instruments of this class.

All of the well-known merits of the Thomson Inclined Coil Instruments are embodied in the new watt-meter and the workmanship is of the highest grade. The present design was adopted after numerous experiments to determine the most advantageous arrangement to facilitate rapid testing of lamps without inconvenience to their users. On account of the rapidity with which readings may be made, the indicating watt-meter will also be found invaluable for testing lamps in barrel lots either with or without the photometer. The watt-meter will accurately indicate the energy used by small fan motors and is, therefore, particularly useful in comparing, for a customer's benefit, the relative amount of energy required by a fan motor and an ordinary incandescent lamp. By supplying the secondary of a transformer with current, its core loss may be easily determined by the indicating watt-meter.

Fig. 4—Thomson Indicating Watt-Meter.

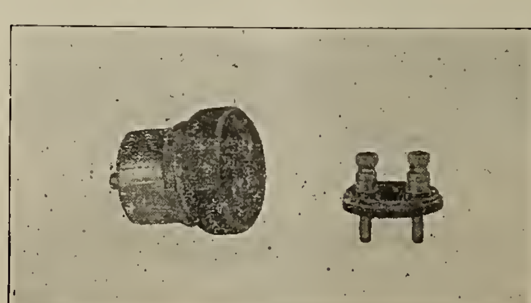


Fig 2—Secondary Attaching Plug.

For rapid connection the watt-meter is supplied with two special plugs, an Edison with T-H adapter, and a Westinghouse, thus providing ready means for connection to the three forms of sockets most generally in use. The lamp to be tested is inserted in one of the receptacles in the base of the instrument, and the proper plug placed in any convenient socket. Lead wires are provided suitably tipped at one end for insertion in the plugs and at the other for connection to the binding posts of the instrument. A small secondary plug arranged to fit the regular plugs and provided with two small binding posts, is also supplied with every instrument. With this convenient device the power required by small motors or other apparatus may be conveniently measured.

The capacity of the indicating watt-meter is 150 watts. Lamps of any candle-power up to 32 and of any voltage up to 150 may be tested, as may also any device, the consumption of energy in which is not over 150 watts at any voltage not exceeding 150.

The fact that the instrument is equally well adapted for use on either direct or alternating currents, necessitates the use of only one instrument in stations using both systems.

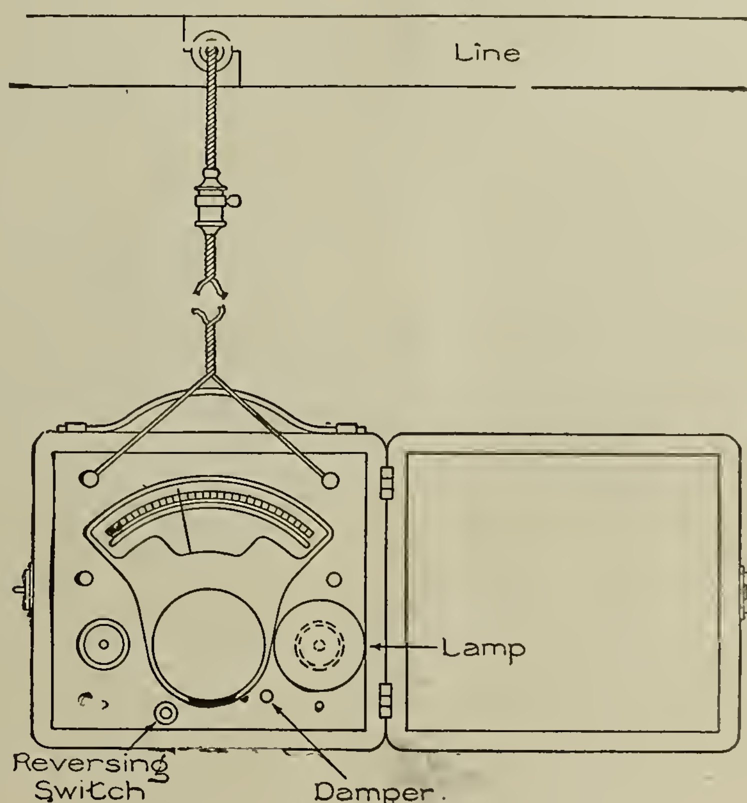


Fig. 3—Method of Connection.

On direct-current circuits reverse readings should be taken to eliminate the possibility of any slight error which may be introduced in all instruments of this class by the presence of local fields. A special reversing button is provided to reverse the current in the instrument and lamp without permitting the needle to fall back to zero. The usual convenience of reversing lead terminals is eliminated by the reversing button. When reversed readings are taken the mean of the two is, of course, taken as the final reading.

Another advantageous feature of the instrument is the damping device. A button is provided which releases the needle or pointer from the damping brake *only* when depressed. When the button is released the needle is held at the point of the last indication; therefore, if the current is turned off and then on again, or reversed, the necessity of waiting for the pointer to swing from zero to a state of rest is avoided and very rapid readings may be taken.

The terminals, reversing and damping buttons are mounted on a vulcanite baseboard above which the graduated dial slightly projects.

The instrument is mounted in a finely polished carrying case, with snap lock. It is light and compact, the external dimensions being 7⅜ in. x 7 in. x 4½ in. All parts are finished in polished nickel plate.

ELECTRIC LIGHT PLANT FOR THE BOROUGH OF NORRISTOWN, PA.

Sealed proposals will be received for an Electric Light Plant by the Finance Committee of the Borough Council of the Borough of Norristown, Pa., until 3 P. M., February 9th, 1898. Specifications and drawings will be delivered to bidders between the hours of 9 A. M. and 3 P. M., on and after January 25th, 1898.

The right is reserved to reject any and all bids, either in whole or in part, and to award the contract to other than the lowest bidder. Security will be required before specifications and drawings are delivered.

For particulars address Dr. W. A. Drysdale, Consulting Engineer, Hale Building, Philadelphia, Pa.

POWER FOR TONAWANDA.

North Tonawanda will have Niagara power early in the spring. This is the most important news that has been made public, in connection with the great electrical developments now going on along the Niagara frontier, since the announcement in December that power was ready for delivery in Buffalo for manufacturing and commercial purposes in practically unlimited quantities!

The Tonawanda Power and Conduit Company expects to be able to deliver the Falls energy to customers by May 1st, and perhaps sooner. Plans are already under way for building and equipping a power sub-station in North Tonawanda and work on the structure will be begun within a few weeks. Among the companies that are considering the use of Falls Power are the Tonawanda Lighting and Power Company and the Houix Manufacturing Company, which recently removed to North Tonawanda from Ohio.

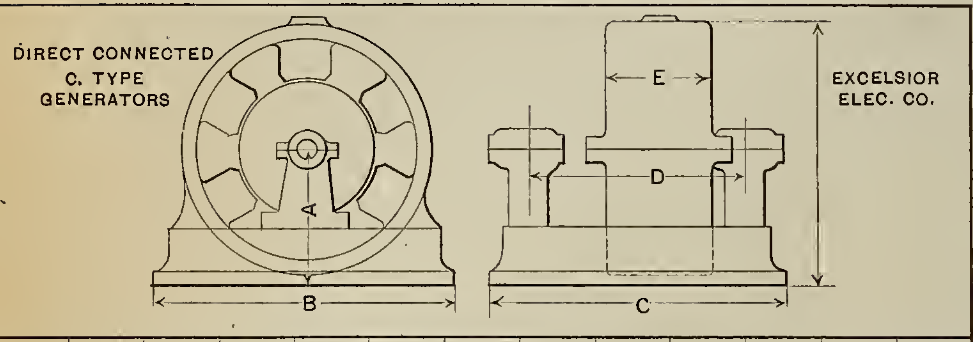
In Buffalo there have been no important power developments since the last number of Greater Buffalo. The Cataract Power and Conduit Company has, however, received many applications for power from manufacturing and commercial establishments in nearly every part of the city.

The successful introduction of the electric current from the Falls into the Great Northern and Electric elevators has attracted attention all over the world, and has led several of the older elevators in the city to put in applications for power.

A number of manufacturing plants at Black Rock are also figuring on the cost of the new power with a view to its exclusive use by them. Some important announcements in connection with the further use of the power in the city may be expected in the near future.

The Cataract Power and Conduit Company has awarded the contract for eleven step-down transformers to the General Electric Company of Schenectady. These transformers are for use in supplying Niagara power to the Buffalo General Electric Company's plant.—Greater Buffalo.

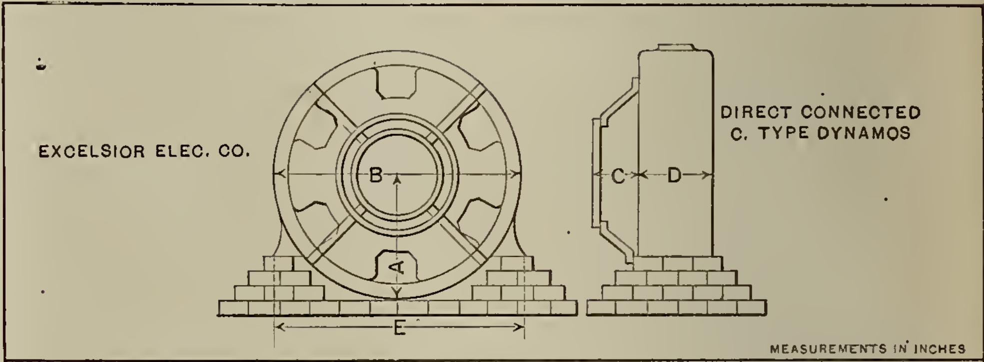
rents in the armature core is negligible. The solidity and substantial appearance of the Excelsior Electric Company's machines appeal to the eye of every competent engineer. The relations between shaft and bearings, the position of the centre of gravity, the design of the base and the ease with which the machine can be assembled or taken apart are noteworthy features. The apparatus built by this company is interchangeable in every respect. Parts are readily replaced and a line dropped to either 115 Broadway or Monadnock Block, Chicago, Ill., will, if re-



NO.	VOLTS	AMP.	K.W.	SPEED	A	B	C	D	E	F	G	DIAM. OF SHAFT
19			25	300	23	45	54	34	16	46		4
20			50	300	26 1/4	58 1/2	60 1/2	40	16 1/2	52 1/8		5
21			75	300	26 1/4	53 1/2	60	49 1/2	20	52 1/8		5
22			100	250	35	68 1/2	58 1/2	44 5/8	20	70		6
23			150	250	35	68 1/2	62 1/2	48 5/8	24	70		6
24			200	225	35	68 1/2	72 1/2	58 5/8	32	70		7
25			300	200								

Bartlett & Co., N.Y.

Direct-Current Direct-Connected Generator.

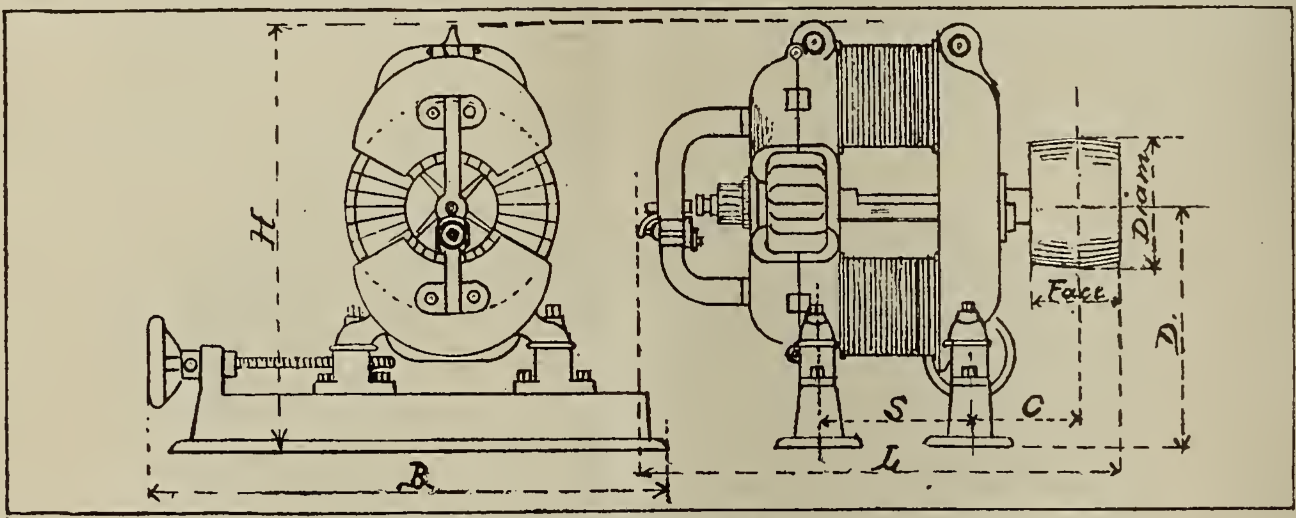


MEASUREMENTS IN INCHES

NO.	VOLTS	AMP.	K.W.	SPEED	A	B	C	D	E	F	DIAM. OF SHAFT
19			25	300	22	44	12	16	44		4
20			50	300	25 7/8	51 3/4	14	16	50 1/2		5
21			75	300	25 7/8	51 3/4	14	20	50 1/2		6
22			100	250	34 1/2	69	15	20	67		6
23			150	250	34 1/2	69	16	24	67		7
24			200	225							
25			300	200							

Bartlett & Co., N.Y.

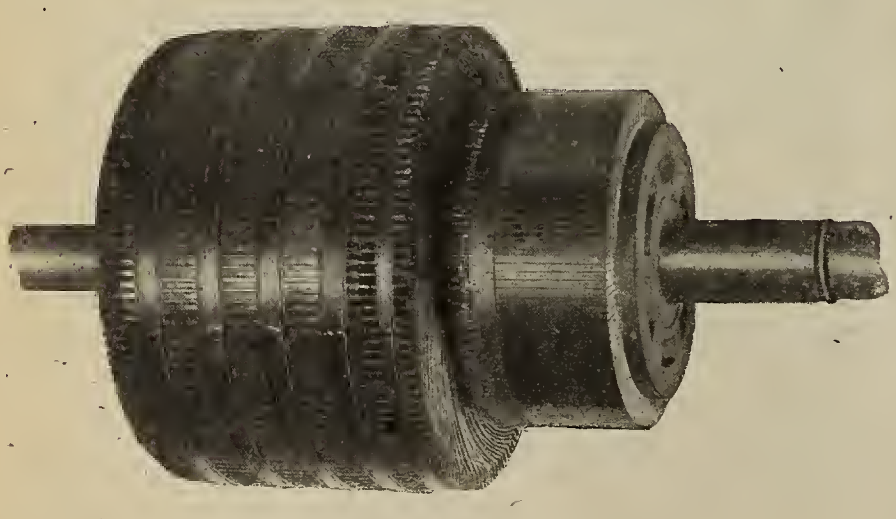
Direct-Current Direct-Connected Generator.



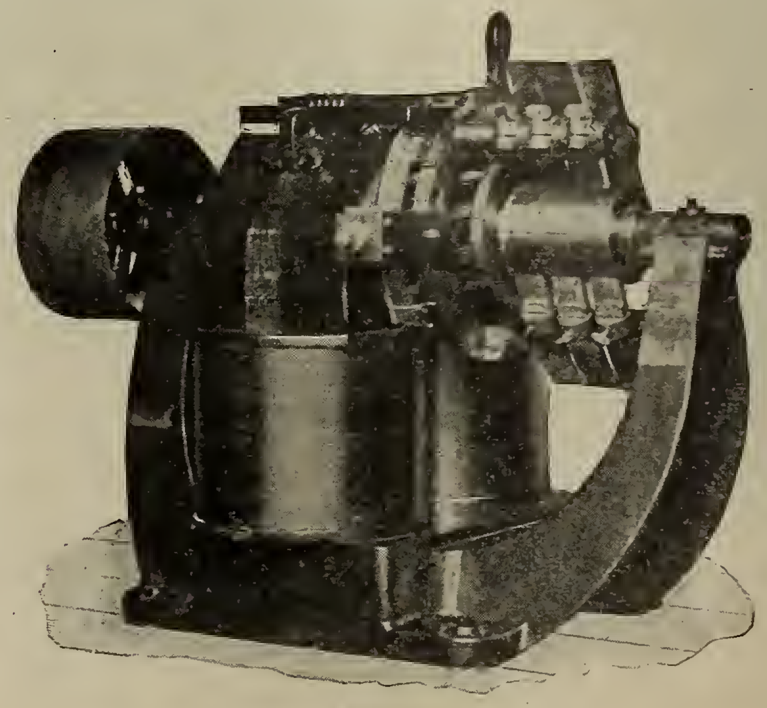
"Excelsior" Constant-Current Generator.

CHURCHWARD ELECTRICAL MACHINERY.

The Excelsior Electric Company, of 115 Broadway, New York City, have placed upon the market motors



Finished Armature.



Plater of Excelsior Electric Co.

and dynamos whose superior qualities and high efficiency are a by-word among the trade. The design of these machines indicates a close acquaintance with the requirements of a good dynamo or an efficient motor. Armature reaction and demagnetization of pole-pieces have been reduced to a minimum. Sparking is entirely absent at all points of load and the loss by hysteresis and eddy cur-

ferring to a special part, receive immediate attention. A carbon brush-holder and frame made of one piece, a solidly built commutator and a capacity of twenty-five per cent. overload are recommendations of the most favorable nature. Constant-current generators for arc lighting, and power transmission are always in stock, likewise multipolar, direct-current dynamos for lighting, power

The Electrical Age.

Established 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
First Floor, World Building.
NEW YORK.

NEW YORK, JANUARY 29, 1898.

CONTENTS.

ELECTRICITY FOR CANAL BOATS.

The Cataract General Electric Company held a meeting January 10, for the purpose of considering the means by which an electric cable way, sixty miles long, can be installed from Whitehall to West Troy, along the route of the Champlain Canal. The company's charter allows them to operate along the State canals and supply power, that is, electricity, to canal boats. The system considered will be one in which a trolley delivering power to motors hauling the boats will be installed. The proposition is merely one of an experimental nature and its success dependent entirely upon its cost and convenience. The motors dragging the boats will certainly do their work if the tractive force is sufficient. The use of a rack-and-pinion method, as advocated in the Schatz system, leaves no question of doubt open for discussion. Experiments in other directions are likely to fail and to be more expensive and less convenient. The fact that this work has been undertaken, however, is pleasant news and will certainly develop to an extent that can hardly be anticipated. Electricity on tap along the canals of New York State will so accelerate transportation of heavy freight, and the expense attached thereto, that it will make its citizens the most independent of any in the Union.

THE PATENT OFFICE.

Inventors frequently consider themselves abused, particularly when their application for a much coveted claim is denied. There is certainly a certain and peculiar condition of things which will sometimes enable an inventor to obtain what he calls his right or prevents him from making the progress he thinks his due.

The patent attorney occupies a peculiar position with respect to the inventor and the Washington office. He operates in the capacity of a strainer, receiving from the inventor a description and possibly a working model which he prunes down and so moulds as to be able to apply in the inventor's name for those rights which in the light of his experience may be granted. It happens in consequence, more or less frequently, that the claims allowed an inventor are but a small percentage of what he expected. If the article is manufactured, well and good, but if it is shelved indefinitely some other inventor, whose investigations have brought him in touch with the practical world and so stimulated his mind as to enable him to produce a new and useful article, may find his work interrupted and the total value of his claims greatly affected by the previous inventor, whose efforts have ceased and work shelved. The granting of a patent should not be entirely on the basis of a drawing but a demand made for a working model, or proof that a practical application of the apparatus is the end the inventor has in view. Unless satisfaction of this kind can be given to the patent office, claims should only be granted conditionally, that is, on the presumption that within five years use will be made of the idea thus monopolized. By this means the inventor intending to manufacture and possessing all the elements required for the commercial success of his crystallized ideas can make rapid headway, without being hampered by those that have merely glanced over the ground, selected a site but refused to build. The prosperity and commercial supremacy of the United States has been and is dependent upon the efforts of its inventors. The progress made in fields of engineering depends directly upon the happy conception flitting through the minds of inventors. But the fact that they frequently interfere with each other, infringe and enter into long and expensive litigations, if not individually, at least in the capacity of a corporation representative, seems to prove that the granting of so-called rights is like the sprinkling of legal gunpowder. Why should inventors lock up their patents? The law granting patents should be such that unless use is made of the claims granted within a specified time, less than seventeen years, regularly allowed, in all such cases a concern wishing to transact business and to manufacture an article, certain points of which are owned by this class of inventors, should be given the right to go ahead and thus add its mite to the general progress of the nation. The dog in the manger principle is utterly opposed to prosperity or any form of national advancement, either in the broad field of invention or commercial circles. To destroy its malign influence and give greater freedom to the good intentioned, the above modification of the patent law might have a lasting and happy effect.

IMPORTANT ELECTRICAL EXHIBITION ARRANGEMENTS.

Larger amounts of space are now taken up for the electrical show next May, the flow of applications is exhausting available space. Prof. F. B. Crocker has accepted the position of consulting engineer, on invitation of the management, which is desirous of associating with itself all that is best in regard to the technical side of the art. Prof. Crocker, who regards the exhibition as a highly useful means of reaching the public, is deeply interested in its success and wishful of promoting its beneficial influence in every way. His name as consulting engineer is a guarantee of good work being done under his supervision by the construction staff in the disposition and safeguarding of the exhibits. Prof. Crocker, as president of the American Institute of Electrical Engineers and professor of electrical engineering at Columbia University, represents the highest technical skill known in the profession.

and plating and alternating-current generators and motors. The above are built for moderate or slow speed as required—both motors. The Excelsior Electric Company is an old established firm, founded by an able electrician, and his work has been continued by Mr. Churchward, of equal ability. The design and construction of lighting and power machinery is therefore familiar to them in all its details.

ELECTROPLATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

PART I.

The essential requirements for electroplating are cleanliness and a slight knowledge of chemical reactions. There is much that may appear to be beyond the scope of the home experimenter in this work, but such is not the case, as the apparatus used is within the means of every careful worker.

The study of electrolysis is based upon the curious though familiar fact that the passage of a current through a solution made of the salts of any metal will cause a deposit to occur.

This deposit may be brought about by the current from a few small primary batteries of closed circuit type or the heavy current of a plating dynamo built and used especially for this purpose. The growing industry of electroplating has made this quite an important branch of the commercial arts. The most common department of plating is composed under the heads of copper, nickel and silver plating.

The more expanded use of these processes leads to the purification of ores by electrolysis, the extirpation of microbes and microscopic organisms from drinking water, and the treatment of sewage for the purpose of rendering it harmless from a hygienic standpoint and useful as a renovator of the soil.

The smelting of ores and the treatment of aluminum can almost be classed under the same head. The production of fine gold and silver ware, and the finer process of plating on glass, has created a new field in the application of electroplating to the higher arts.

And the sub-department of electrotyping in all its branches has been established on a firm footing in publishing and engraving firms.

Almost 100 years ago the first experiment, in the depositing of metals was performed in a small way, and from then on until forty years had passed the germ of growth was stayed.

The gradual evolution of the different methods now prevailing grew from that time on.

Electroplating is the process of depositing a layer of metal on another body by an electric current.

One of the simplest forms of plating coming into notice, and one within the scope of the reader, is the process of copperplating.

Copperplating.—A solution is made of pure water and crystals of sulphate of copper.

The copper crystals or bluestone, as it is commonly called, is dissolved in sufficient water to make a semi-saturated solution. The addition of a few drops of sulphuric acid greatly improves the conductivity of the bath. About four tumblerfuls of water to one-half a pound of crystals will suffice.

A plate of pure copper is secured to the positive pole of the battery or dynamo, and the object to be plated to the negative pole. The passage of the current will cover the object with a copper film of gradually increasing thickness.

The purity and excellence of the deposit is subject to the following conditions :

Pressure in volts.
Current in amperes.
Condition of solution.

Pressure in volts in copperplating is determined by the condition and nature of the bath.

A copper solution acidulated and a copper cyanide require the following :

	Volts.
Copper acid bath,	.5 to 1.5
Copper cyanide bath,	.3 to .5

The following facts in relation to copperplating will prove of value. The electro-chemical equivalent, or the amount of metal deposited by one ampere per second, is the basis of this table.

Simple Plating Cell.

COPPER.

			Weight in Grammes.
Current	1	ampere deposits	.000326 per second.
"	1	" "	.01957 " minute.
"	1	" "	1.17390 " hour.
"	851.8	" "	1. kilogramme per hour
"	386.4	" "	1. pound per hour.

The further facts worthy of consideration depend upon the extent to which the plating is done for their usefulness. When a great quantity of copper is to be deposited each day, the following is a valuable fact to remember :

One hundred pounds of copper deposited in a day of ten laboring hours would require 3,864 amperes of current.

To return to the process and precautions necessary—the material to be plated must be thoroughly free from grease and oil.

A coating of oxide sometimes forms from exposure to the air ; both can be removed by using two baths for cleansing, as mentioned below :

Stripping or acid bath.
Cleansing or lye "

PART II.

The stripping bath if used for a dip or two of the metal to be plated will remove all traces of oxide; in fact, it will act so successfully on a plated object that it will remove all the deposited metal in short order. The alkali bath of caustic soda attacks any and every form of grease, oil, etc., leaving the object clean and ready for a second cleansing in a vat of live water.

Metal, especially copper, can sometimes be deposited on a body due to the fact—the relation existing chemically will cause a coating of pure metal to form.

Bright steel dipped into a copper solution receives a red coat of copper, the metal being precipitated without the aid of any current. A weak current will deposit upon the cathode or negative pole a deposit that is inclined to be brittle and crystalline in nature.

A strong current will cause a deposit that appears to be composed of disintegrated particles of copper. They are black and powdery and of no use at all, thongh consisting of pure copper.

The proper current will give a characteristic deposit of tough and close-grained copper.

The determination of the proper current can be obtained by noting the current in amperes for a given surface of copper and regulating it as the table indicates.

Proper current for deposit.

	Amperes per 100 square inches.
Copper cyanide bath..........	2 to 3
Tough deposit................	1.5 to 4
Very tough...................	4 to 10
Very solid...................	10 to 25
Solid, but sandy at edges......	50 to 100

For weak solution and a strong current a black deposit ensues, and gas is liberated at the cathode pole.

For a strong solution and a weak current the deposit is crystalline and useless.

It is sometimes considered good practice to connect a number of vats together in series; in such a case the volts required for the total number of baths on the basis given must be applied. For ten baths of three volts each 30 volts pressure is necessary. Plating can be done with a solution and a carbon anode.

If such were the case, however, the anode being unable to waste, the liquid would suffer, becoming greatly weakened, and unless strengthened by the addition of more salts ultimately losing all its metal, whether copper, nickel, silver or gold.

It is the practice to refine copper by using large vats in series with each other, as described. A dynamo of the requisite pressure sends the current through the series.

Huge blocks of the crude ore are connected to the positive pole and used as anodes.

The cathode is a thin plate of copper. Only pure copper is deposited upon it, and this is allowed to thicken until it is in the shape of thick plates or large ingots.

They are taken and rolled into wire or used for miscellaneous purposes, being about 96 to 98 per cent. pure copper.

The sediment or sludge is retained and the metal it holds, either in the shape of salts or particles, is recovered.

About three dollars' worth of gold and silver is obtained from each tank after a few days' run. The richness of the copper ore in these valuable impurities greatly varies, being from a dollar to three or even more per ton if the ore is rich.

Quicking a piece of metal is the process of covering its surface with mercury before plating. A solution made by dropping mercury into nitric acid will be useful for this purpose, if applied to the surface of the object.

When the article has received a coating of sufficient thickness it is removed from the bath and dried in sawdust, after being washed. It is then buffed, or, if the surface is rough, exposed to the action of a circular brush having wire instead of hair or bristles as its effective portion.

Scratching is the name applied to such work, and between the two the object becomes perfectly smooth and endowed with a bright lustre. To perfect the work further and produce a surface of excellent quality, the process of burnishing is carried on.

This is done by means of a smooth curved surface applied to the deposit very briskly and with considerable pressure. An object that has been covered with a coating of metal under which exists a surface of oxide is likely to peel. The way to eradicate this trouble is to treat the surface beforehand to a dilute solution of acid, or to give it a rapid dip in the stripping bath.

Certain classes of solutions do not conduct electricity very well, such as tetra-chloride of zinc for instance; nitrates in solution are very difficult to handle because of their rapid oxidizing power. The deposit of metal can only be obtained by the greatest care. The free acid released by electrolysis is the direct cause of the trouble. The best solutions are made up of sulphates or cyanides of the metal.

An excellent formula for a copper sulphate solution is as follows:

Acid copper solution.—Prepare a saturated solution of copper sulphate; warm water will be very effective in this respect for the rapid preparation of an intense solution.

Take 1 gallon of saturated solution.
1 quart of water.
1 ounce sulphuric acid.

The preparation of an alkaline solution for deposition upon iron and zinc is covered by the following:

Alkaline solution of copper.—Mix a solution of copper sulphate and cyanide of potassium together. A precipitate falls to the bottom of copper cyanide. The precipitate is washed in pure water and strained, then redissolved in a solution of cyanide of potassium and water.

A cyanide of potassium solution is made by dissolving two pounds of cyanide to one gallon of water.

After the copper solution has been obtained by the above method, two ounces of cyanide is added to each gallon of copper solution.

This solution works but at 100° F., but a heavy current will cause a good deposit at 30° F.

In nickelplating certain precautionary measures are adopted to insure good results. A very strong solution will be as injurious to the deposit as a heavy current. The solution and current therefore determine the quality of the deposit, while it is known that about 30 to 40 grains per hour of copper express the limit for good plating; the conditions of nickelplating forbid a similar statement.

Nickel is best deposited from a salt composed of two in active conjunction—salts of nickel and ammonium. The processes of preparation are two-fold; when separately obtained they are mixed as described.

(I.)

Sulphate of nickel.

3 parts nitric acid.
1 part sulphuric acid.
4 parts water.

Dissolve in this solution two pounds of nickel to each gallon and gradually heat until the nickel is entirely dissolved. When this occurs add one-quarter of its volume of hot water and filter.

(II.)

Ammonia solution.—Dissolve sulphate of ammonia in hot water until the solution is saturated; about four pounds to the gallon will be sufficient.

The two solutions of nickel and ammonia are mixed in equal quantities.

The precipitate that falls when both are mixed is then washed in a portion of the ammonia solution.

This sediment is the plating salt, the double salt of nickel and ammonia.

For use mix three-quarters of a pound of this salt to one gallon of water. The solution must be chemically neutral. This is accomplished by testing with litmus paper.

The paper is simply dipped in.

If the litmus paper becomes red add sulph. ammonia.
" " " blue " nickel.

QUESTIONS FOR REVIEW.

(1.) What is electroplating?
(2.) How is copper plating performed?
(3.) What affects the deposit?
(4.) What is the electro-chemical equivalent of a metal?
(5.) State the advantage of connecting vats in series.
(6.) How is copper refining carried on, and what are its benefits?
(7.) What is quicking?
What is scratching?
What is burnishing?

QUESTIONS FOR REVIEW.

Last week—On Capacity.

(1) What determines the capacity of an insulator?

(2) How can the quantity of electricity a condenser will hold be estimated?

(3) With E = 100 volts and F = 10, how many coulombs are absorbed?

(4) What is Specific Inductive Capacity?

(5) How is the capacity of a group of condensers affected by connecting them in series?

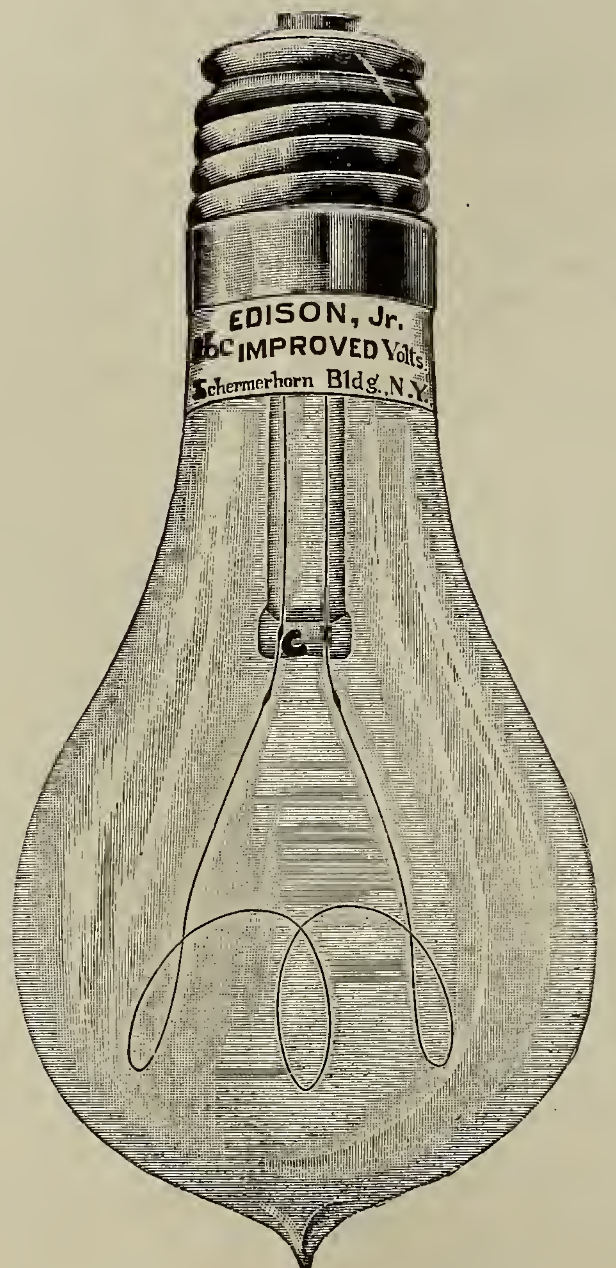
(6) What is the formula for calculating the capacity of a set of condensers in series? In multiple?

(7) Explain the method of obtaining the capacity of a condenser by comparison.

EDISON, JR., INCANDESCENT LAMP EFFICIENCY TEST.

Test of Edison, Jr.'s 55 volt 3½-watt lamp, ordinarily using $\frac{9}{10}$ of an ampere at 55 volts.

One of these lamps was put on a 117-volt circuit and ran for eight minutes without injury to the lamp. This lamp was shown in competition with a new arc lamp just installed in the Schermerhorn Building, 96 Broadway, in Mr. Thos. A. Edison Jr.'s office. The Edison, Jr., 55-volt lamp gave the greatest amount of light during the test of eight minutes. Mr. Swann, of the Swann Manufacturing Co., 123 Liberty street, N. Y., frosted one of these 55-volt lamps for test. It was tried on the 117-volt circuit and was still burning when the representative of the Electrical Age left the office twenty-five minutes afterwards at the same brilliancy. You could not keep your eye on the lamp for a moment without seeing all kinds of stars. There is no doubt but that the lamp was up to 2,000 c. p., showing the high efficiency and long life of the Edison, Jr., lamps. No other maker of lamps have shown the efficiency and life on similar test. This test also shows the remarkable strain the carbon can stand without injury. W. T. H.



SPARKING, ITS CAUSE AND EFFECTS.

(Continued from page 46.)

Perfect commutation for any particular position of the brushes can therefore only take place at one value of the load. At heavier loads than this critical one the current is not completely reversed before the segment leaves the brush and at lighter loads it is more than reversed. This problem may be stated a little more precisely in the following manner :—

Assume that the brushes are set as far back as is consistent with sparkless running at the maximum load at which the machine is required to run sparklessly. This means that the reversal E is just equal to the coil impedance E at that point. Now let the load be removed gradually. The impedance E of the coil under commutation is reduced while the reversal E remains practically constant. The tendency is therefore for the current to be more than reversed, and this tendency increases as the load is reduced, until finally, when the load has been removed entirely, there is no current to reverse, and the reversal E simply tends to produce a current in the coil under commutation. The production of this current is now opposed by the inductance and resistance of the coil, and by the resistance of the brush contact surfaces, the contact surfaces of the two segments being in series as regards this current. If the impedance of the coil is low as compared with this contact resistance, the reversal E would be small compared with the CR drop across the contact surfaces at full-load current. Therefore the current produced by the reversal E would be small as compared with the full-load current.

We may also note here, that, whereas the variation of the contact resistances aids the reversal of the current, as soon as this current becomes greater than that which flows through the armature, the excess current must pass across the contact areas of both the segments under the brush. The resistance of these two surfaces are then placed in series as regards this current, and the lowest possible resistance that these could have, would be reached when the brush covers an equal surface on each segment, making the contact resistance in the path of this current equal to twice the resistance of the contact surface of either segment at that time. The resistance of this path then starts at infinity, decreases to this minimum and goes back to infinity again.

Now examine more closely the order of events in commutation at no load. The resistance of the coil circuit first starts at infinity and rapidly decreases, while the reversal E starts at a minimum and more slowly increases. As soon as a current commences to flow, inductance T enters the problem. If there were no contact resistance, the current would reach its formal full-load value at about the middle of the commutation period. This, of course, assumes that the reversal E is of such a magnitude as to reverse the current at full load without the aid of the varying contact resistances. In fact the reversal E does a very small part of the reversing at full load when the inductance is small compared with the contact resistances. The current at the middle of the commutation period would therefore be much smaller than the normal full-load current, even if there were no contact resistance to limit it. Now introducing this contact resistance, which starts at infinity and decreases to a minimum, which may be several times greater than the impedance of the coil, the current must be reduced at least in the proportion of the impedance to this minimum resistance. During the rest of that period the resistadce is increasing till at the end it has reached infinity again. The current, already very small, is rapidly cut down till it is too small to produce a visible spark at the break, and the commutator has not been heated up enough at any point to produce arcing.

The same principles hold in the case of machines whose brushes must be shifted, the range of sparkless commutation only being less.

There have been some machines, however, which would not run sparklessly for any position of the brushes. This is readily explained on the hypothesis of too high an impedance, for in that case the variation of the current during commutation will be mainly governed by the impedance and reversal E, instead of by the variation of the contact resistances, so that even if complete reversal is exactly attained, the current density at other parts of the commutation period does not remain constant, with the result that the total energy of commuation is increased. A large part of this energy is concentrated at the beginning and end of the commutation period, thus producing heating at the edges of the segments with its corresponding melting of the copper and arcing.

These considerations indicate two ways by which sparkless commutation may be assured. First by increasing the brush contact resistance, and second by decreasing the impedance of the coil under commutation.

The limitation of the second of these conditions is merely one of economical design, lowering of the inductance below a certain point increasing the cost of the machine.

The limitation of the first condition is that of rise ot temperature of the commutator. It has been shown that for perfect commutation the current density is constant and uniform throughout the whole period of commutation. Its value is found by dividing the total brush current by the contact area of the segments under a brush. This varies inversely with the brush contact area, and the energy developed therefore varies in the same proportion. The amount of commutator metal to be heated, as well as the radiating surface, also varies inversely with the current density so that the rise of temperature probably varies nearly as the square of the current density, provided the commutation be practically perfect.

The increasing use of the carbon brush in place of the copper brush is thus explained by the fact that the contact resistance of carbon on copper per square inch is much greater than that of copper on copper. Increased resistance is obtained with the copper brush by reducing its contact area, but this also reduces the metal to be heated in the commutator, as well as its radiating surface, so that the same amount of commutating energy will result in a much greater rise of temperature.

By taking these facts into consideration, however, and properly proportioning the contact areas and inductance, commutating machines may be designed to run as cool with copper brushes as with carbon wherever this may be desirable.

The reasoning so far has been based on the assumption of but one coil being commutated at a time. This assumption will only be true when the brush thickness is equal to, or less than the width of one segment, plus twice the thickness of the insulation between segments. In practice, brushes are often made to cover a segment and a half, sometimes two segments or even more than this without deleterious sparking. This means that the current in two or more coils is being commutated at the same time.

(To be continued.)

New York.

Newton Harrison, E. E., Electrical Age Publishing Company, World Building, New York City.

Dear Sir:—I have received a copy of the Electrical Age from some unknown source. I have an idea that you kindly sent it to me. Be this so or not, let me congratulate you on the general appearance of the paper, and particularly on the more than ordinary excellence of its editorial commentaries and the articles which engendered them.

Wishing you every success in your undertaking, I am,

Very truly yours,

DR. OTTO A. MOSES,

Cable Address: Florian. 49 Exchange Place.

West Chester, Pa.—The Philadelphia and West Chester Electric Railway is to be extended from Newtown Square.

New York, N. Y.—The Colonial Electric Co. has been incorporated to furnish heat, light and power. Capital stock, $25,000.

Harrietstown, N. Y.—The Saranac Lake Light, Heat and Power Co. has been incorporated by P. A. Gould and others.

New Orleans, La.—The People's Telephone Co. has been incorporated with George N. Norton, president; Wm. P. Curtis, vice-president.

Philadelphia, Pa.—Valle Bros. & Co., electrical supplies. New firm, same style.

Battle Creek, Mich.—An electric railroad will probably be built from Battle Creek, through Barry county, to Grand Rapids.

Bloomfield, Ia.—City clerk may be addressed concerning establishment of a telephone exchange.

Farmington, Mich.—An electric road will probably be built to Farmington.

Denver, Col.—Louis Enricht has been awarded contract for the construction of the Canon City & Cripple Creek electric road.

Lexington, Va.—The Spottswood Telephone Co. are adding many improvements to their line.

Maysville, Mo.—Frank Costello and Charles Lytle have been granted a telephone franchise.

St. Louis, Mo.—The Missouri Electric Light and Power Co. and the Edison Electrical Co. have consolidated, under title of Missouri Edison Electric Co. The new company will, it is reported, issue $4,000,000 of gold-bearing bonds.

Corbin, Ky.—An electric light plant will be established.

NEW ELECTRICAL INCORPORATIONS.

Albany, N. Y.—The New York and Staten Island Electric Co. has filed a certificate of increase of capital stock from $500,000 to $1,500,000.

Hyattsville, Md.—An electric light plant will be erected, and funds will be raised for same.

Hyattsville, Md.—A telephone line has been completed from Hyattsville to the Maryland Agricultural College at College Park.

Everett, Mass.—The West End Street Railway car-house was destroyed by fire recently, together with ninety electric cars. The loss on the building is estimated at about $30,000, and on the cars at $120,000.

Harrisburg, Pa.—The Pennsylvania Electric Co., of Marietta, has been incorporated by E. Burd Cassel, H. L. Haideman, E. L. Reinhold, H. S. Rich, Marietta; E. H. Hershey, J H. Myers; to manufacture and sell all kinds of electrical and electric mechanical appliances. Capital stock, $25,000.

Corunna, Mich.—Clarence Hawley, of Detroit, has been granted franchise for an electric light plant for Corunna.

Baldwinsville, N. Y.—Baldwinsville Telephone Co. has been incorporated by Wm. F. Morris, Horam Howard, and W. H. Tappan. Capital stock, $10,000.

Minneapolis, Minn.—The Gladstone Electric Lighting and Power Co. petition of the stockholders for the dissolution of the company has been granted.

Fort Wayne, Ind.—The Fort Wayne Electric Company contemplates the erection of an addition to its plant.

Chicago, Ill.—The Western Electric Co. will make extensive additions to its factory.

Baltimore, Md.—The Consumers Ice Co., August Fenneman, President, will erect an electric light plant to supply Electric Park at Arlington.

Baltimore, Md.—The Baltimore, Annapolis & Drum Point Telephone Co. has been incorporated by George Weems, Williams, and Frank R. Biedler, John B. Gray and William H. Hellen and others. Capital stock, $12,500.

Topeka, Kan.—The Kansas City, Lawrence & Topeka Electric Railway and Power Co., incorporated, to construct an electric line between Kansas City and Law-

FRANCIS BROS. & JELLETT, incorporated, contracting engineers, 704 Arch street, Philadelphia, St. Paul Building, New York City, have removed their offices from the St. Paul Building to Nos. 70 & 72 Trinity Place, where they will have ample room for the conduct of their business. By this move they will combine their offices, drawing-room and shop, giving them a closer oversight over their work. They will be better equipped to do jobbing work and for making repairs promptly. They make a specialty of the better class of steam heating and ventilating, and undertake to furnish and erect complete mechanical plants for buildings of any size and for all purposes.

They solicit an opportunity of submitting estimates and can give satisfactory references as to their ability and financial standing. Telephone connection.

ONE HOUR BY RAIL TO PHILADELPHIA.

[From the Journal, Jannary 25.]

One hour to Philadelphia on an electric railroad from Jersey City, is the latest project. The Central Railroad of New Jersey is behind the scheme. The controlling stockholders of the Jersey Central will furnish the bulk of the capital for the new venture and the Jersey Central tracks will be used for the greater portion of the way.

An old elevated railroad franchise, which permits the building of a road from the Jersey City terminal, at Communipaw, to Jersey City Heights, has been secured by parties representing the Jersey Central Company. This road will be extended over the meadows to Newark, and by use of the Jersey Central tracks part of the way, and new tracks where a shorter route can be built, the line will be extended through Trenton to Philadelphia.

The third-rail, Watkins alternating system will be used, whereby a speed of more than eighty miles an hour can be attained The principal difficulty with the electric third-rail system along surface roads lies in the danger to life from the highly charged electric rail. This difficulty has been overcome by a late improvement which leaves the rail charged with electricity only when the car is passing over it. This invention also permits the power to be utilized for 300 miles instead of 15 miles, as heretofore.

The ostensible promoters of the scheme are Charles N. King, secretary of the New Jersey Corporations' Agency; Postmaster Robert Jordan and Garrett Van Horn, who originally owned the "L" road franchise. These gentlemen are believed to be acting for the Jersey Central Railroad. They all declined to talk in refeience to the matter, although they admitted that the "L" road was to be constructed and that it was not merely for the purpose of connecting Jersey City Heights with the Jersey Central Ferry.

Strange as it may seem, there is no way by which residents of lower Jersey City and Jersey City Heights can reach the Jersey City Ferry now except by going to New York or paddling across a sheet of water in an old scow.

The trolley roads have cut heavily into the Jersey Central's business to Newark, and even beyond that point.

The "L" road will tap the most populous districts of Jersey City and at the same time afford the most rapid route to the principal towns through the State of New Jersey, while the main line can be used for ordinary passenger business and the freight and local traffic.

There have been rumors in Wall street that the Jersey Central is to become an integral part of a trunk line to Buffalo and Chicago, in which the Buffalo, Rochester & Pittsburg and the Wheeling & Lake Erie will be links. It was impossible to ascertain, however, whether the new electric line to Philadelphia, under the auspices of the Jersey Central, was only a part of the greater trunk-line scheme.

The Watkins third-rail system has already been tried on a section of the New York, New Haven & Hartford line, where a speed of eighty miles was attained without the later improvements.

THE GARVIN MACHINE Co.

SPRING AND VARICK STS.,
NEW YORK.
PHILADELPHIA STORE, 51 NO. 7th ST.

No. 2 HAND MILLING MACHINE.

MANUFACTURERS AND DEALERS IN

METAL WORKING MACHINERY

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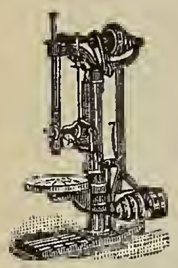

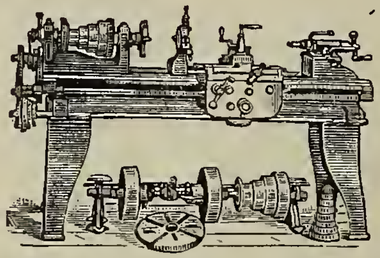

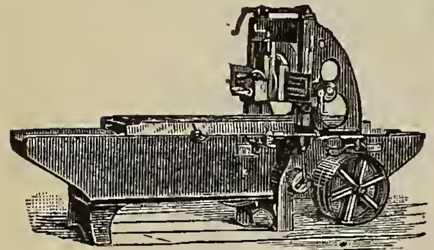

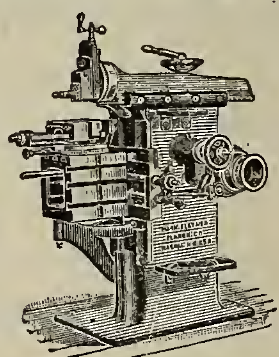

MILLING MACHINES, SCREW MACHINES, DRILL PRESSES, PROFILERS, HAND LATHES, TAPPING MACHINES, GEAR CUTTERS, SCREW SLOTTERS, CUTTER GRINDERS, DIE SLOTTERS, WIRE COILERS, SURFACE GRINDERS, MILLING CUTTERS, ETC.

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BLAISDELL LATHES AND DRILLS,
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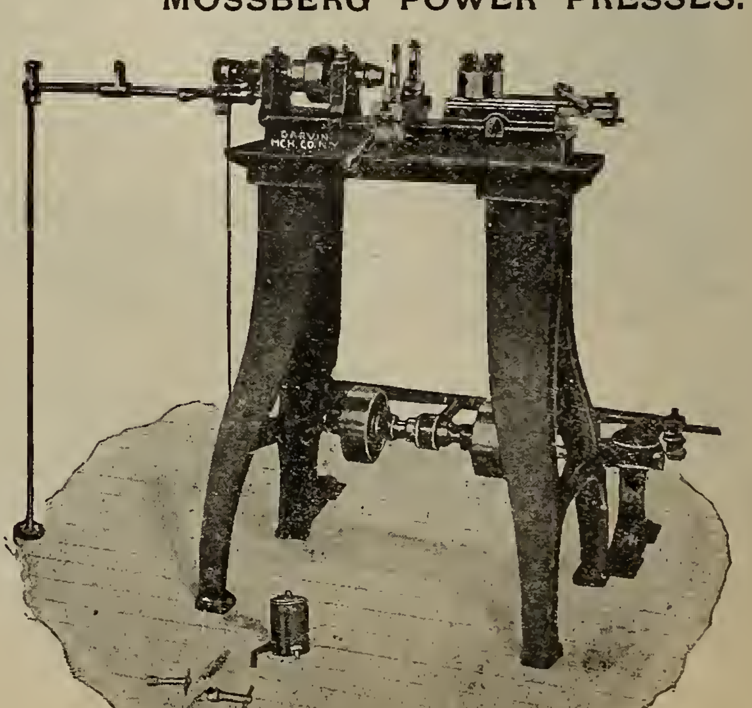


No. 00 SCREW MACHINE (WIRE FEED).

The Electrical Age.

VOL. XXI—No. 6 NEW YORK, FEBRUARY 5, 1898 WHOLE No. 560

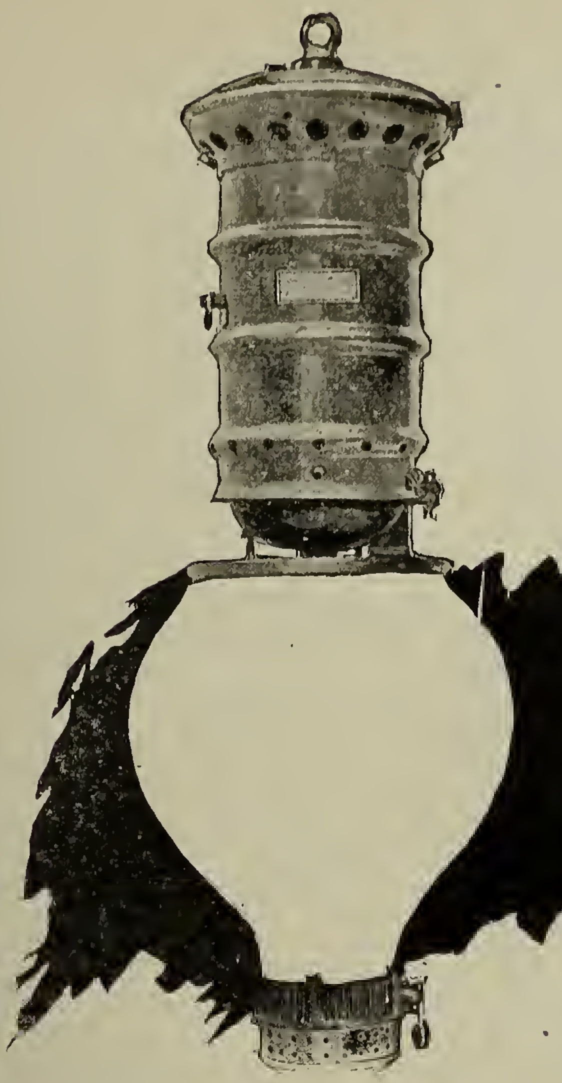


Fig. I.

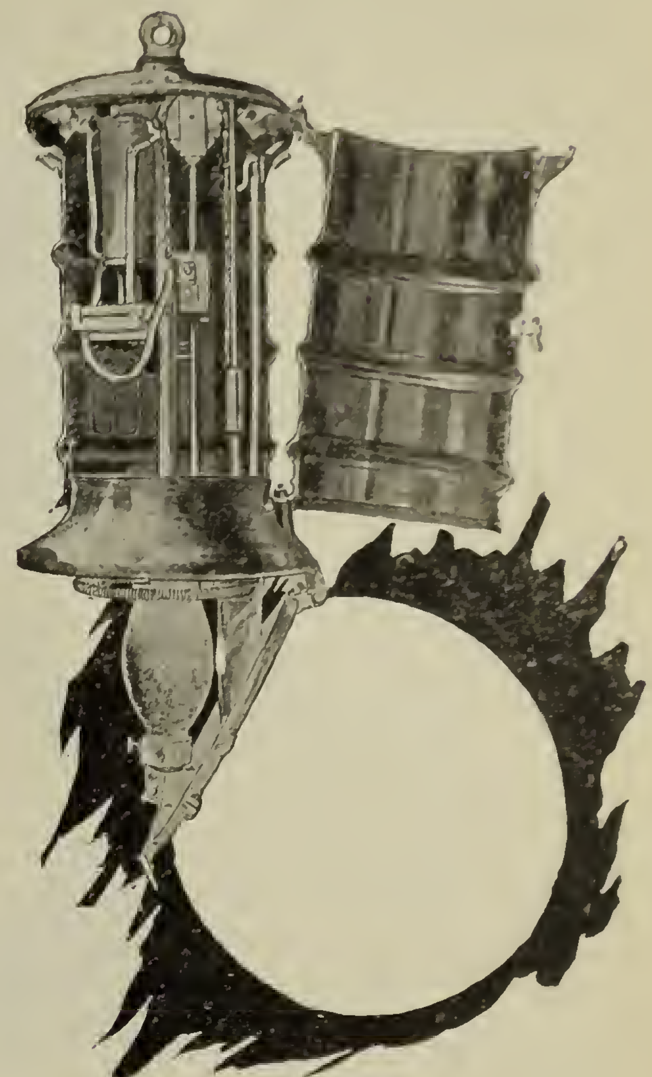


Fig. II.

THE WALKER ARC LAMP.

Like the dynamo, the arc lamp is now a well understood principle and almost anyone can make an arc lamp that will operate. There are, however, many desirable features which involve both workmanship and principle. In setting forth the features of this arc lamp, the Walker Company respectfully invites comparison with the product of other makers, and judgment as to whether these desirable features have not been realized in the highest degree.

Length.—The public now demand a short arc lamp, and unless a lamp has this feature it may as well stay out of the market. It is obvious that the minimum length of a lamp using straight carbons is that of a fresh trimming, and if the lamp is but a few inches longer than the total length of the carbons that it feeds the most critical could not reasonably ask for more. The length of a fresh trimming of carbons for the Walker arc lamp is 26 inches, and the total length of the lamp is 34¼ inches. Thus the percentage of increase is only 32 per cent., and when it is realized that many lamps are 150 per cent. longer than the carbon that they feed, it cannot be contested that the Walker arc lamp is notably excellent in this respect. After a careful measurement of the length of similar types, it can be safely said that the Walker lamp is shorter than any other burning the same length of carbons under the same conditions.

Workmanship.—It would be very foolish for the Walker Companv to compromise its reputation for excellent workmanship by producing an arc lamp that was inferior. As regards workmanship, the words "Walker" and "best" have been and always will be synonymous.

General Appearance.—It will be seen from the cut of the lamp (fig. 1) that it is a solid and substantial affair, but is susceptible of highly decorative design. The figure depicts a lamp for outdoor service and places where an ornamental lamp is not necessary. Being newly on the market there has not been time to devote to this feature of decorative appearance, which for the most part is a mere matter of the shape and material of the case, but shortly there will be offered an assortment in which the most critical æsthete can find something to gratify his tastes.

Mechanism.—This is, of course, the most important part of the lamp, and in order to appreciate it better a brief discussion of general principles is necessary. There are two great classes of lamps, one of which feeds by a rack and pinion connected with an escapement, and the other with a smooth rod and clutch. The working of the former is admittedly superior to the latter when both are in good order, but the complications of the rack-feed lamp make it undesirable from a point of maintenance. The principle of the clutch lamp is as perfect as that of the rack lamp, but owing to the difficulty of producing rods that were both smooth and straight and clutches that would grasp with equal friction on any part of them, the lamp has never been able to burn with the same steadiness that the rack lamp does when it is in good order. The clutch lamp had the good feature that it was much harder to totally disable, because it was more simple.

The Walker Arc Lamp has been designed with the idea of obtaining the steadiness of the rack feed, and the simplicity of the clutch. The solution of the problem was a theoretically perfect clutch lamp. It was realized at once that the rod was the cause of much trouble and it was done away with, and in its place was substituted a wheel of small diameter with an accurately turned rim, on the edge of which the clutch operated. Such a clutching surface it is almost impossible to spring out of true, or mar, as is easily done, and frequently happens with a rod. The carbons are fed by a chain, as shown in figure

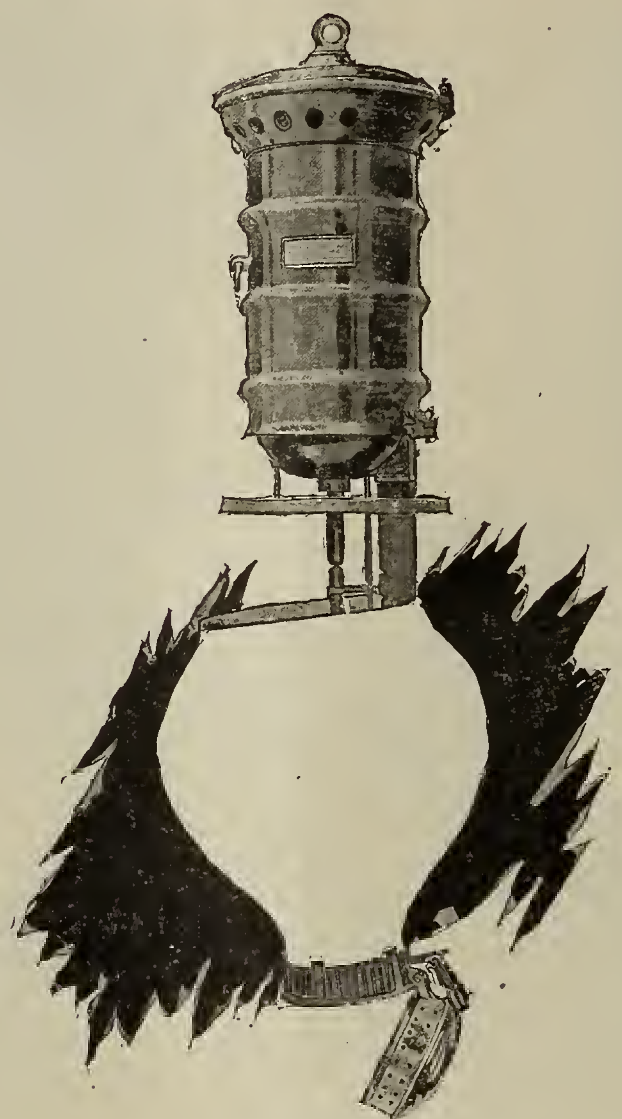


Fig. III.

2, and this chain drives a sprocket wheel, mounted on the same spindle that carries the clutch wheel. Both carbons are fed, and the arc remains practically stationary. The next improvement was to connect both carbons positively with their sources of supply by means of flexible cables. In most arc lamps the current is transmitted to the carbons through some part of the moving mechanism, and in many cases the absurd device of using a brush against the surface to be clutched is employed. Sparking and imperfect action of the clutch is sure to follow.

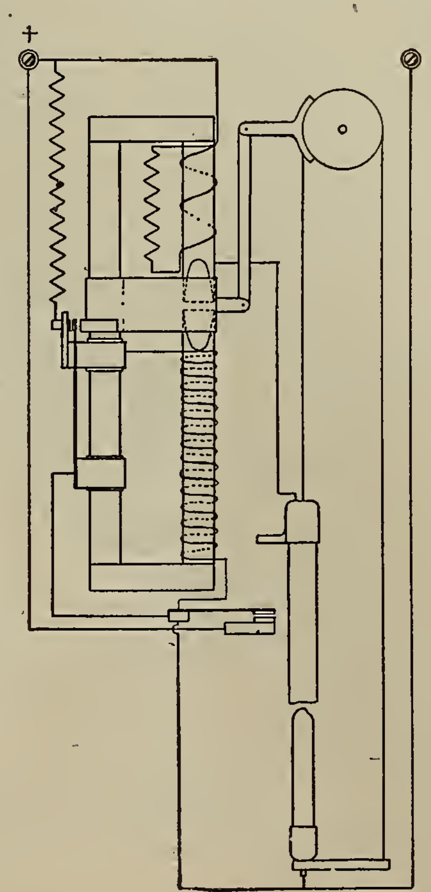


Fig. IV.

We next come to the electromagnetic mechanism controlling the clutch. This is very simple. It is mechanically differential mechanism, that is, the series bobbin and the shunt bobbin are separate and pull in opposite directions on the same armature. The electro-magnet is shown in diagram in Fig. 4. The armature is cleft at its extremity, and this cleft travels over the wedge-shaped cores of the series or shunt bobbins, according as the one or the other predominates.

electrical connections of the lamp will be understood by consulting Fig. 4. When the lamp starts, there are across the terminals three paths, and two that are im-

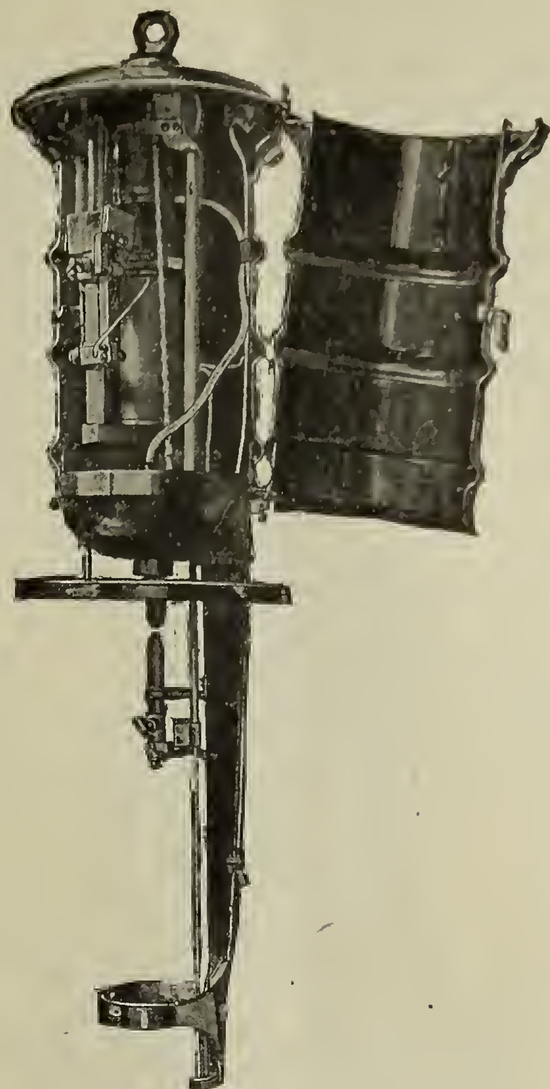
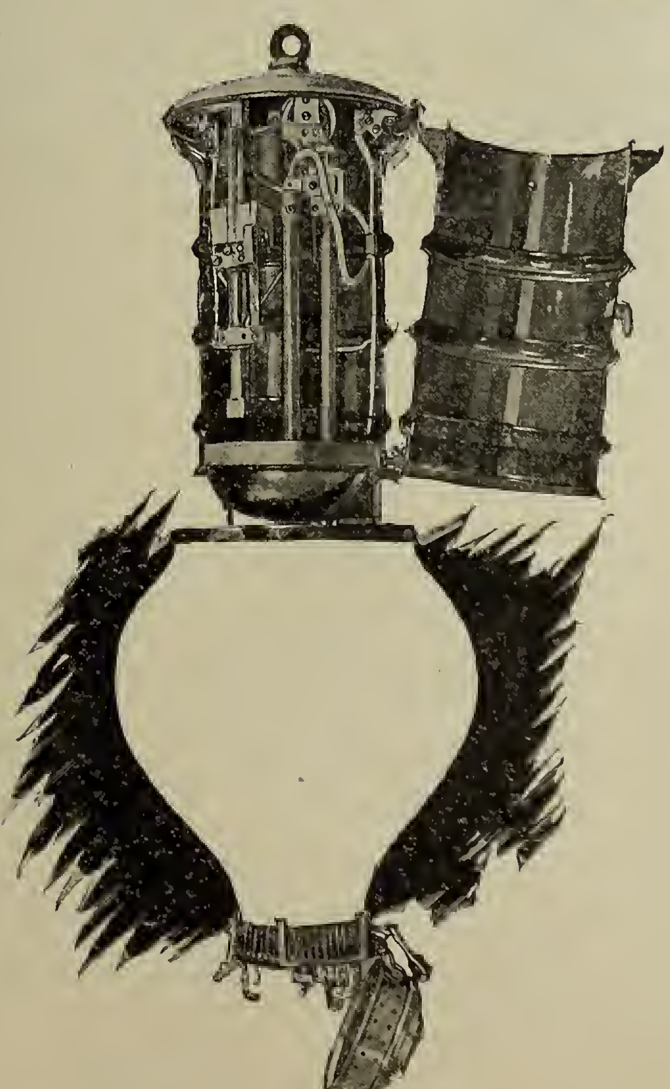


Fig. V.



Mechanism Exposed.

Lamp Complete.

By this device the pull on the armature is made uniform throughout its travel, and there is no need of a complicated system of weights or springs, which successively come into play to balance a variable pull. The

portant. One is a resistance of about one ohm shown at R. This resistance performs an important office that will be presently considered. The second path is through the carbons, which are together, via the series coil. The third is the shunt bobbin, but at the start the current in this part is too small to be considered. The resistance R is of such proportion that enough current passes through the series coil to start the lamp the moment the armature moves, and when the carbons are drawn apart R is cut out by a special cut-out, which is diagrammatically shown in the figure. The voltage of the lamp rises to its normal value. The shunt coil takes hold and regulates and feeds the lamp in the ordinary way.

Cut-Outs.—There are two distinct automatic cut-outs in the Walker lamp which act under different circumstances. They are both mechanical and one is operated by the same mechanism that operates the carbons and the other by the upper carriage which supports the upper carbon.

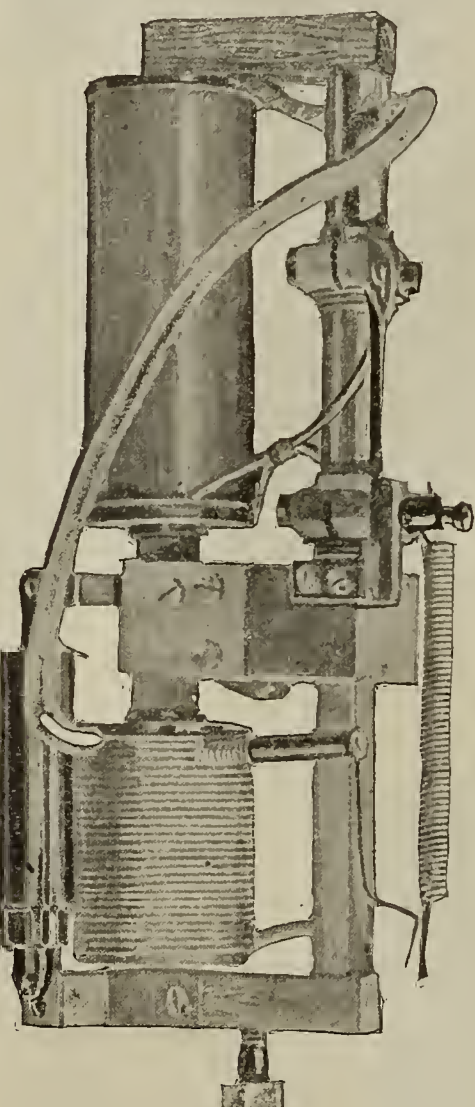
The latter, which is in the base of the lamp, dead short-circuits the lamp when the carbons are burned out, and as stated above is actuated by the weight of the positive carbon carriage, which descends directly upon it. This cut-out is also moved by a lever from the outside when it is desirable to cut out the lamp for trimming or any other purpose.

The other cut-out has the same functions that the ordinary cut-out in a series arc lamp always has, namely, to provide a shunt circuit for the current in case the carbons stick and fail to feed, or in case either carbon should be broken, or through some accident should become unduly separated.

It also provides a path for the current when the carbons are consumed, if for any reason the cut-out in the base of the lamp fails to act.

The resistance which is inserted between the positive terminal and this cut-out is for the purpose of shunting sufficient current through the series coil and carbons to start the lamp, and is common to all differential series arc lamps. In the Walker lamp this resistance is made of especially high resistance wire, having a resistance approximately three times that of German silver, and also having mechanical properties which are such that it can be heated to redness without affecting it in any way.

Convenient Features.—These appeal to the trimmer and user, and are numerous and unique. Both the carbons are clamped at one end with a universal joint, and are made to nose together with two centring rings, which are as near the arc as is practicable. The upper centring ring consists of a bushing in the base of the case. The upper carbon is contained in the case with the mechanism and feeds out through this bushing. The globe is readily lowered for trimming and is covered with a reflector plate, which performs the double service of arresting the sparks and reflecting the light downward. The carbon dust can be brushed in the dust-cap below, which can then be removed and emptied. These features are well illustrated in Figs. 3 and 5. It is important to note that no part of the lamp frame is alive, as is common with so many lamps, and which a number of fatal accidents have proved a dangerous practice.



Cut-Out.

The arc, as before stated, is practically stationary, and the heat on the globe is therefore uniform and not liable to crack it as is the case with the travelling arc. The photographic views accompanying this circular, when consulted in connection with this description, cannot fail to give a comprehensive idea of the lamp, and if the party is interested enough to give a trial order, he need read no further literature to be convinced of its sterling qualities.

THE 121ST MEETING OF THE INSTITUTE, which was held at 12 West 31st street, New York, Jan. 26th, was devoted to the discussion of the question of standardizing generators, motors and transformers. The discussion was opened by Mr. E. W. Rice, Jr., and was participated in by Messrs. Lozier, Kennelly, Wolcott, Hutchinson, Lieb, Dunn, Coho, Pattison, Henshaw, Steinnetz, Mailloux, Osterberg, Mosscrop.

The appointment of a committee to consider the question was suggested and subsequently the whole matter was referred to council for such action as it may deem proper.

At the meeting of council in the afternoon the following associate members were elected:

Chas. R. Bangs, special agent, American Telephone and Telegraph Co., 15 Dey street, New York.

M. C. Beebe, assistant in electrical engineering, University of Wisconsin; residence, 271 Langdon street, Madison, Wis.

Hugh Thomas Brown, superintendent electrical department, Selma Gas and Electric Co., Selma, Ala.

Edward P. Burch, electrical engineer, Twin City Rapid Transit Co., 517 6th avenue, S. E. Minneapolis, Minn.

Eben Clinch Crocker, electrical engineer, American Ordnance Co., 29 Harriet street, Bridgeport, Conn.

Albert B. Elias, electrician, Davis Coal & Coke Co., Thomas, West Va.

Chauncey Graham Hellick, electrical engineer, The Chicago Telephone Co., residence, 193 Dearborn avenue, Chicago, Ill.

Jacque L. Morgan, electrical inspector, Kansas City Fire Department; residence, 1702 Locust street, Kansas City, Mo.

Herman A. Prosser, electrician, Baltimore Copper Smelting & Refining Co., Keyser Building; residence, 1222 Madison avenue, Baltimore, Md.

John Joseph Swann, assistant editor, Engineering News, 220 Broadway; residence, 347 West 34th street, New York.

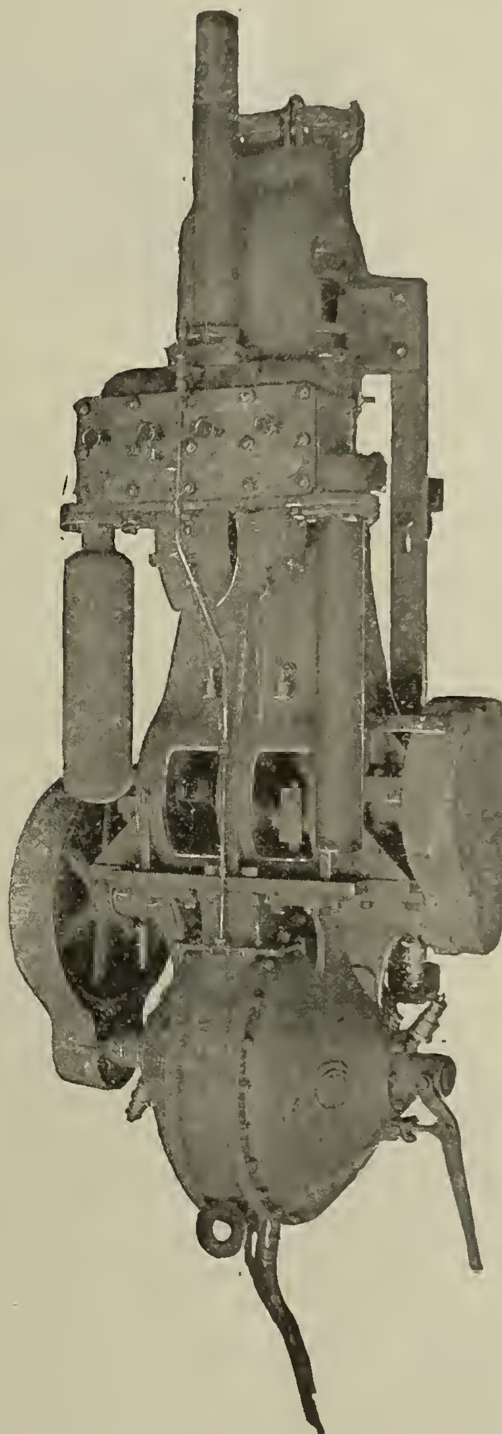
C. Walton Swoope, instructor, electrical engineering, Spring Garden Institute; residence, 12 North 38th street, Philadelphia, Pa.

Jin Tachihara, General Electric Co.; residence, 106 Union street, Schenectady, N. Y.

AN ELECTRIC MINE-SINKING PUMP.

A mine-sinking pump, light in weight, compact in form, of good capacity and efficiency, and not easily damaged by moisture or hard usage, has recently been constructed by the General Electric Company. A special form of motor is used completely enclosed with its gear and operating mechanism in a water-tight steel casing.

The pump itself is a 5 in. x 6 in. duplex double-acting Knowles pump, with outside packed plungers. It runs at 75 revolutions per minute and has a capacity of 150



G. E. Mine Sinking Pump.

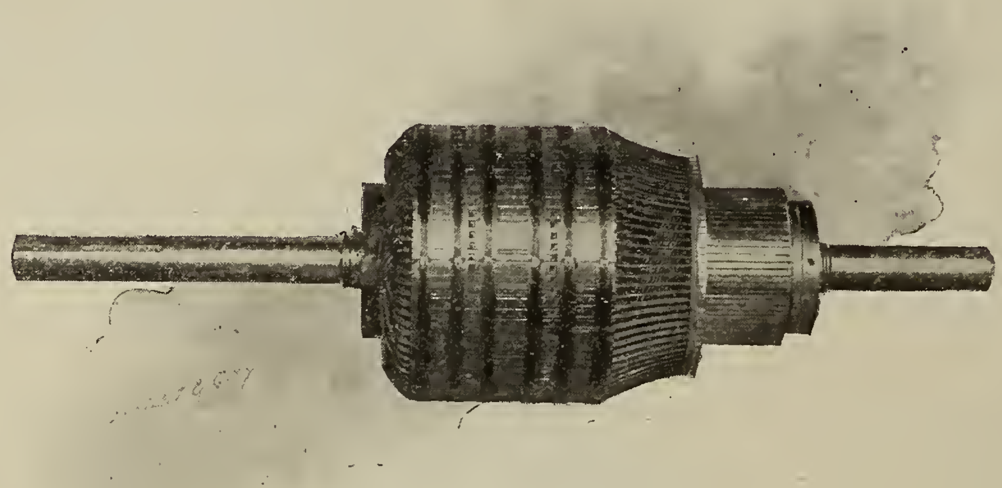
gallons against 300 ft. head. It is driven by a 15 h.-p. induction motor, absolutely water-tight, with the shaft and starting lever arranged to pass through stuffing boxes. The casing was tested for leakage with steam pressure up to 35 lbs. per square inch. The wearing parts are all large and of extra heavy design, the crank shafting being one solid forging fitted with brass bearings. The connectiug rods are of the marine end type and are forged. The guides are bored in the intermediate mechanism so that the cross-head must always be in line with the pump cylinders. By removing one plate on the pump, all the valves may be reached at one time.

This apparatus was designed to stand without injury all the hard usage that a sinking pump can be subjected to. As the case is water tight, the pump works as well under water as out. It may be completely "drowned" by a sudden inrush of water in the mine, and its operation not be affected. This pump is now in operation at Pachuca, Mexico.

HIGH GRADE MULTIPOLAR GENERATORS.

The relation existing between a single cylinder and quadruple expansion engine is the same as that existing between a bipolar and multipolar dynamo. In the first case, crank bearings and shaft are used for one cylinder and piston. In the second case, the same parts are used in connection with two, three or more cylinders and pistons. A multipolar dynamo is therefore merely a succession of bipolar machines, having a common armature, commutator, shaft and bearing. The requirements of a good bipolar machine are merely accentuated in a multipolar machine. All that makes a bipolar machine unworthy of the market likewise affects a machine of the multipolar type. Dynamos built by the Excelsior Electric Company, of 115 Broadway, New York City, designed by Mr. Churchward, represent the full realization of the proper principles of design.

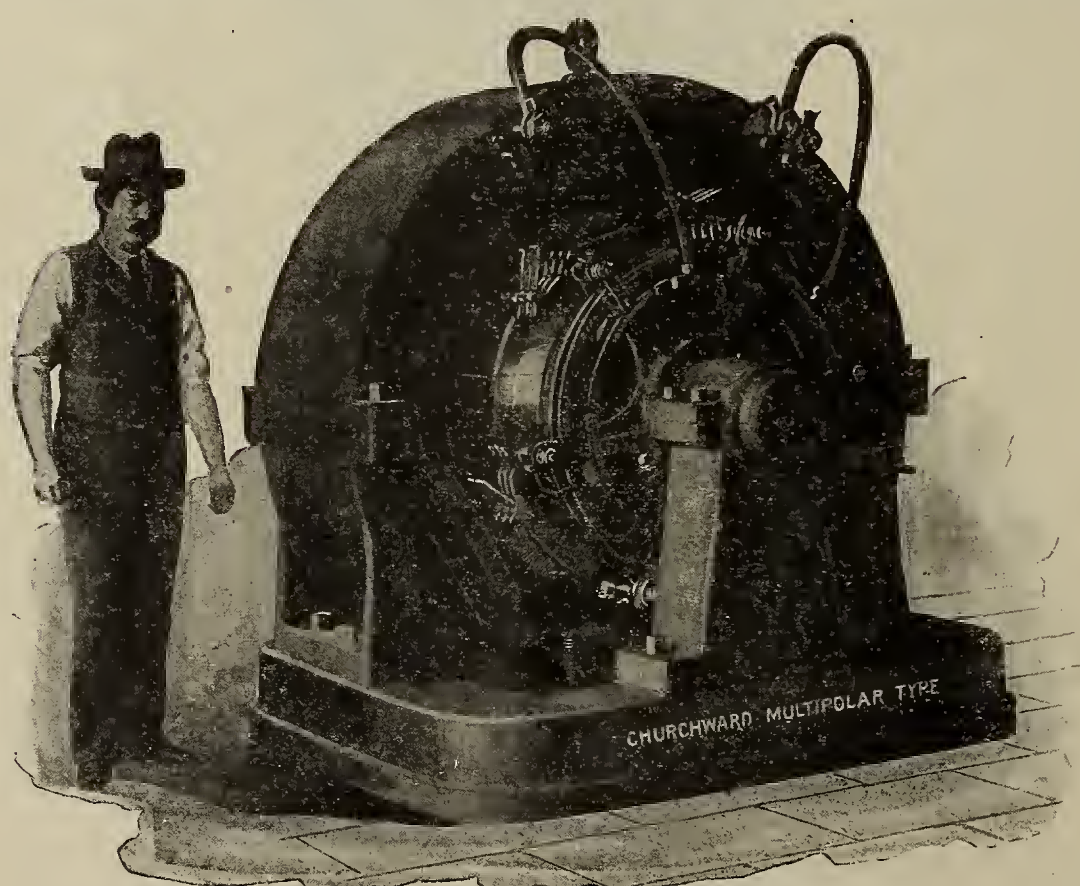
In the illustration is represented one of the Excelsior Electric Company's generators. The fields and armature run very cool, the C^2R loss being at a minimum. The permeability of the magnetic circuit is very high, thus calling for but little magneto-motive force to produce a strong field. The depth of winding, size of wire and radiating surface are such that the machine will not heat, Whereas the principle that iron is cheaper than copper has been observed, a noteworthy feature of the machine is the presence of plenty of copper in the commutator and armature; the excellent mechanical design insures smooth running and no loss through friction of bearings. The additional illustration of the armature of a bipolar machine shows the excellent workmanship and careful attention this important part of the dynamo receives.



Belt-Driven Armature, 2½ to 65 Kilowatts.

The office of the company is in charge of officials who will be glad of the opportunity of showing prospective purchasers methods of manufacture, quality of material and the size of some of the plants the company have installed. Excelsior apparatus is gaining ground every day and can be highly recommended by all using it.

Mason, Mich.—The Lansing, Dexter & Ann Arbor Electric Road will be constructed.



150-Kilowatt Direct-Connected Generator.

UNITED STATES ELECTRIC PLANTS FOR MALAGA.

Under date of January 9 Consul Bartleman, of Malaga, transmits a newspaper extract which states that two companies have sprung into existence there to supply the demand for electric lighting in Malaga. "With a population of about 125,000 inhabiting some 20,000 to 25,000 houses or flats," adds the article, "it is evident that there is ample room for two works. One company is of German and the other of English foundation, identically

The Electrical Age.

ESTABLISHED 1888.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - $2.50
One Copy, six months, - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, FEBRUARY 5, 1898.

CONTENTS.

THE THOFERN SYSTEM OF REFINING COPPER.

The art of refining metals has been developed in the last twenty years through the application of electricity and the broader experience possessed by the superintendents of electrolytic plants. The great mining regions of the West have become rich fields for enterprising men and paying sources of investment to capitalists since the old mining methods have been abolished and the newer, cheaper and dividend paying system of electrolytic refining taken its place. The production of pure copper is of the greatest consequence to the electrical profession and it is a marvellous coincidence that the best method of purifying it should be found in the employment of those scientific principles upon which its use mainly depends. The Thofern system of refining copper is now used by the Anaconda Copper Company in place of the Hayden series process. About one hundred and fifty tons of refined copper per diem represents the output of the Anaconda mining plant by this new system. Its economy and success go hand in hand and are of so pronounced a nature that it will probably become as generally employed as the Bessemer process for the refining of steel or any other well known process.

The plant at present installed consists of four 270 K. W. Westinghouse generators, direct-connected to two triple expansion engines of 900 horse-power each, in addition to which is another large Westinghouse generator, belt-driven by a double Corliss 800 horse-power engine, In this gigantic plant a reserve 220 K. W. generator is held, to be belt-driven when required by a 400 horse-power compound engine. The battery of boilers evaporates 62,200 pounds of water per hour. Two triple expansion engines use 23, 160 pounds while generating 1080 watts in the dynamos.

The above mentioned Corliss utilizes 22,500 pounds of water per hour in producing 490 K. W. 1500 pounds of steam are consumed each hour in the operation of the electric light and power plant and about 900 pounds for the operation of the acid pumps. With this grand total a hundred and fifty tons of copper are produced from the refining vats every twenty-four hours. The cost of production, which includes every expense attendant upon the handling of the copper, the making of the cathodes, working the silver mill and running electric lights, reaches about 17½ horse-power hours per ton, which on a dollar and cent basis, would rate the cost of production. Wooden tanks are used in the electrolyzing process, each tank eight feet three inches long; four feet seven inches wide; three feet, three inches deep. Ten vats are placed, end to end, in a row, each row built on an inclined plane, the electrolyte passing from one to the other.

The blister copper, used as an anode, carries the following materials: 98 per cent. of copper, 110 ounces of silver, ⅓ of an ounce of gold per ton in combination with such impurities as arsenic, antimony, iron, lead, tellurium and selenium. In each tank the slimes or silver mud is taken to and treated in the silver refinery. Laboring under present expenses, which represents a payment of $3.00 per day per man and $5.50 per ton for fuel, each ton of refined copper costs $14.00.

In Thofern's process, from ten to twenty amperes per square foot are used. The copper wire produced from this quality of metal has about 98 per cent. of the maximum conductivity. The object of going into the details of this great system is two-fold; first, because the application of electricity to the processes of refining are so valuable that commercially they cannot be replaced. Second, a close study of the methods employed will give the scientific and practical mind an opportunity of so economizing in the employment of electricity that a greater output is possible under improved conditions with a given amount of power than before.

From either standpoint the natural result is a great diminution in the cost of production, a greater out-put of copper, a lower price, and in total a greater stimulus to the arts and allied industries, which co-ordinate in its production.

UNITED STATES STUDENTS IN FRENCH SCHOOLS.

General Horace Porter, United States ambassador to France, writes from Paris under date of January 11, 1898, in answer to an inquiry in regard to the admission of a student from the United States into the School of Mines. No foreign student, he says, can enter any of the schools of France — medicine, pharmacy, dentistry, veterinary, painting, design, architecture, music, declamation, engineering, etc. — without the formal application of the diplomatic representative of his country. In most cases two letters suffice, one making application, the other expressing thanks when the request is granted. Sometimes more correspondence is necessary, for the reason that those proposing to enter any of the high-grade schools have to produce certain certificates of studies, or diplomas, which the authorities accept only when they come through the embassy. These rules, says General Porter, apply to all foreign students. No discrimination is made against Americans; on the contrary, the authorities extend all possible facilities to them. There is a large number of American students in Paris, and, as a rule, they are much liked by the teachers in French institutions.

As for the School of Mines, he continues, foreigners can be admitted there either as foreeign pupils, in which case they have to stand an examination, or as free auditors, in which case there is no examination. All the courses, however, are not open to that class of students, and no diploma is granted them. In both cases they have to pay 50 francs ($9.65) for matriculation. If the school is full, as occasionally happens, the application for admission is put off until the next year.

as is the case in Madrid, where the two rival companies, working each on the same tariff, have so satisfactorily divided the business that they both made a profit of over £30,000 last year. Our concern at the moment, however, is not with the German but with the English works.

"In one respect, the Malaga company gives a lesson to its English confreres, for it has adopted the principle of free wiring, with the result that it starts with a paying load at once, and has thereby placed itself in the position of being able to earn a dividend in its first year, instead of having to spend two or three years in pioneering, as in the case of almost every English concern.

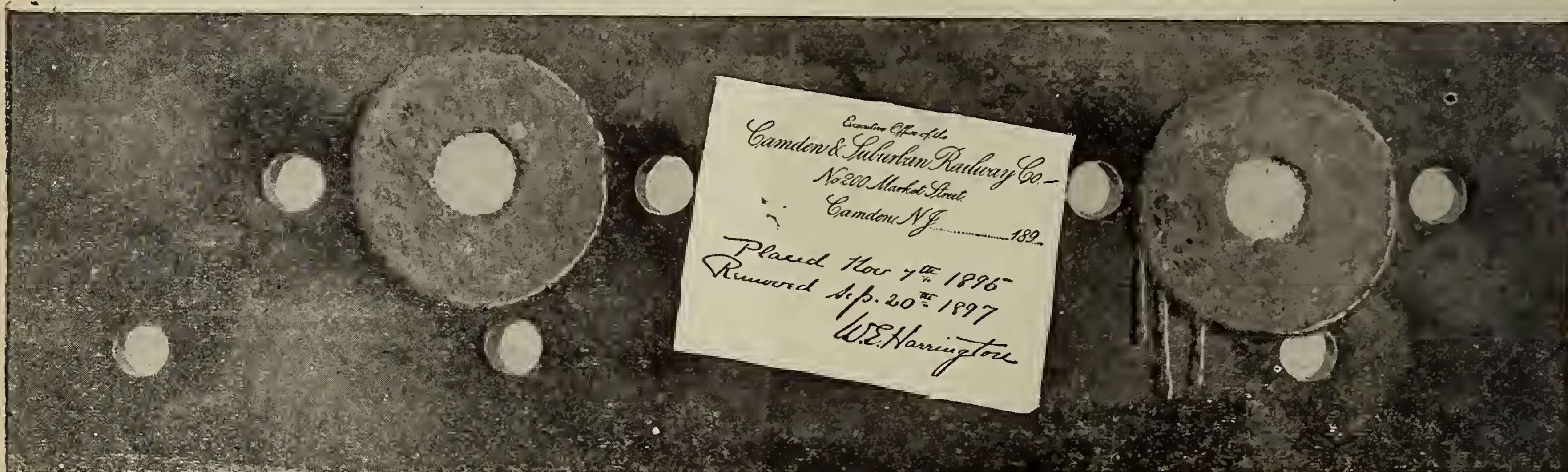
"The capacity of the plant at present in operation is 330 kilowatts, and Messrs. Fowler & Co. still have in hand under their contract another set similar to those in use; but the completion of this has been seriously delayed by the strike in the engineering trades. The great demand for electricity, however, has rendered essential the erection of further generating plant, and, as the engineering strike in England has prevented the completion of English-made machines, the directors have had to place their orders in other quarters. They have arranged with the Westinghouse Electric Company, of Pittsburg, to supply immediately two sets of plants, each of 135-kilowatts capacity, and these are now on their way to Malaga and will be erected early in the new year. The total capacity will thus be raised to 765 kilowatts, and, in addition to this, we understand that the directors have under consideration the consulting engineer's estimates for two further sets of plant, each of which is to be of 300 kilowatts capacity.

"From this it is very evident that the business in Malaga is making rapid strides, and that the undertaking will develop into a highly profitable enterprise. Of this we can have no doubt; and, if we had, it would be dispelled by the intelligence to hand from Malaga that up to the end of November last, after the works had been in operation for less than two months, upwards of 800 consumers had applied for a supply of electricity, and that 7,200 lamps were then connected to the mains. On the day when the supply was started, the maximum load was 16 kilowatts and the output for the day only 29 units, but by November 30, the load had reached 128 kilowatts and the output for the day had advanced to 884 units, while on December 11, 148 kilowatts was recorded as the highest load and 1,093 units as the day's output.

THE EDISON PLASTIC RAIL BOND.

Modern practice in rail-bonding for electric traction calls for a generous amount of copper, with a rail contact area seven to ten times its cross-section, and with heavy bolts, nuts or wedges to hold the two metals together. When such a joint is covered with a viscous paint it would seem to be mechanically and electrically perfect; but careful measurements of the drop in these joints, even when new and at their best, give startling results with heavy currents. The thermo-electric difference between steel and copper evidently causes a loss many times that due to the resistance of the copper alone. But when this joint has been submitted for even a few months to the acidulous moisture of a city street, and to the mechanical changes encountered in service, the loss grows rapidly greater. Only a short time is required to deposit a slight film of iron rust between the surfaces of rail and bond; this film is of high resistance, and serves as a channel for the admission of more and more moisture, and conductivity decreases rapidly. Every passing car and each change in current aids in the work of destruction.

Since the spring of 1889 experiments have been in progress at the Edison laboratory, with its magnificent equipment for investigation, in order to obtain a rail bond of permanently low resistance, which would make an absolute electrical union and would be proof against rust and against mechanical injury from the hammering of wheels, the changes of temperature and variations of



Edison Plastic Rail Bond.

current. Hundreds of promising schemes were tried and found wanting. Every practical combination of metals, every method of joining, of excluding moisture, of providing for expansion and contraction, has been tested with heavy currents and then buried for the test of time. The contact surfaces have been welded together, have been machined and scraped to an exact fit, bolted together with heavy pressure, plated with tin, nickel or copper, provided with sheet lead, tin-foil or other soft metal, or with various non-rusting alloys placed under insulation, or a combination of several of these. Only a single one of these has successfully withstood the test of time and has proved to be a satisfactory rail bond. After a test of about five years on buried rails, it showed no increase of resistance, carrying 1,500 amperes with a loss of but $\frac{1}{16}$ of a volt. A large number of these joints were dug up for examination, and showed no trace of rust on the contact surfaces. This long experience resulted in the invention of the Plastic Rail Bond, which has been in actual service for the past three years.

For this bond, no holes in the rail are needed, nor any wires, plates, bolts, nuts or rods, and the completed joint is perfectly protected by the fish-plate. The plastic bond is composed of two portions; a plastic or putty-like metal compound which makes contact between the rail and the metal of the joint, and a flexible elastic cork case to hold same in position, as near the end of the rail as possible.

The current passes from one rail through the bond to the angle plate, and then through the second bond from the plate to the next rail. In putting this bond in place, contact spots about two inches in diameter on both rails and plates are cleared of scale and rust, and the centre of each of these surfaces is rubbed with a special alloy, discovered by Mr. Edison, which instantly changes any iron rust to pure metallic iron, and forms a silver-like deposit which repels water and will not corrode. A permanent iron amalgam, which has been considered a chemical impossibility, is thus produced upon the surfaces, and in this lies the cause of the low resistance and durability of the bond.

One side of the case is then placed upon the prepared surface of the web of the rail and a plug of the plastic metal surrounded by an amalgamated steel spring washer is put into the hole. A second case and plug is then similarly placed on the adjoining rail, and the fish-plate is bolted down. The tightening of the bolts compresses the cork to half its former thickness, and makes its surfaces stick firmly to the steel, the spring forming a distance piece to prevent too much compression. The fish-plate nuts are locked in position, but even if they should slacken and the plate drop back even one-quarter of an inch, the cork will expand or be pulled out to its former thickness by the adhesion of the insulating compound to the steel; and the plastic metal, by gravity and the expansion of the spring, will maintain a perfect electrical contact.

In fact it is hardly accurate to call this junction a contact; "union" is a better word, since the adhesion is so great between the prepared surfaces of the steel and the metal of the bond that its conductivity is equal to that of the rail itself. The plastic metal cannot be injured by the blows of passing wheels. It is sealed from air and water, and remains plastic indefinitely, if properly applied. The elasticity of the cork permits the movements of rail and fish-plate due to expansion and contraction, produced by changes in temperature. Even though water or any acid or alkali likely to be encountered in the streets should get to the plastic metal, it cannot affect it nor corrode under the prepared surface of the steel, into which the amalgam seems to penetrate.

The remarkable conductivity of the joint and its low drop has been demonstrated by tests after two or three years' use in the United States, South America, Australia, and England. As this bond has a conductivity equal to the rail itself, a large reduction in feeder wire can be made by its use.

It is cheaper than a copper bond of half its carrying capacity, and will last as long as the fish-plate. It is evident that no road using bonds of copper wires can be overated with the greatest economy of power, as the loss in transmission with copper is from seven to ten times greater than the loss with the plastic bond.

Chestertown, Md.—W. J. Hoffman and J. K. Wright have been granted franchise to light the town, and will erect a $15,000 electric plant.

Bay City, Mich.—The Bay, Tuscola and Huron Electric Railway Company has been formed to construct an electric road from this city to Sebewaing.

TELEGRAPHING WITH AND WITHOUT WIRES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

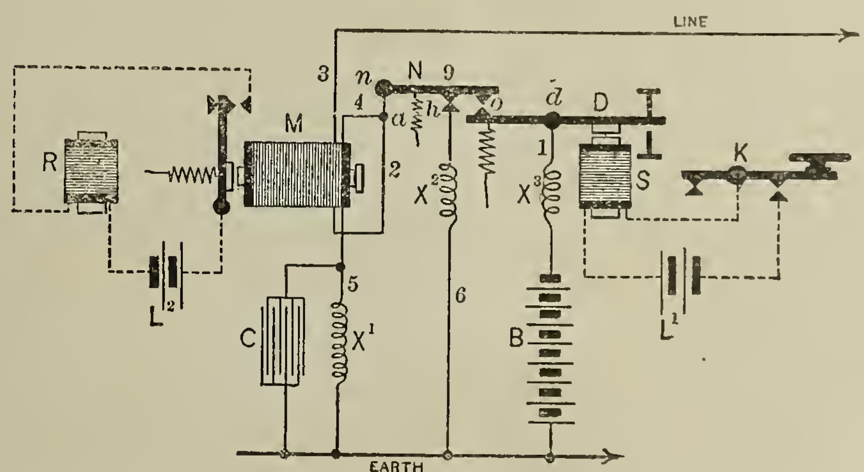
BY NEWTON HARRISON, E. E.

The art of transmitting signals is of recent growth, but the history of earlier attempts dates back to at least a century ago.

When the fact became known that bodies could be arranged into two general classes—conductors and non-conductors—the transmission of signals electrically to distant points became a possibility.

At present the Western Union Telegraph Company possesses 600,000 miles of wire and sends annually about 50,000,000 messages.

This is the result of one man's work, S. F. B. Morse, who was impressed with the importance of a telegraph system, and through whose earnest efforts we are able today to sit in our homes and send messages thousands of miles away with inconceivable quickness and dispatch.



Single-Current Duplex.

The labors of Henry in practically inventing the electro-magnet made Morse's work a simpler matter than had been expected. It is even believed that an electric telegraph was invented by him, consisting of an electric bell actuated by a key. This was in the year 1831. But it seems to the reflective mind that perhaps the greater discovery of all was the invention of the electro-magnet, irrespective of its innumerable applications. It is in all reality the breath of life to electrical mechanism, such as motors, all signalling devices and a host of other important pieces of laboratory apparatus.

We can look back to a period prior to either Morse or Henry's and meet with Oersted, whose notice of the reaction between a compass needle and a current-carrying coil sent a wave of discussion through the scientific world.

Sturgeon subsequently built an electro-magnet whose core was of soft iron, in place of the steel previously used.

Henry constructed a powerful electro-magnet capable of holding 2,000 pounds in suspense, which is in existence today.

The genius of Morse lay in the thorough appreciation of the value of a telegraphic instrument for direct use, the same in his time being practically an electro-magnet with a stylus or point cutting or marking the band of paper automatically fed beneath it, the point being actuated by an armature controlled by an electro-magnet and a keg at some distant point.

The telegraph systems of today are about reducible to one—the Morse system.

Wheatstone, of England, Elisha Grey and others produced printing and needle telegraphs, but none other than the printing telegraph besides the Morse has survived. The Morse outfit in its simple form consists of

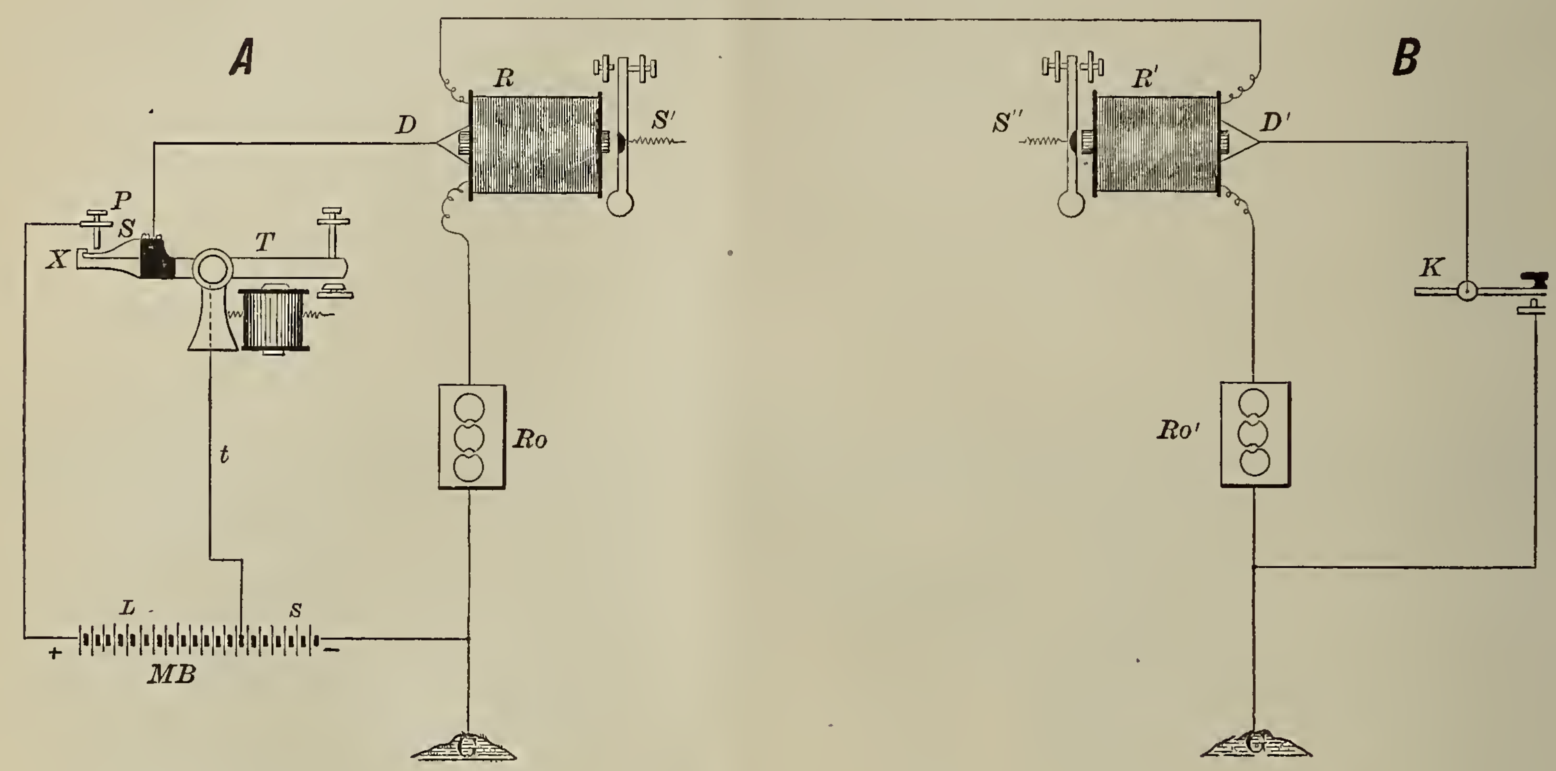
Key,
Sounder,
Line,

and a set of cells to operate the same.

The key consists of a simple switch, the part pressed by the hand making contact with a point below, but springing back when pressure is released. The spring or lever portion connects with one wire and the point below with the other wire of the circuit.

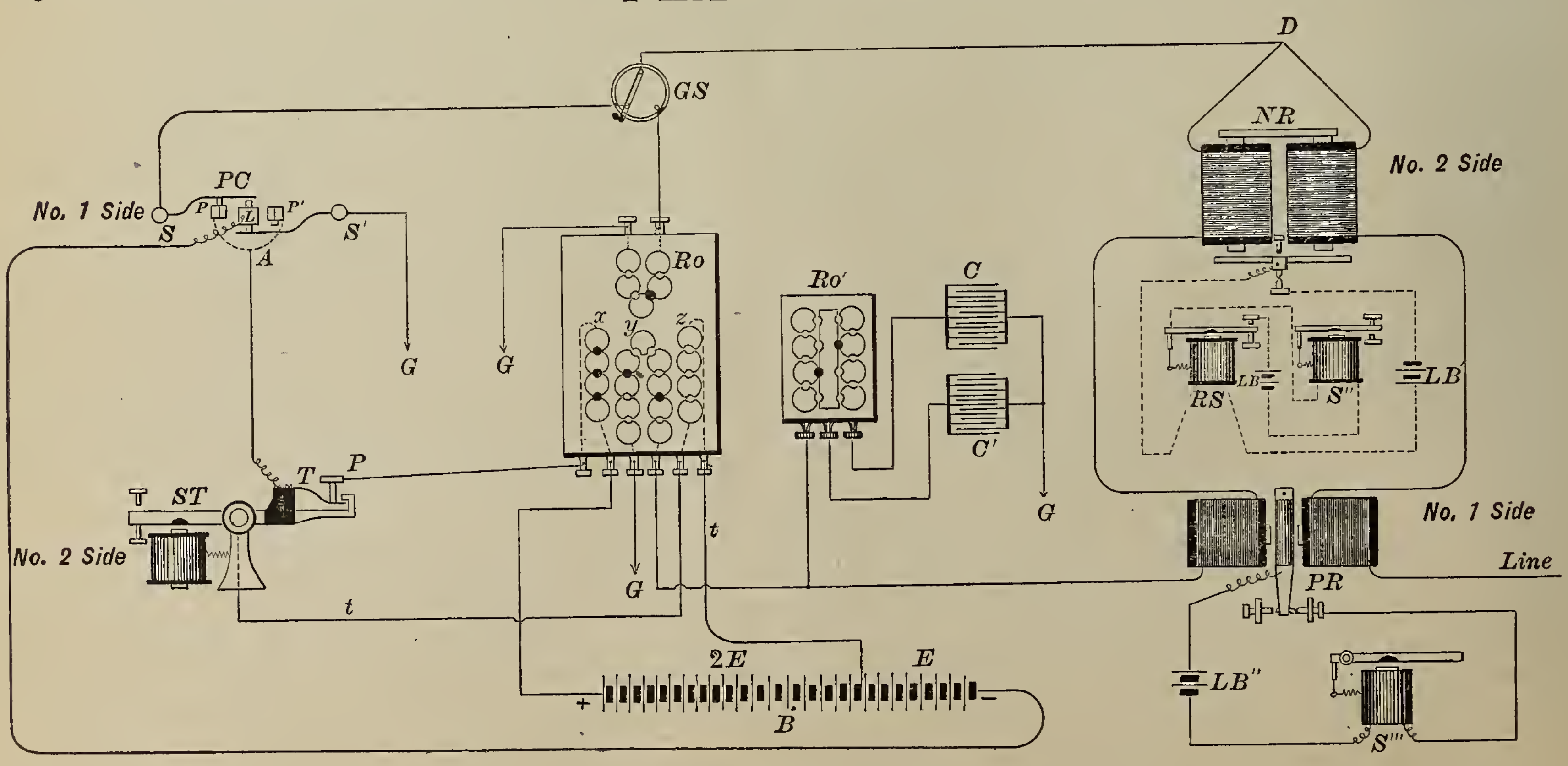
The sounder—whose original form was that of an electro-magnet which moved an armature, connected to which by an arm was a marking or cutting point making a series of dashes upon a paper strip—has been replaced by the original electro-magnet and lever with armature at the end. It was eventually noticed that the click of the older form of apparatus was capable of imparting a signal as well as the mark. Telegraphers became so experienced that the audible click was all they required to frame their sentences. The tape was then dispensed with for long-distance work, leaving the modern sounder in its place.

PLATE XV.



STEARNS' DUPLEX WITH BATTERY AT ONE STATION ONLY.

PLATE XVII.



THE QUADRUPLEX.

MATTHEWS, NORTHRUP & CO., ENGRS. & PRS., BUFFALO, N. Y.

The great genius of Morse lay in his ability at that period to place before the public an instrument whose simplicity was an absolute guarantee of its success.

The line was supported then, as now, upon poles with insulators. The first line connected with Washington and was only erected after a donation from Congress had been received. Its success was heralded all over the world as an achievement which at once elevated mankind immeasurably above the plane of life he had been living in for untold ages.

Since Morse constructed the first simple, single-message telegraph, other inventors have improved upon it by the addition of mechanism for sending two, four or more messages over the single connecting wire at the same time.

A two-message system is called a duplex, if coming from opposite ends; from the same end, a diplex message. A double diplex or double duplex constitutes the quadruplex. A system covering more than a single message at a time might justly be called a multiplex system, but is usually called such only when the number exceeds four at a time.

Part II.—Multiple Telegraphy.

It is a matter of considerable difficulty to describe within a limited space the principles of multiple telegraphy; yet by careful analysis it is possible to reduce the subject down to a few simple principles.

Single Message System.—A simple circuit, including within its limits a key, sounder and battery, offers no difficulties to the understanding. The line may be a double metallic circuit or it may consist of an overhead line with an earth return. To secure an earth or ground return, the extreme ends of the line are twisted around a gas or water-pipe respectively, or attached to a metal plate sunk into moist earth and involved in a bed of coke, charcoal or scrap metal. But one message can be transmitted through a circuit of this description, and over but a limited length of line, if no accessories are added. The longer the line the greater the battery power required to compensate for the leakage occurring throughout its length. It is impossible to send a current many miles without great loss; it therefore becomes neessary to employ a device called a relay to remedy this difficulty.

Relay.—A relay consists of an electromagnet whose armature, when attached to the poles of the electromagnet, closes a switch; that is, brings two contact-points together, which open and close a small circuit containing a series of cells and the sounder. The original current coming over the line operates this relay, which a very weak current will actuate. At the end of a long line a relay will prove a most serviceable piece of apparatus, because the current it takes would never be sufficient to work a sounder distinctly, yet proves enough to move the armature of the relay a trifle, thus closing the independent, local circuit in which the sounder and new cells are placed. The sounder, by this means, gives a most emphatic signal, perfectly audible and satisfactory.

Importance of the Relay.—The entire practice of duplex and quadruplex telegraphy depends to a great extent npon the relay, modified, of course, to suit either, but still retaining its position and performing its functions as described.

Kinds of Relays.—There are several kinds of relays known under the names of

Neutral relays,
Polarized relays,

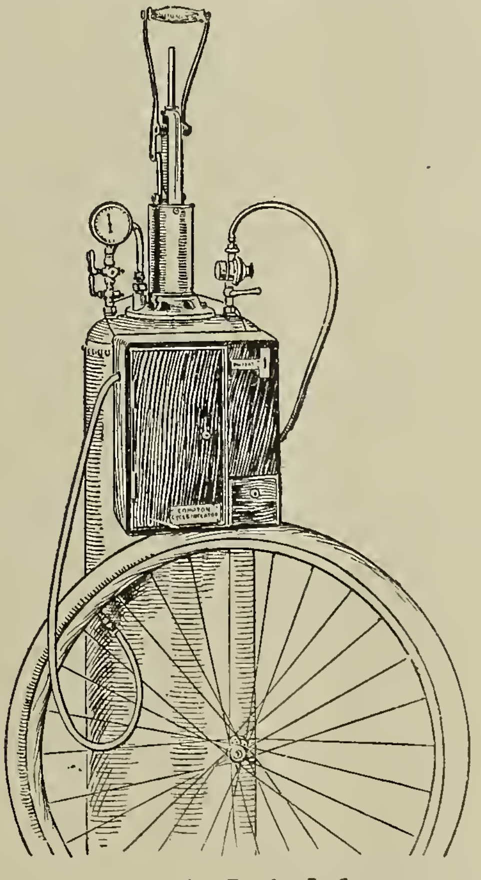
each of which may be wound with a form of winding that is called differential winding.

(To be continued.)

"A PENNY DOES IT."

The Compton Automatic Cycle Inflator—The Latest Boon to Wheelmen.

A penny-in-the-slot machine for inflating tires is the one thing wheelmen need. Mr. Compton, the inventor of the automatic cycle inflator, seems to have hit the bull's-eye. The inflator does the whole business. All that is necessary is to attach the flexible tube to the valve on cycle tire, drop a penny in the slot and in a few seconds your tire is hard. There is no lever or pump handle to work, nothing in fact to do but simply produce the price, one cent, and the machine does the rest. The machine will be found along all the streets, avenues and roads traversed by wheelmen the coming season. A regulation sign will be displayed wherever one of the machines is located so that wheelmen, as they ride along the street are informed "where they are at." Mr. Sydney B. Bowman has leased a thousand for Greater New York; Charles S. Smith & Co. have leased five hundred for Philadelphia, and leading cycle dealers are hustling to get control of the machines in their respective cities. No one will think of using a pump after they have once tried this automatic inflator. Pennies instead of pumps will be carried by wheelmen in the future for "a penny does it."



Automatic Cycle Inflator.

Mr. Melvin B. Compton, the inventor of the cycle inflator and president of the company, is one of the most ingenious and successful inventors of the present time, having invented the automatic electrical control and Compton's magnet thermostat system, which has been so successfully introduced throughout the country for automatically controlling the temperature in large buildings, theatres and especially private residences, now owned and being introduced by the Compton Automatic Control Company, Times Building, New York, and 114 N. Broad st., Philadelphia, Pa. Another of Mr. Compton's successes is the Compton Electrical Bulletin Company, of 112 N. Broad street, Philadelphia, whose electric system reproduced the baseball games to crowded houses at Music Hall, Boston, last summer.

DEATH OF WM. HABIRSHAW.

Wm. Habirshaw, only son of Mr. W. M. Habirshaw, of the India Rubber and Gutta Percha Insulating Company, died of pneumonia at Yonkers, N. Y., on Sunday, of this week. He was a young man of great promise, and had been an assistant to his father in the manufacture of Habirshaw wires and cables.

SIEMENS & HALSKE ELECTRIC COMPANY.

The New England representative of the Siemens & Halske Electric Company of America, N. E. office, 178 Devonshire street, Boston, have just obtained the contract for the new Municipal Lighting Plant at South Norwalk, Conn. This plant will be of interest to the engineering fraternity generally, as it is to be run on the straight 220-volt two-wire system for arc and incandescent lights as well as power. While a large number of these stations have been put in abroad there have been comparatively few installations of the kind here, except for isolated plants.

The New England business of the Siemens & Halske Company has been very satisfactorily increased during the past year—one of the most notable contracts being for the Boston City Hospital.

Another plant is being installed in the new theatre at Springfield, Mass., of two 75-k.w. machines running at 100 r.p.m.

Still another theatre plant has been running for several months at the Academy of Music, Fall River, Mass., while one of the largest orders secured, and now in satisfactory operation, is that for a large manufacturing plant, in which motors ranging from 10 to 100 H. P. in capacity, (aggregating a total of about 1,000 H. P. full-load capacity) with 100 Manhattan lamps and several hundred incandescents, are operated from a single set of bus-bars at 220 volts, current being furnished by two machines of 400-k.w. capacity each, with a smaller one for night service.

The generators in all the above-mentioned plants are of the Standard Siemens & Halske external armature type, while a large number of internal armature belted machines in both the slow and moderate speed types for generating and power service have been installed in Boston and vicinity during the past few months.

H. C. Spaulding acts in the capacity of special sales agent at the address given above.

MESSRS. CARRÈRE & HASTINGS beg to inform you that they have removed their offices to 28 East Forty-first street, Madison avenue.

HENRY ELECTRICAL SOCIETY.

Rooms, Nos. 111–115 West 38th street, New York.

January 26, 1898.

The 96th meeting of the Henry Electrical Society was held at Columbia University, Engineering Building, Room, No. 302, on Friday, February 4, 1898, at 8:15 P. M., at which A. H. Ford, E. E., delivered an experimenal lecture on "Transformers."

BEAUTIFUL WHITE MAHOGANY BOARD FINished in rich plush, all ready for exhibiting all kinds of goods; size 4 feet 6 x 7 feet 6 ins., will be sold low for cash at the office of H. P. Ball Manufacturing Co., 101 Beekman street, N. Y.

ELECTRICAL SHOW NEXT MAY AN EDUCATIONAL FACTOR.

An auxiliary and educational committee has been formed to take general charge of exhibition matters other than commercial, and to co-operate with the Advisory Committee which represents the New York Electrical Society. The Auxiliary Committee comprises men of the highest standing, all of whom intend to take an active part in the work and are now making extensive and interesting plans. Mr. T. C. Martin, who was chairman of the very successful committee of the 1896 show has again consented to serve in the same capacity. With him are associated Prof. F. B. Crocker, of Columbia University; Prof Morris Loeb, of the University of New York; Prof. W. E. Geyer, of the Stevens Institute of Technology; Dr. Chas. A. Doremus, of the College of the City of New York; Mr. Herbert Laws Webb, of the New York Telephone Co.; Mr. J. B. Taltavall, editor of the Telegraph Age; Dr. Park Benjamin; Secretary G. H. Guy, of the New York Electrical Society; Mr. W. T. Wheeler, vice-president and national deputy, National Association of Stationary Engineers; Lieut. G. O. Squier, U. S. A., and Mr. Thos. A. Edison, Jr. (who is in charge of some special decorative and mechanical effects).

It is believed that this committee, enjoying as it undoubtedly will the heartiest confidence and co-operation of all, will be able to accomplish some extremely useful and memorable work in behalf of the science of industry.

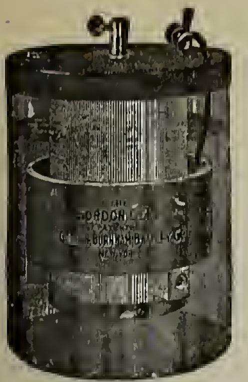
As already announced, the New York Electrical Society is the body under whose auspices the Exhibition is to be held, and it has appointed an Advisory Committee entrusted with its interests, and composed of its present officers and past presidents, namely, present officers, Dr. M. I. Pupin, president, and Messrs. Dunn, Sinclair, Case, Osterberg, Guy, Riker, Coho and Ker; and past presidents as follows: Messrs. F. W. Jones, Small, Pendleton, Crocker, Wetzler, Mailloux, J. W. Lieb, Jr., and Dr. C. E. Emery.

REMOVAL NOTICE.—We beg to announce to our friends and patrons that on and after February 1st, 1898, our office and factory will be found at No. 27 Rose street, New York City. DE VEAU & CO.

South Boston, Mass.—The Boston Electric Light Co. will erect a plant.

Johnstown, Pa.—The Lykens & Williams Valley Street Railway Company has been incorporated with John B. Skyles, president, to construct and operate an electric line between this place, Schuyler County, and Lykens, Dauphin County, a distance of 10 miles.

Spring Green, Wis.—G. S. Post may be addressed concerning construction of electric light plant.



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Edison Phonograph Agency,

Edison Building, New York, N. Y.

Telephone Users (INTENDING)

are reminded that the next quarterly issue of the TELEPHONE DIRECTORY will go to press on March 1st. To obtain the advantage of listing in this issue of the directory it will be necessary to make contracts during the present month.

NEW YORK TELEPHONE CO.

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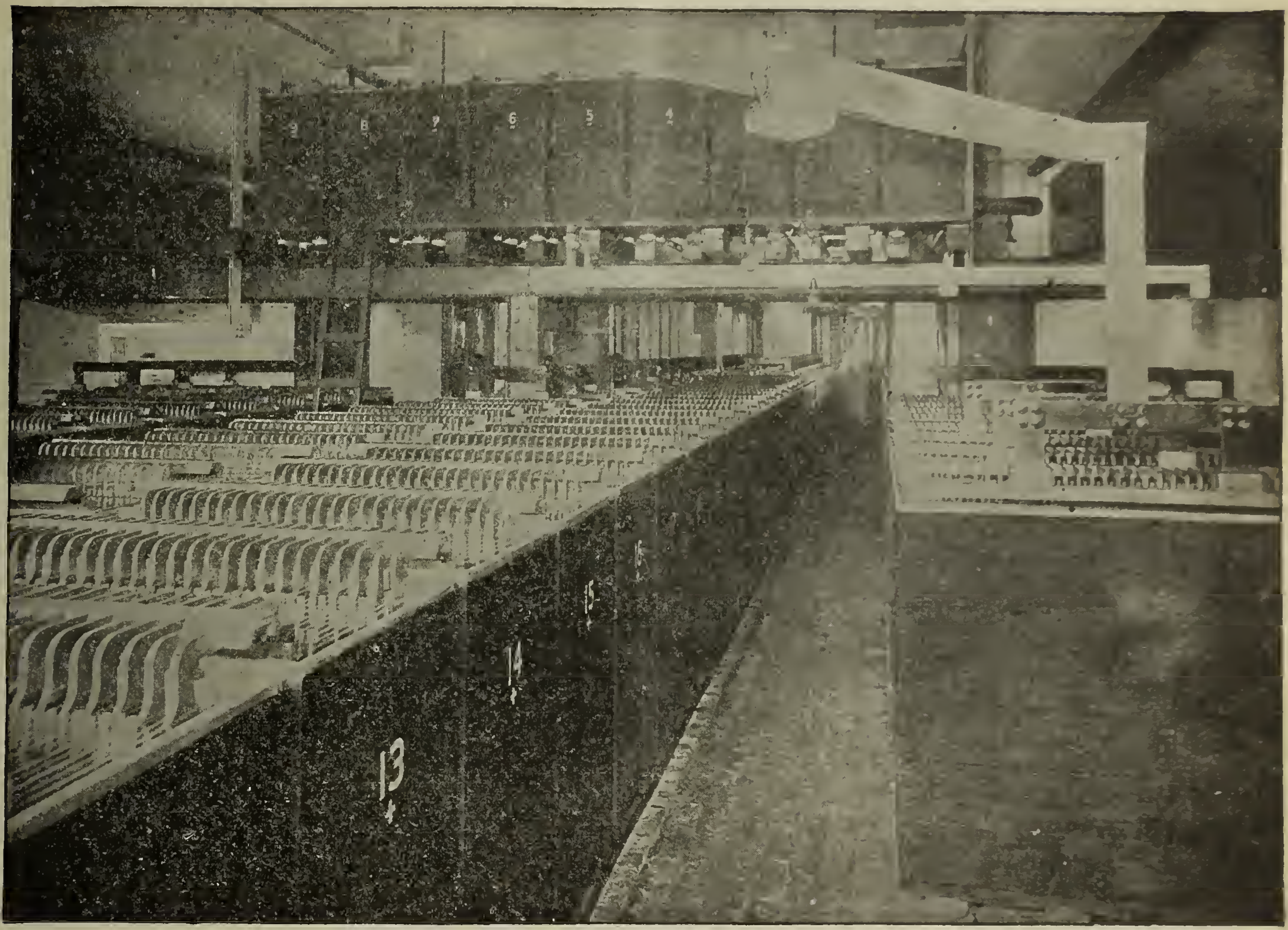
Contains 10,000 code words arranged in tables, numbering 75,000 to 85,000.

THE LIEBER PUBLISHING CO.,

STONE STREET, NEW YORK. 23 LAWRENCE POUNTNEY LANE, LONDON, E. C.

The Electrical Age.

VOL. XXI—NO. 7 NEW YORK, FEBRUARY 12, 1898 WHOLE NO. 561



Plant of the Edison Electric Illuminating Co., Philadelphia, Pa.

THE CHLORIDE ACCUMULATOR.

Electrical engineers have instinctively groped in the past for some means whereby storage batteries could be used with advantage to electric light plants. The time has now arrived, not only for proving that they have their function to perform in this profession, but that for years success in many directions has been hindered by their non-usage. The present chloride accumulator possesses advantages which appeal to the mind of every competent engineer with tremendous force.

The fact that the plates composing a chloride accumulator are mechanically strong, free from the familiar diseases so frequently afflicting other types, is encouraging to a high degree. Buckling is absent and plate deterioration cannot occur. The plugs are firmly attached to the foundation in which they rest and the capacity of the plate or cell can be called upon without risk to give up its stored energy, without the collapse frequently expected in many experimental types of storage batteries. For electric light work, the advantages derived from the use of accumulators are only too evident.

First, reduction in coal consumption and general operating expenses, due to the generating machinery being run at point of greatest economy while in service and being shut down entirely during hours of light load, the batteries supplying the whole of the current.

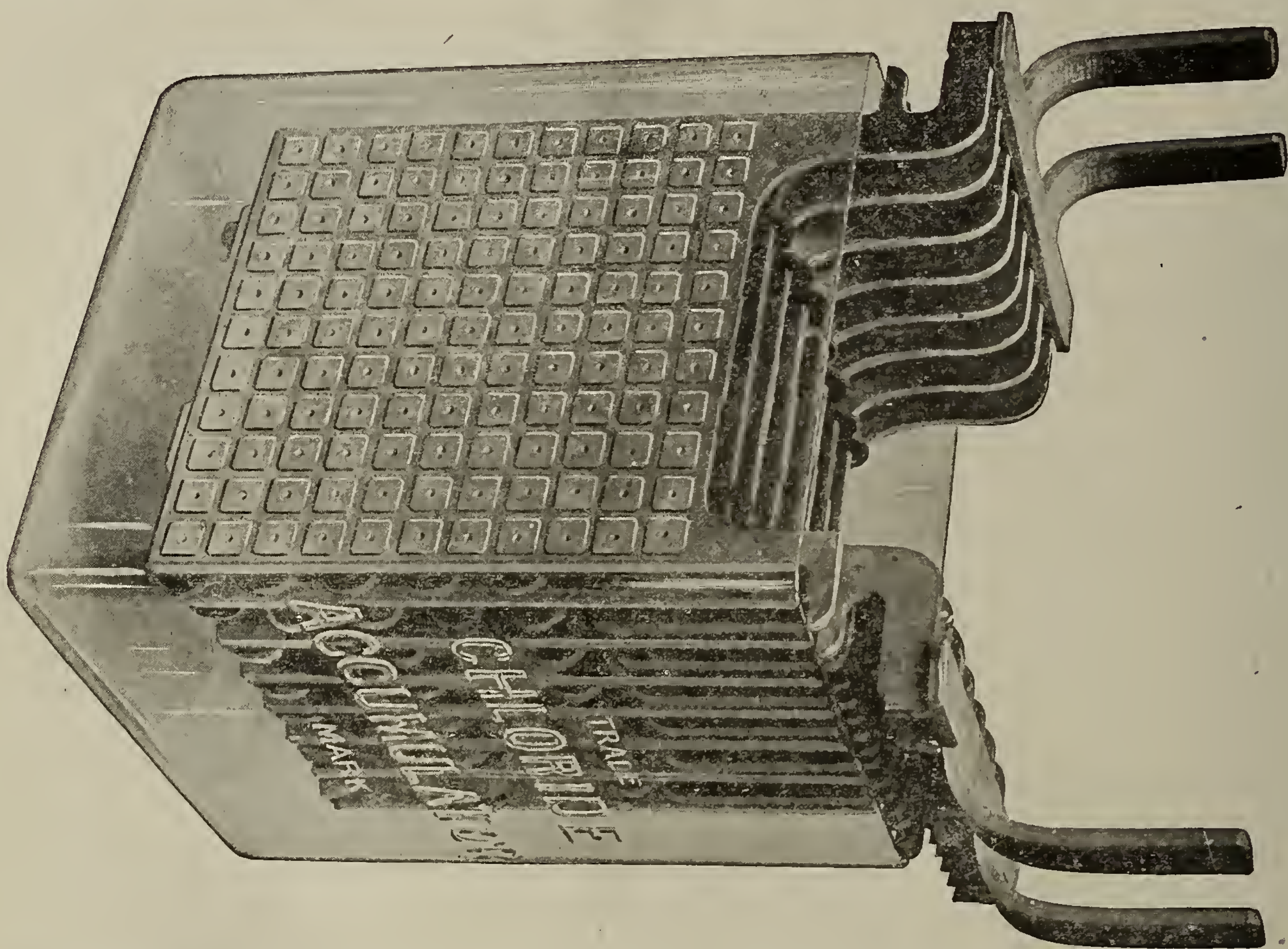
The possibility of obtaining good regulation in pressure during fluctuations in load, especially when the day load consists largely of elevators and similar disturbing elements.

To meet sudden demands which arise unexpectedly, as in the case of darkness, caused by storms or thunder showers; also in case of emergency due to accident or stoppage of generating plant.

Smaller generating plant required where the battery takes the peak of the load, which usually lasts only for a few hours, and yet, where no battery is used, necessitates sufficient generators, etc., being installed to provide for the maximum outfit, which in many cases is about double the normal output.

For this purpose, it has been demonstrated that the battery is a profitable investment, the cost being equal, or, in fact, less than the generating plant required to supply the maximum output; and when the other advantages are considered, there is no doubt whatever that the storage battery is an essential feature, both technically and commercially, in a central station plant. It is certain that as time rolls on other applications will be made of the storage battery, as it gradually diminishes in weight and increases in capacity. In the equipment of a central station provision is of course made for the normal load it is supposed to supply; but in such cases, where the load increases beyond the capacity of the plant, it is found cheaper to add an accumulator installation to carry the so-called peak than to provide an additional equipment of dynamos and engines which may be called upon only for a couple of hours each day and possibly not even pay the interest on the original cost of their installation. The storage battery equipments put in by the electric

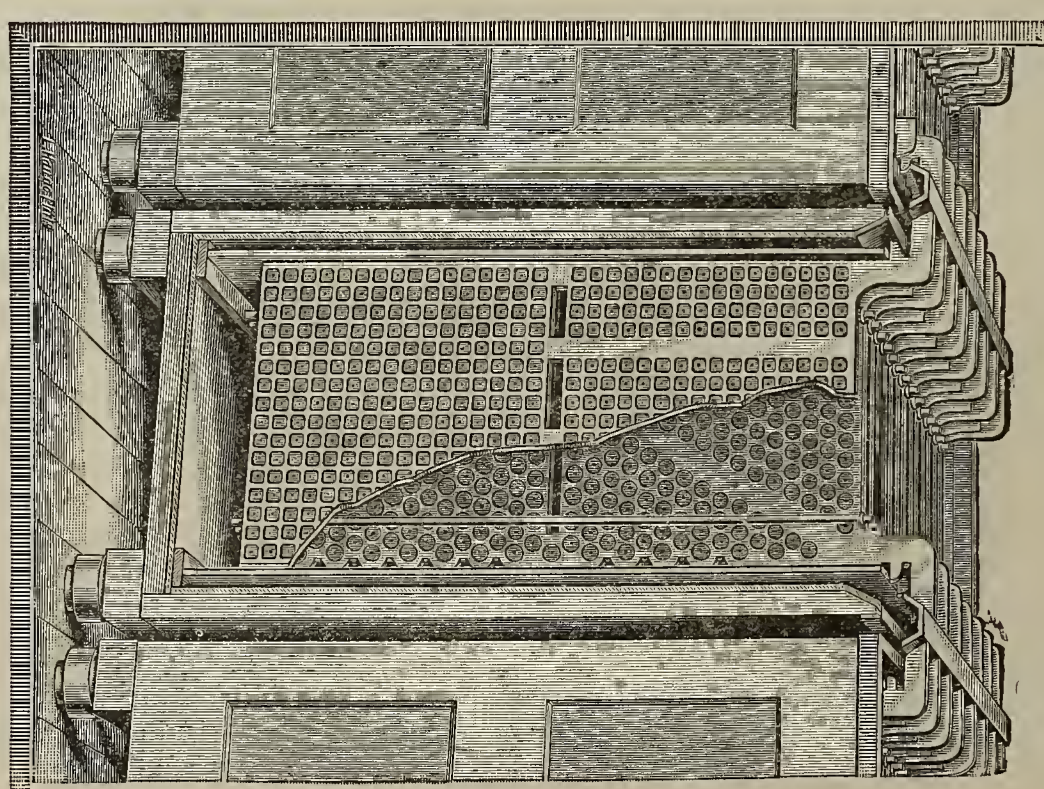
Storage Battery Company, of the Drexel Building, Philadelphia, are about the very best that the engineering profession can expect. The cells are strong, reliable and able to endure sudden changes of load, which would rapidly deteriorate all other types.



Type "F"—15 Plates, in Glass.

The success the chloride accumulator has met with is entirely due to its excellent qualities, and depends in no way upon the talking up usually depended upon for the success of other types.

The policy of the Electric Storage Battery Company



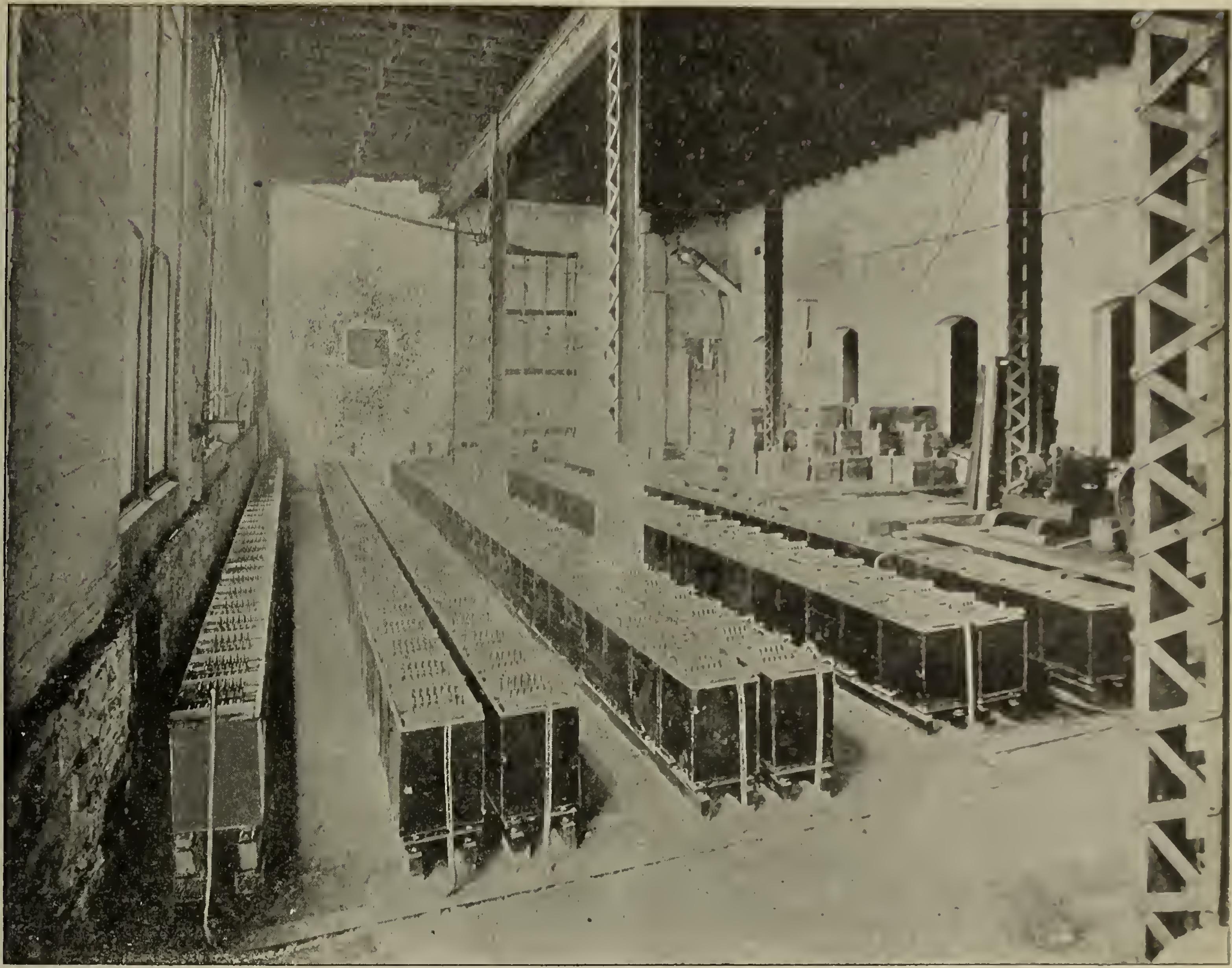
Type "H"—15 Plates in Lead Lined Wooden Tank.

has been from the very first to protect the users of storage batteries in their rights. To carry out this policy the Electric Storage Battery Company about three years ago acquired all the basic patents and patent rights underlying the manufacture of storage batteries whereby it secured to itself the sole right to supply in the United States all the important types of storage batteries developed to that time.

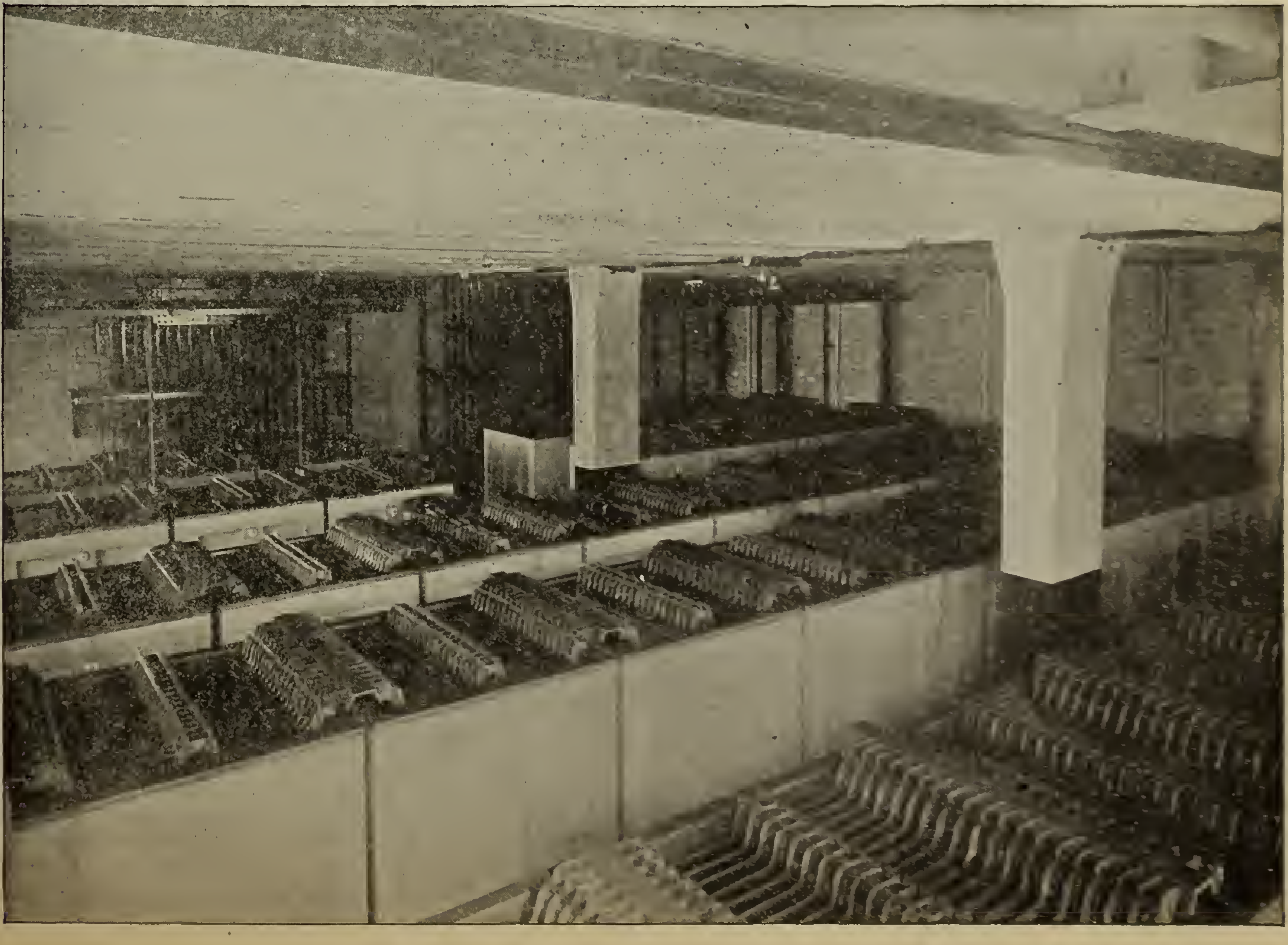
The advantages accruing to the public from this cannot be overestimated. For the first time in the history of electrical arts storage battery companies are in a position to furnish the individual types of batteries best adapted to special purposes. Not only that, but the united effort to perfect storage battery practice has already been attended with excellent results, whereby the manipulation of battery plants has been made easier and longer life and higher efficiency given simultaneously to the cells.

It is unnecessary to speak more fully of the advantages of a storage battery equipment. They are so self-evident that a little more patience on the part of the Electric Storage Battery Company will secure for them all the prestige and good will they may in the future desire.

Lewisburg, Tenn.—A new telephone line is to be constructed from Lewisburg to Thick.



Storage Battery Plant at Oakland Station, Consolidated Traction Co., Pittsburg, Pa.



Head Place Plant, Edison Electric Illuminating Co., Boston, Mass.

BOOK REVIEWS.

A revised edition of "The Elements of Electric Lighting," by Philip Atkinson, A. M., Ph. D., has been reissued by D. Van Nostrand Company, 23 Murray and 27 Warren street, New York. This is the ninth edition and came out at the close of 1897. Several chapters have been re-written and the book, as a whole, brought fully up to date. It treats of the generation, measurement, storage and distribution of electricity. It is written to be read, not alone by technical students but by thousands of interested laymen, who desire general information. The price of book, $1.50.

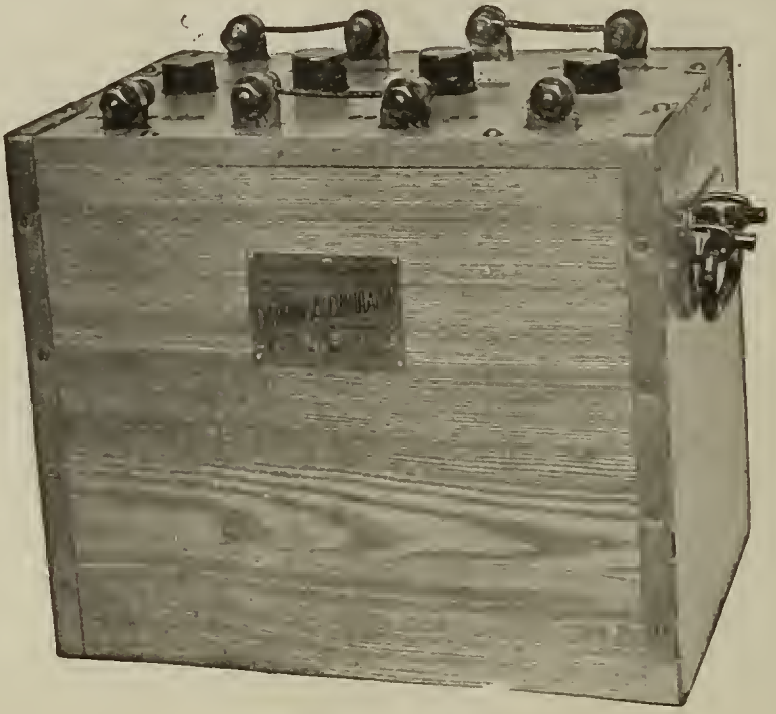
The Standard Electrical Dictionary, published by Norman W. Henley & Company, of 132 Nassau street, New York, is one of the most complete dictionaries of words, terms and phrases used in the electrical profession. It is a valuable book to the lay reader and one that cannot be replaced by the technical student. It covers the ground thoroughly and considers the lesser details relating to apparatus, methods, circuits and phenomena so exhaustively that a study of the science is directly possible by the aid of this book. A bird's-eye view may be taken of the electrical science in all its branches on examining subject matter of the "Standard Electrical Dictionary."

The present edition is the second published and contains a convenient appendix, with such other additions as bring it fully up to date, right to the front in the latest fields of thought. Artisan, electrical engineer and student of pure science will find this volume exceedingly valuable. 624 pp, 350 illustrations, price, $3.00.

"The Arithmetic of the Steam Engine," by E. Sherman Gould, is a small treatise written in an able and simple manner on the fundamental principles of the steam engine. In many respects this book will prove of the highest value to readers because of its simple character. It is true that all calculations are reducible to arithmetic, but it is likewise true that many simple formulæ are not available to the untechnical mind because the author has not given an example pertaining to the same. In the "Arithmetic of the Steam Engine" not only are the principles of steam engineering clearly set forth but instructive problems given and solved of the greatest benefit to those interested in any part of the profession. Mr. E. Sherman Gould is a member of the American Society Civil Engineers, and the author of a "Primer of the Calculus." D. Van Nostrand Company publish the above; price, $1.00.

"The Elements of Electro-Chemistry," by Dr. Robert Luepke, published by J. B. Lippincott Company, of Philadelphia, is probably one of the most able books written upon the subject of electro-chemistry of the closing century.

The subject of physical chemistry and of the various reactions and remarkable phenomena occurring in an electrolyte is one that has given rise to a variety of opinions and a host of theories. There are few scientists that have grasped the subject well enough to be able to speak with any degree of authority. But the volume on the principles and laws underlying electrolytic action by Dr. Robert Luepke is certainly worthy of the greatest attention by electrical engineers. A better comprehension of this subject will mean a quicker solution to the greatest of modern problems, the production of electricity direct from coal. It is therefore advisable for all desiring to be scientifically well informed to review the pages of Dr. Robert Luepke's "Elements of Electro-Chemistry." Price of book, $2.50.



Portable Battery.

"Electric Smelting and Refining," by Dr. W. Borchers, published by J. B. Lippincott Company, of Philadelphia, is a perfect compendium of facts relating to electro-metallurgy. It treats of the extraction and treatment of metals by means of the electric current. In our opinion it does far more. It places before the reader all known and legitimate methods in vogue for the refining and smelting of ore. The illustrations save the author from dealing in abstractions and give the reader a healthy interest in the subject matter under notice. The book is divided into parts. The first treating of alkalies and alkaline earth metals; the second treating of the earth metals; the third the heavy metals, and thereby taking into consideration gold, silver, iron, mercury, tin, lead, etc. The volume is in every sense complete, up to date and, through the aid and care of Walter G. McMillan, clearly and ably translated into good English. Dr. Borchers is a great authority on this subject and his translator, McMillan, is a lecturer on metallurgy in Mason College, Birmingham. and an author of electro-metallurgical works likewise. The book is sold for $6.50.

"The Power Catechism," published by the Power Publishing Company, New York, contains the correct answers to direct questions covering the main principles of steam engineering and the transmission of power. "The Power Catechism" is compiled from the regular issues of "Power" and is intended for special assistance in preparation for examination or where direct information is desired. The way the public is best taught is by a method of questions and answers. The very best sources of information have been utilized in supplying the proper material for this choice catechism. Not only will the above book teach the reader and practical man what is best to do, but be of the greatest assistance in the diagnosing of troubles that all steam appliances, engines, etc., are heir to. The practical man and student of steam engine design will find this book a valuable aid in all work that he may contemplate. A great deal of excellent data is added which will save considerable time in calculations.

"Scientific American" has issued a bound supplement, containing a catalogue of valuable papers. It is of the greatest use to the reader, as it will guide him in obtaining information on a multitude and wide range of subjects. The cloth bound copy is called "The Scientific American Supplement Catalogue" and covers the matter treated of in the supplement proper. It is supplied on application to subscribers by Munn & Company, publishers, 361 Broadway, New York.

"American Telegraphy, Systems, Apparatus and Operation," written and published by William Maver Jr., 27 Thames street, New York, is a most complete book on telegraphy extant. It covers the subject of telegraphy in all its branches and takes into consideration every detail relating to the operation of any given system. Mr. Maver has certainly a thorough grasp of the subject, as shown by descriptions of the utmost value to technical readers. Not only is the ordinary Morse system described but the use of the dynamo in telegraphy, the function of the condenser, galvanometers, line testing, Delaney system, automatic writing, submarine and synchronous telegraphic systems, as well as automatic burglar alarms, railway electric clock signalling systems and innumerable facts relating to the care, supervision and operation of each. Considered as a whole, no volume treating the subject could be more interesting, more up to date and complete than Mr. Maver's work on American telegraphy. The volume is profusely illustrated, containing as many as 450 cuts, and is far above the plain or the mediocre in every respect. We strongly recommend this book to such of our readers as desire real information on the subject of telegraphy. It is certainly the best ever written.

TELEGRAPHING WITH AND WITHOUT WIRES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Differential Winding.—When a magnet core is wound with wire half way in one direction and the remainder in the opposite direction, a current passing through it would produce no magnetic effect. One set of turns would neutralize the other and the magnet or relay remain unaffected.

Duplex Telegraphy.—The system of sending and receiving a signal at the same time over one wire is possible in the following manner:

Home end unaffected by outgoing signals.—The operator desiring to send a message out does not want his relay disturbed under such circumstances. If the relay used is differentially wound, and the current is sent through it, the outgoing signal leaves it unaffected.

Balancing the line.—The differential relay is supplied with two opposite windings; when the current issues from the station it is necessary to preserve each winding of the same strength, the one connected with the outside line and the other connected to the earth. If one of the differential windings connects to the line which possesses

Resistance and
Capacity,

the other grounded to the earth requires an artificial equivalent of the same. A condenser and a rheostat are therefore inserted between it and the ground connection.

Artificial line.—When a current is sent out, one half goes through one of the windings of the differential relay and then on to the main line; the other half passes through the remaining winding to the earth.

Current in each winding of differential relay alike.—By this balancing up of the real line by artificial means the current is equally split in each of the relay windings and it is totally unaffected by an outgoing signal.

Direction of current and signal.—It may be known that a false opinion prevails regarding the direction of a current and a signal. It is not necessary to have both current and signal moving in the same direction. A signal sent from one end of a line may be due to a current leaving the other end and vice versa.

In this case the single-current duplex, the outgoing current, leaves the station unaffected; but it is still sensitive to signals sent in from the other end, although these signals are only received by more current being drawn from the first end.

Diagrammatic Explanation.—In the diagram these principles are illustrated as follows:

(1) Signal sent out: K is depressed,
D is attracted,
O is lifted,
B supplies current to point *a*, where it divides between 4 and 2; one half through differentlal winding and 3 to line; the other half through differential winding, 5, C and X to earth. Result, relay unaffected.

(2) Signal being received.
Batteries at other end in series with B,
K depressed at other end,
More current drawn from 3 station sending signal,
Strengthens one of the differential windings; with the result that relay operates and works its sounder. Both keys at each station may be simultaneously pressed, yet each station receives what the other has sent without interference.

The technical names of the principal devices used in this system are the

Transmitter	K
Differential Relay	M
Rheostat	X′
Condenser	C

It is absolutely necessary to keep the line balanced at each end, otherwise the sending of signals is impossible without working the relay.

Signals travelling in opposite directions do not mean currents opposing each other. In this system, according to diagram, the current producing a signal passes through line, 3, 2, n, 9, 6 to earth.

QUESTIONS FOR REVIEW.

(1) Who invented the electro-magnet? the telegraph?
What is a sounder?
What is the line?

(3) Explain the meaning of a
Duplex,
Diplex,
Multiplex system?

(4) What is a relay?
What is a neutral relay?
What is a polarized relay?
What is a differentially wound relay?

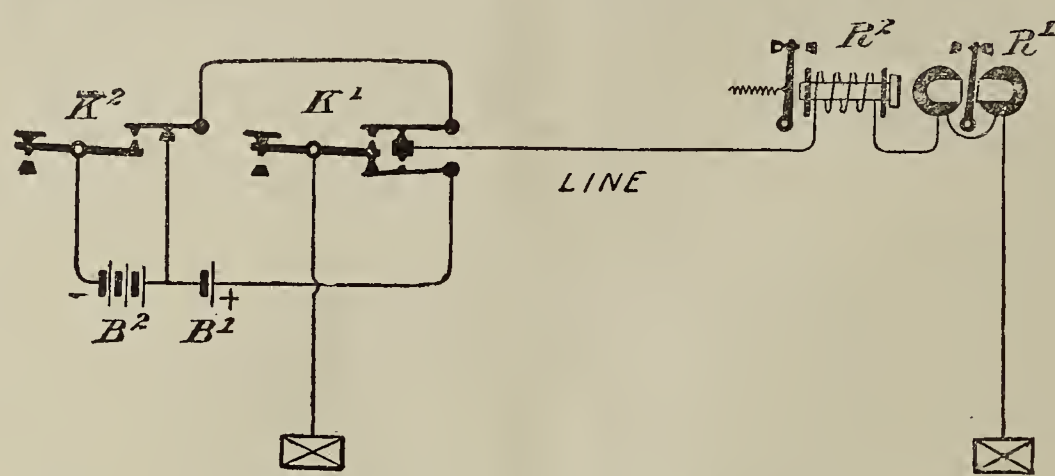
(5) What does a duplex system consist of?

(6) Outline its operation.

The Quadruplex.—The meaning of a quadruplex system of telegraphy may be traced to a combination of two systems, the single and double-current duplex systems.

Double-Current Duplex.—The explanation of the quadruplex necessarily involves the analysis of the double current duplex upon the basis of which a four-message system on one line becomes possible. In double-current duplex work a double-action key is employed at each end of the line. When either is depressed they reverse the direction of the current without breaking the circuit.

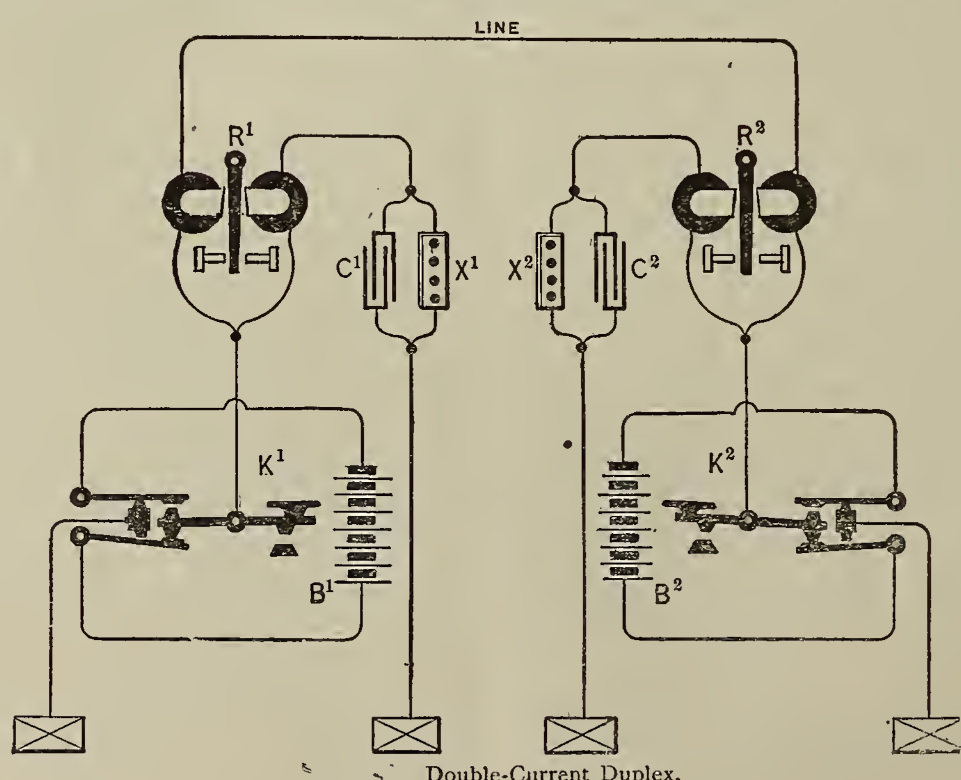
Polar Relays.—The use of the polar relay is found in this method of telegraphing, and it serves the following purpose: When current is sent into a polar relay, the relay is only effective in opening or closing the circuit when the current flows in a given direction. A polar relay is an electromagnet whose armature is a magnetized piece of steel. The steel, having poles, is attracted either one



Basis of Quadruplex.—Duplex Telegraphy.

way or the other according to the polarity of the electromagnet, the polarity of which is determined by the direction of the current circulating in its coils. A polar relay therefore possesses a polarized armature; an armature with poles.

Polar relay differentially wound.—The relay, if differentially wound, will leave the armature unaffected even with a current circulating at the same end as that at which the key is depressed. This current at the distant end is received by the station at that point, and operates



Double-Current Duplex.

the relay there. When the key is depressed a current issues outward, a positive current; when it is raised a current enters, a negative current. The direction of the current sent out therefore is the only means of affecting the polar relay at the other end, and this system may be distinguished as one dependent upon direction and not volume, as in the last single-current duplex system. While one end is sending a message the other may be also doing likewise; both signals are therefore sent and received at the same tine at each end respectively.

The System.—The artificial line is supplied in this as in the single-current system, and the main point to recollect is the fact that it involves the use of a double key at each end, which reverses the current, and a differentially wound polar relay sensitive to such changes.

Quadruplex Telegraphy.—For the quadruplex transmission of signals a double set of keys is used. One similar to the last described performs the function of reversing the current. The other merely controls the current of greatest strength.

Its Principle.—Perhaps the fact has been already noted that in single-current duplex telegraphy, the relay is affected by the changes in the strength of the current, and in double-current duplex entirely by the direction of the current. It seems evident that upon this basis a double system could be constructed, such that either the strength of current affected one relay or the direction of the current the other; and with this combination, currents could be sent and received depending upon their quality to the extent of four at one time.

Polar relay and neutral relay in series.—By having both the polar and neutral relays in series, a given direction of current will only affect the polar, and a given strength the neutral relay. Two keys are therefore used controlling each condition.

The reversed currents moving the polar relay are too weak to operate the neutral relay, therefore it is exempt from that influence, being entirely under the control of the stronger current sent forth by the other key.

An electrostatic discharge sets into action ether waves of varying duration and intensity. The experiments of Dr. Hertz, Prof. Lodge, Prof. Marconi, and Prof. Rhigi have been fruitful in showing a method of telegraphing or signalling without wires. If an electric circuit, consisting of bell, batteries and a tube filled with metallic powder be so placed as to be swept by the ether

The Electrical Age.

Established 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
First Floor, World Building.
NEW YORK.

NEW YORK, FEBRUARY 12, 1898.

CONTENTS.

TELEGRAPHING WITHOUT WIRES.

It is well understood that logic is the lever of human progress. But it seems to be likewise true that human reason is deficient and useless as far as its relation to certain consequences or results may be concerned. It has often happened that the first crude experiments performed elucidating a known principle and showing certain tremendous possibilities in the near future have been cried down by men of high standing. This prejudice, bias or antagonism, is not always the result of careful thought, but frequently due to impulse or egotism. The perversity of the human mind is such that it will face truth unflinchingly and yet deny its existence. It will stand with brazen face before a well-based enthusiasm and decry it. There are some that so fully rely upon their extensive knowledge in certain departments of science as to believe that their word is infallible and their opinions unassailable whenever advanced.

At present the future of wireless telegraphy is surrounded by the same clouds of doubt as have attended the appearance of other great inventions. The conservative have passed beyond the limits of conservatism. They do not speak of the limitations of this system, but of what they consider its greatest deficiencies, its most salient causes of failure.

Looking upon the progress that has thus far been made, unbiassedly, we are forced to conclude that in its present inchoate condition it is almost impossible to give issuance to an opinion that can stand the light of scientific criticism. The experiments made abroad and the energy and persistence with which they have been carried on in this particular field of experiment show conclusively that many practical men are firmly convinced of the present and future value of this remarkable system of telegraphic communication. We have so accustomed ourselves to dealing with what we consider the most material that we have forgotten that it is illusive and as unreal in its inherent nature as many other scientific phantoms have been.

The transmission of signals without wires, strikes us as wonderful because it is novel; yet we must remember that familiarity with such a system will quickly remove the newness and make it appear as prosaic as the ordinary Morse system, which in its day was considered the greatest marvel of the century. The production of etheric waves controlled in intensity and quantity by special apparatus is certainly not an abstract problem, but one which seems to be in perfect harmony with our present progress. The objections advanced by some of our authorities against the further development of this system are not based upon practical experiments and exist only in the minds of their originators. The world is waiting for a new departure. It actually requires a newer system of communication and scientific men cannot but concede that the use of Hertzian waves is the best, most plausible and most practical method of establishing communication between distant points that the mind of man has ever evolved.

The problem at present is one of comparative simplicity. It relates to the construction of two circuits in electrical resonance with each other, whose resistance, self-induction and capacity are tuned so that action in one will produce a response in the other. It likewise relates to the distance waves of given amplitude can travel and still retain sufficient energy to operate the distant coherer.

It is therefore evident that the limitations of wireless telegraphy are not known, and that investigation carried on systematically with a scientific basis will supply us with data that will be productive of conclusions of direct practical value. Let us but know the penetrative power of Hertzian waves, the most sensitive type of coherer for receiving them, and we can draw conclusions as to the reach and commercial value of wireless telegraphy. Until then the question lies in abeyance, and no opinions are of any value unless based upon purely practical experiments.

* AMERICAN COMPETITION IN EUROPE.

The year now drawing to a close will be remembered as an epoch in the industrial and commercial relations between the leading European countries and the United States. The remarkable fact of 1897 has been the enforced recognition of the truth that in several important lines of manufacture—notably that of iron and steel—the scepter of economical production, combined with payment of the highest wages to labor, has passed from the Old World to the New.

For years European economists have struggled against the conclusions which practical men are now forced to accept. It has been argued that, through what they regarded as a false fiscal policy, and the exaggerated wages accorded to labor, high cost of living, and lack of general technical education, American manufactures, in which labor formed an important percentage of cost, could never seriously compete in the world's markets with the low wages, frugal living, and patient twelve-hour toil of the Old World, where, in many places communities have been trained for generations in specialized forms of industry.

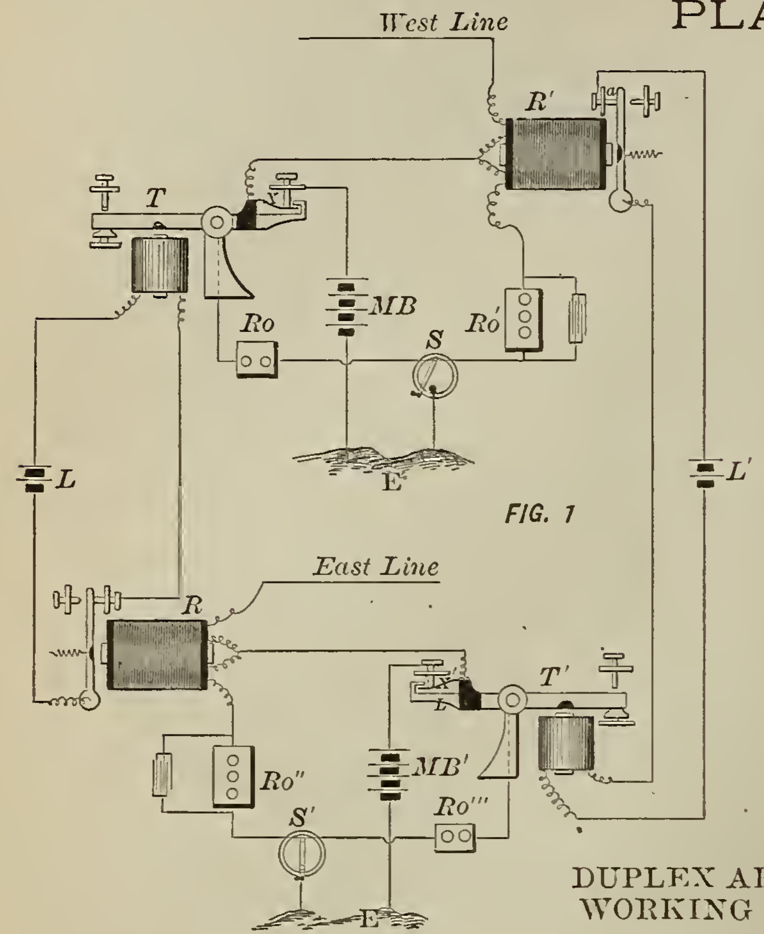
But it has been demonstrated that, under intelligent, progressive management, highly paid labor, especially when employed to use complicated machinery, is, after all, the cheapest, and that in the race for supremacy the inert, congested populations of the Old World have been in many cases left behind by the people who, more than any other, have reduced economy of labor to an exact science. Says Mr. Jeans, Secretary of the British Iron Trade Association, an expert of the highest authority in his profession:

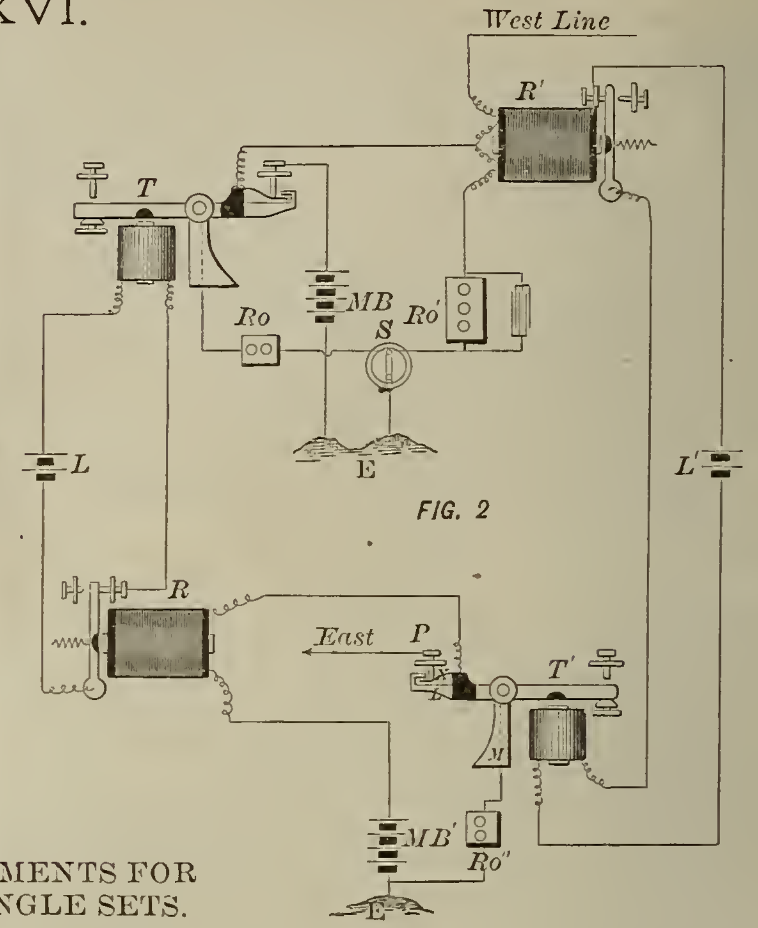
(Continued on page 94.)

waves proceeding from a discharge of an electrostatic nature, the current will flow through the circuit just mentioned only when the waves affect the tube. The parts comprising an outfit that dispenses with wires are a

cause a discharge in air between the knobs, or absolutely essential to success to produce discharges in oil; in either case the waves appear and will strike the coherer. This device usually consists of a glass tube with a metal plug

PLATE XVI.





DUPLEX ARRANGEMENTS FOR WORKING INTO SINGLE SETS.

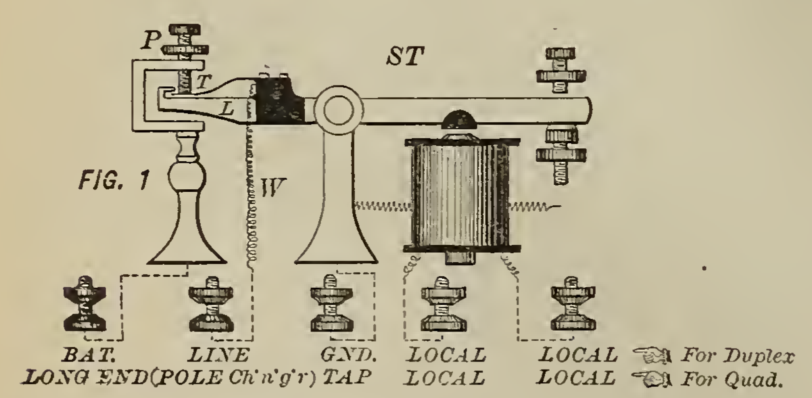
Transmitter,
Coherer,
Relay.

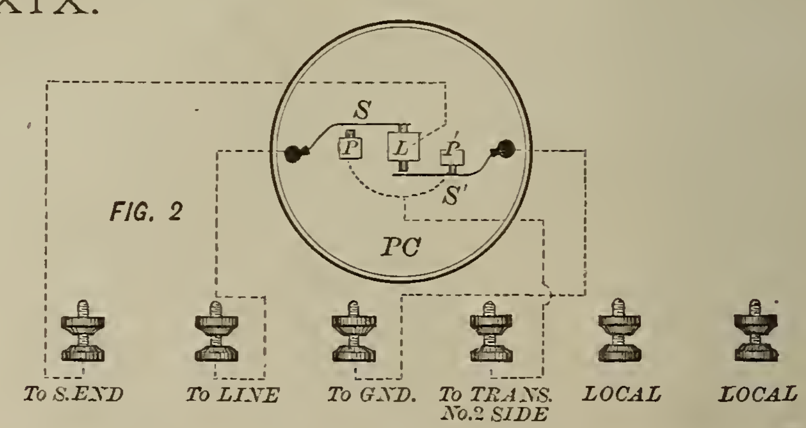
The last two are used conjointly the coherer forming part of the circuit operating the relay.

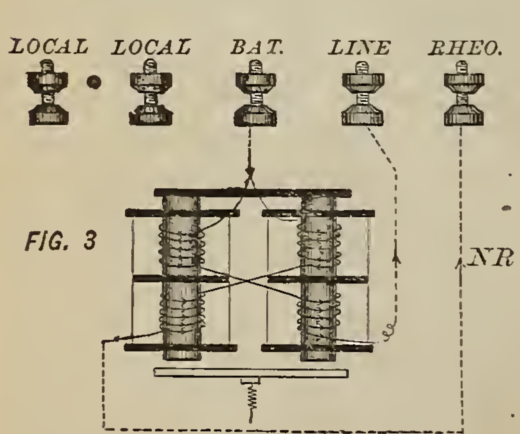
The transmitter consists of two or more brass spheres insulated from each other and connected to a spark coil, operated in the usual manner. The discharge of the coil may occur in air or in a tube filled with oil, the brass

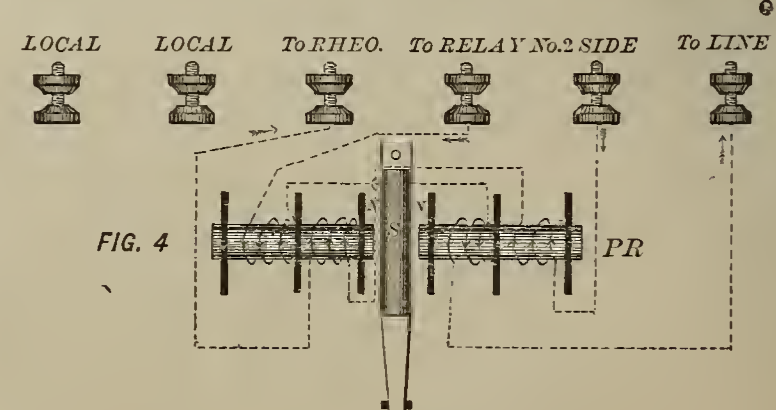
in each end reaching almost to the centre, the space between the metal plugs being filled with metal filings. The coherer is in circuit with a simple relay and dry cell. If the filings lie loosely arranged, the current will not operate the relay, but if the proper adjustment is made so that the coherer is in resonance with the transmitter, the waves proceeding from the same will affect the filings in the tube, close the circuit, and operate the relay; unless means are taken to decohere the filings in

PLATE XIX.









DUPLEX & QUADRUPLEX APPARATUS.

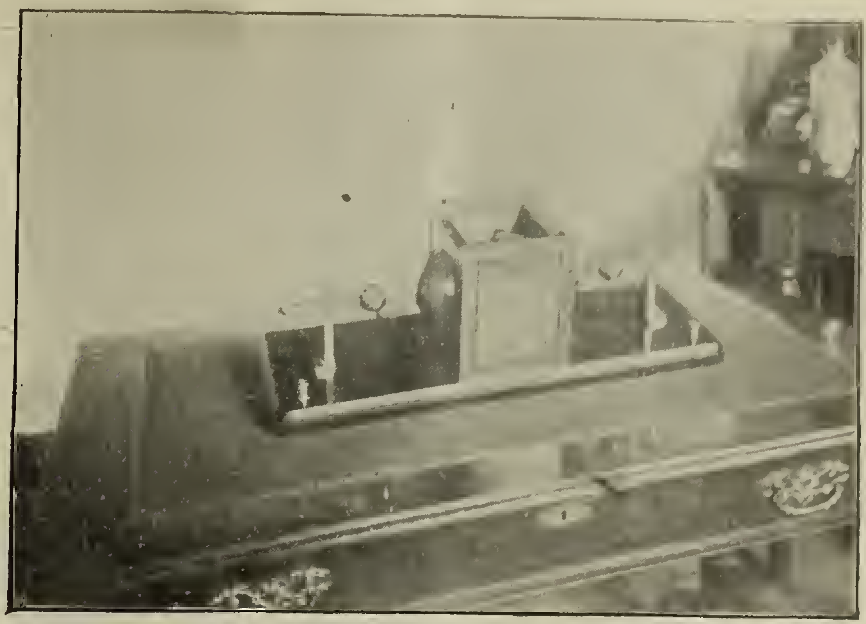
balls forming plugs at each end. The high potential discharge taking place between the knobs originates waves in the ether, which travel forward similar to sound waves, though differing from them in character. These waves travel with the rapidity of light. It is not necessary to

the tube, the signalling apparatus operating by its aid will continue to give signals, that is, if it be a buzzer or bell. But, if a decoherer is made use of, which vibrates the filings and thus mechanically opens the circuit after the ether wave has passed, the signal will cease when the sparks in the transmitter have died out.

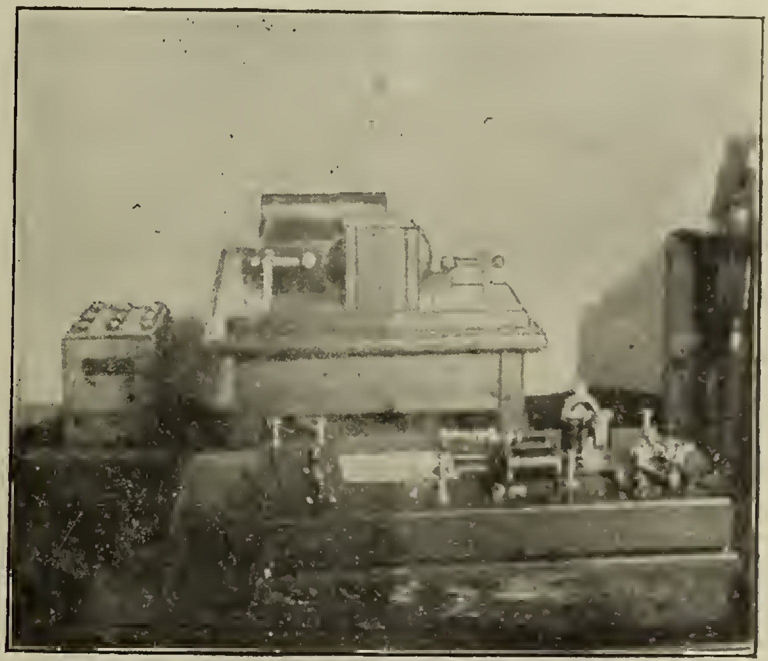
The resonance of any two circuits or any number of circuits depends upon the relations existing between their individual capacity, self-induction and resistance. It may be said therefore that the circuits are tuned electrically to each other. The transmission of signals over long distances is possible if two general courses are pursued.

First, the production of very heavy discharges without a mirror; second, the use of weaker discharges with a mirror or reflecting device.

The investigations of Bjerknes have shown that the height of electric waves changes as they recede from their origin, and that long waves are preferable to shorter ones for long-distance signalling. The use of very powerful discharges is necessary for the production of long waves and by using a mirror the rapid decay that ensues can be temporarily delayed. A light wave travels with uniform amplitude, that is, moves with the same sized



Device Producing Hertzian Waves Used in Wireless Telegraphy.



Complete Outfit for Wireless Telegraphy, Including Spark Coil, Transmitter, Coherer and Morse Telegraphic Apparatus.

Board Mounted with Sounder, Key and Relay with Coherer in Circuit. (Coherer at Lower Part of Board in Middle.)

waves, but it differs in this respect from a Hertzian wave, which constantly decreases as it recedes from the transmitting spark gap.

With Clark's apparatus it is possible to signal over distances of several miles. It consists of a spark coil, a transmitter, composed of an oil cylinder and discharge knob as above described, which send the Hertzian waves forward. The receiving device comprises a coherer, Morse telegraphic outfit, sounder and relay. The waves strike the coherer, thereby allowing the battery current to act, operating the relay. The filings in the tube are separated by a slight air-gap and the coherer is prevented from packing by means of a vibrator, which automatically taps it whenever the relay operates. Very distinct signals are produced by this apparatus.

Signals have been sent and received a distace of eight miles, and the future possibilities in this particular field of work can hardly be gauged off-hand. Its most valuable feature is its simplicity, and the future service it will be capable of giving depends entirely upon the extent to which resonance can be established. Privacy can only be preserved by an observance and careful study of methods of tuning the two circuits. Information at present is rather meagre concerning experiments that have been made, but much is expected in the near future.

QUESTIONS FOR REVIEW.

(1) What is a quadruplex system of telegraphy?
(2) Describe its most prominent features.
(3) What principle is involved in wireless telegraphy?
(4) What is a transmitter?
(5) What is a coherer?
(6) How is the coherer kept in working order?
(7) Under what conditions are the signals kept private?

The Steel Storage and Elevator Construction Company, according to "Greater Buffalo," which last month moved its headquarters from Connersville, Indiana, to this city, in order to secure a more central location with reference to its field of operations, has experienced great prosperity since the change was made. Within the last four weeks the company has secured contracts for the erection of four steel storage elevators in different parts of the country, as follows: an elevator of 100,000 bushels capacity for the Decatur Cereal Mill Company, of Decatur, Ill.; two elevators of 200,000 bushels capacity each for the American Malting Company, one at New York and the other at Chicago; and an elevator of 50,000 bushels capacity for Frederick Reynolds at Bellefonte, Pa. The Steel Storage and Elevator Construction Company built the new electric elevator, of 1,000,000 bushels capacity, and which is operated by Niagara Power, in this city.

"I know of cases where the labor of a ton of billets and rails is 25 to 35 per cent. less in America than the lowest cost I have ever heard of in this country, although the rate of wages paid in America is materially higher.

* Frank H. Mason, Consul General, Frankfort, Dec. 31, 1897.

(To Be Continued.)

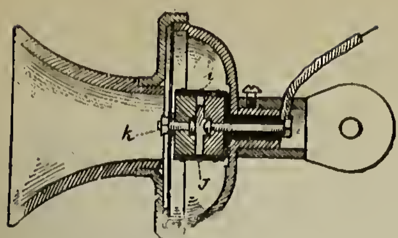
PHŒNIX ELECTRIC TELEPHONE COMPANY.

The growth of the telephone industry in this country has been very rapid in the last few years. But in spite of the fact that everyone is interested in this rapid and convenient way of sending messages, we do not average the same number of 'phones per hundred citizens that some of the more conservative countries in Europe have for years past laid claim to. The public are by this time thoroughly well acquainted with the benefits of rapid communication. They cannot fail to understand the superior advantages offered by a well installed system, yet due to some reason, the Americans are a little behind their European neighbors in the use of the telephone. But there is every evidence that in the near future one of the most familiar objects in a private house will be a telephone, which will eventually become an essential part of a household equipment—as necessary as the kitchen range and as useful as other common household accessories.

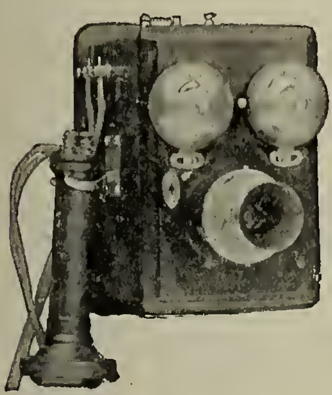
The Phœnix Electric Telephone Company, of 93 Washington street, New York, control the patents of the Sutton microphone, patented June 2, 1896, and magneto-bells with automatic cutouts, patented November 10, 1896. They have been in touch with the desires of the public and anticipated the general demand which now rolls in for telephone systems. Possessing a microphone which is certainly one of the clearest and best transmitters manufactured by any electrical concern, they realize that the public need merely be a little better acquainted with their apparatus to become fully assured of its incontestable virtues and superiority over similar devices. Their long-distance granular carbon telephone contains all the improvements worthy of note, including the Sutton transmitter, patented 1896. Using a granular carbon microphone, unaffected by atmospheric changes and free from the deficiencies of all other types, it may be said that in no respect can even the Anthony White compare or compete with this particular type. The generators, bells and automatic switches supplied with the Phœnix Electric Telephone Company's outfits are of the most reliable make and certainly ensure success to all that are fortunate enough to choose so excellent an outfit.

The battery telephones of the above company are guaranteed in every respect. The manufacturers feel certain that upon trial they will secure a good customer, and therefore invite the readers of this article to come and see what they have done in this broad field of work. They make a great many types of transmitters and receiver s; their desk telephones being well received by all customers. The desk 'phone consists of a standard Blake transmitter box, with switch standard receiver, mounted on a niekel-plated standard. Magneto or battery call bells are used to signal with. These outfits are cheap and highly efficient. In addition they sell standard receivers mounted on arms, as shown in illustration.

Their new improved switchboards with self-restoring drops, each drop and jack combined, occupying a minimum of space, have attracted considerable attention on account of their compactness, certainty of action and general excellence. All that relates to telephonic apparatus is manufactured and sold by the above company, who believe in the axiom known to all practical workers, "that things done by halves are never done right." Correspondence is solicited on all matters or installations relating to telephonic apparatus at the address given, 93 Washington street, New York.



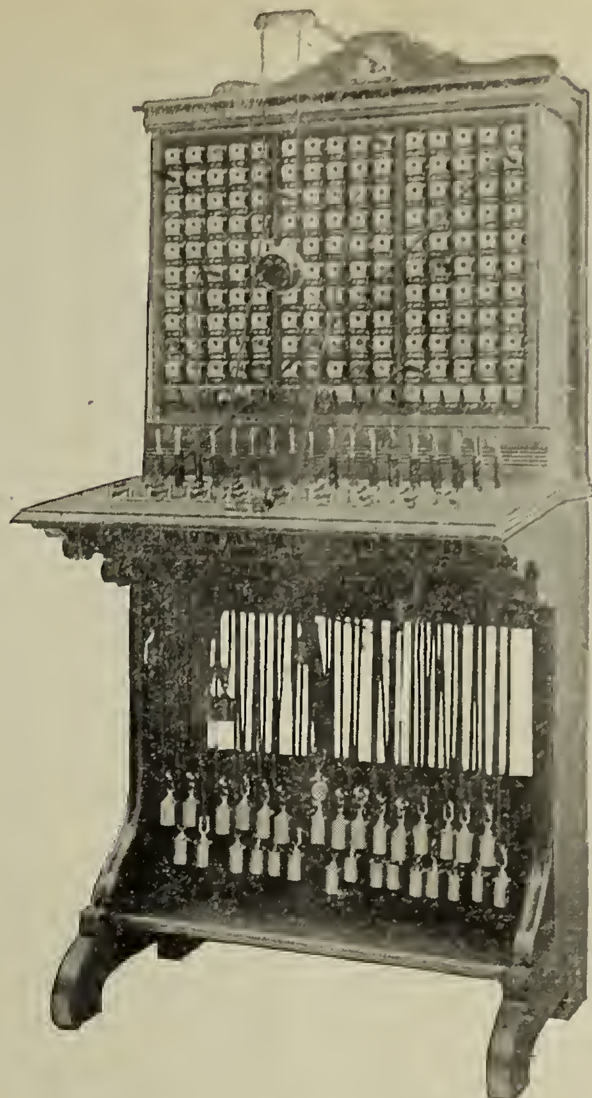
Sutton Microphone.
Patented June 2d, 1896.



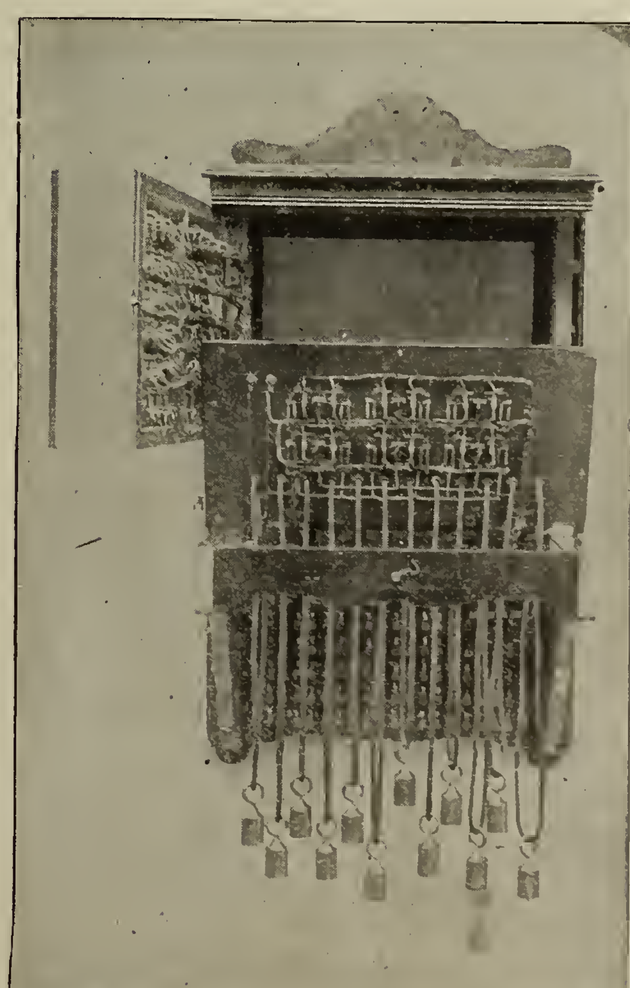
Style No. 4.

Desk Set No. 7.

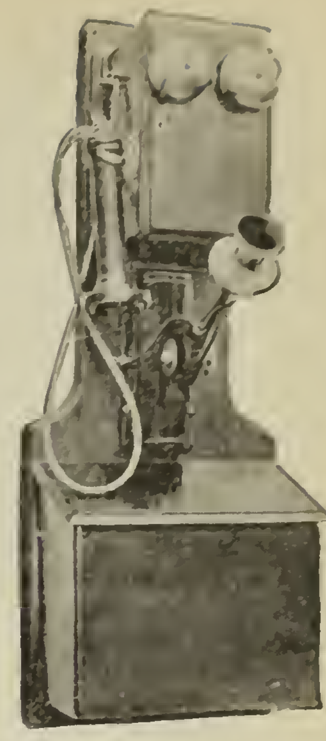
Style No. 1.



150 Drop Switchboard with Stand.
Self Restoring Drops.
Patent Pending.
Each Drop and Jack occupy a space of 1½ ins. square.
100 Drop Board, 15 ins. square.



50 Drop Switchboard without Stand.
Thrown back on hinges, showing Jacks and Magnets.
Table thrown up, showing Switching Movements.



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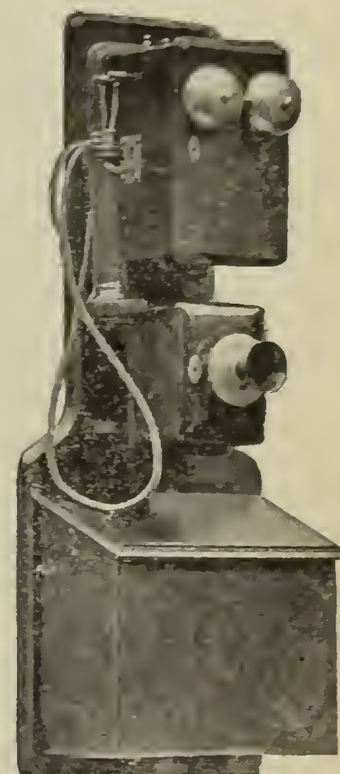

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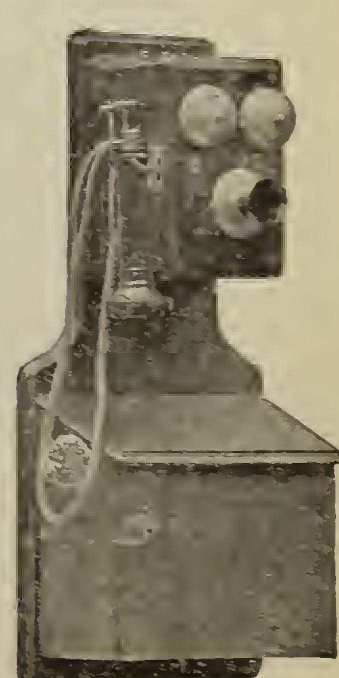


Style No. 2.

NOTES.

The new and attractive works of the John Stephenson Company (Ltd.), at Elizabeth, N. J., is creating considerable attention, especially the great tower containing the largest electric clock in the world. Mr. Charles H. Davis, the prominent electrical and mechanical supervising engineer of Cedar and Church streets, New York, the president of the company, expects to have the works in operation about March 1st. 48 Lundell motors are to be installed, direct-connected, and geared to the variety of machinery used in building electric street-railway cars for which the Company is so well known.

ELECTRIC VEHICLE COMPANY, 1684 Broadway, N. Y., has ordered 100 new cabs for New York service, all of which will be operated by chloride accumulators, made by the Electric Storage Battery Company, of Philadelphia and New York. Charles Blizard, New York, manager.

H. B. COHO & COMPANY, St. Paul Building, N. Y., manufacturers of switchboards, switches, repairers of dynamos, motors, etc., have the contract to make and fit out the big board for the big lighting and power plant for the new building of the John Stephenson Company, Elizabeth, N. J.

UNIVERSAL ELECTRIC COMPANY, 126 Liberty street, N. Y., are furnishing fifty of their lightning arresters to use in the lighting and power plant of the John Stephenson Company Works.

O. B. Greene has opened offices at 102 Fulton street, New York, where he has established agencies for all kinds of electric light and power supplies, and where he will conduct a general construction and repair agency.

NEW YORK ELECTRICAL SOCIETY.

The 185th meeting of the Society was held at the College of the City of New York, 23d street and Lexington avenue, on Friday, February 11, at 8 P. M., in conjunction with the New York Section of the Amercan Chemical Society.

Mr. Joseph Wetzler lectured on "Electricity Direct from Coal." (Illustrated by lantern.)

Dr. G. F. Barker, of the University of Pennsylvania, gave an address on "The Status of the Physical Relations of Electro-Chemistry," and Dr. Edgar F. Smith gave an address on "The Application of Electricity to Chemical Analysis and Laboratory Research."

GEORGE H. GUY, Secretary.

NEW ELECTRICAL INCORPORATIONS.

Britton, S. D.—The electric light plant is about completed.

Dalton, Ga.—The mayor may be addressed for information concerning erection of electric light plant.

White Castle, La.—Colonel James A. Ware is interested in the establishment of an electric light plant.

Glens Falls, N. Y.—The Consolidated Electric Company has been incorporated by E. J. West and others. Capital stock, $10,000.

Schoolcraft, Mich.—City clerk may be addressed concerning establishment of electric light plant.

Indianapolis, Ind.—The Jenney Electric Plant will rebuild plant which was recently burned.

Rochester, N. Y.—The Rochester Electrical Manufacturing Company has been incorporated with a capital stock of $50,000.

Council Bluffs, Iowa.—The Carson Electric Light Company has been incorporated by William Holtze, David A. Snapp and James S. Campbell, and they will soon commence the erection of a plant at Carson.

McComb, Miss.—The mayor may be addressed concerning establishment of electric light plant, for which Sanders & Porter, of Louisville, Ky., will prepare plans.

Washington, D. C.—The Standard Cold Electric Light Company has been incorporated, with John Boyd as president, to manufacture electric lights for surgical use. Capital stock, $100,000.

Charlotte, N. C.—J. A. Helvin has secured franchise for construction of telephone system.

Lusk, Wyo.—A telephone line has been constructed between this city and Manville.

Litchfield Minn.—A company has been formed to put in a local telephone system to be extended over the county.

Westminster, Md.—The Westminster Maryland Telephone Company will issue bonds for $8,000 to provide funds for extending its telephone lines to Baltimore City.

Baltimore City, Va.—The Virginia Electric Company has been incorporated with A. D. Bodson, secretary and treasurer. Capital stock, $1,000,000.

Kansas City, Kan.—A large electric power house will probably be erected for the manufacture of electricity.

New Rochelle, N. Y.—The Huguenot Electric Street Railway Company has been formed by Louis K. Fries and Jacob M. Schuyler, to construct an electric line 11 miles in length.

Stanton, Mich.—An electric railway is to be constructed from Grand Rapids to Belding, Stanton, Crystal, Ithaca, and Saginaw.

Kansas City, Mo.—The Kansas City, Lawrence & Topeka Electric Railroad and Power Company, which was granted by the secretary of state a charter, a few days ago, has been organized under this charter in Kansas City, Kan. Capital stock, $3,000,000.

South Pittsburg, Tenn.—The East Tennessee Telephone Company has just completed an exchange at South Pittsburg.

Casper, Utah.—M. M. Maghee will put in an electric light plant.

Tipton, Ohio —A company has been organized for the purpose of constructing five miles of electric railway to connect with Atlanta, on the southern edge of the county.

THE GARVIN MACHINE CO.

SPRING AND VARICK STS.,
NEW YORK.

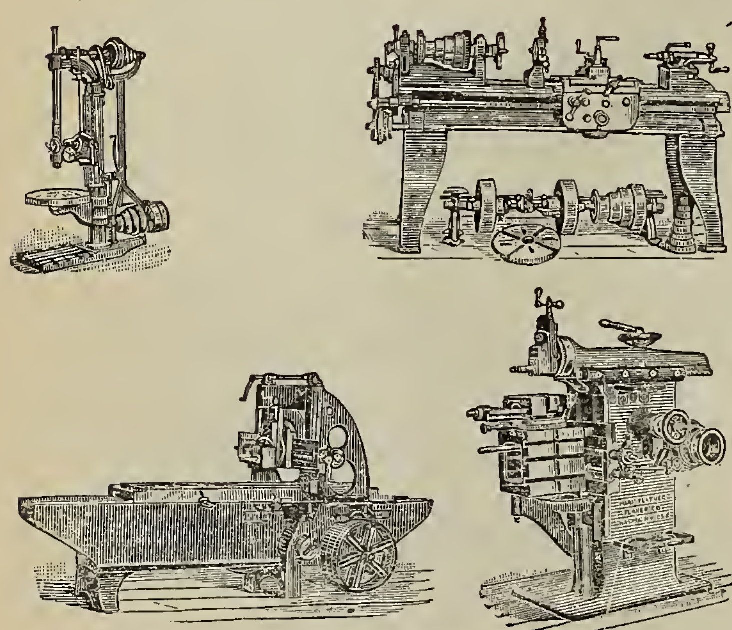
PHILADELPHIA STORE, 51 NO. 7th ST.

No. 2 HAND MILLING MACHINE.

MANUFACTURERS AND DEALERS IN

METAL WORKING MACHINERY

OF EVERY DESCRIPTION.



MILLING MACHINES, SCREW MACHINES, DRILL PRESSES, PROFILERS, HAND LATHES, TAPPING MACHINES, GEAR CUTTERS, SCREW SLOTTERS, CUTTER GRINDERS, DIE SLOTTERS, WIRE COILERS, SURFACE GRINDERS, MILLING CUTTERS, ETC.

ALSO LARGE STOCK OF

BLAISDELL LATHES AND DRILLS.
FLATHER PLANERS AND SHAPERS.
HAMILTON LATHES AND DRILLS,
WHITCOMB PLANERS,
DIAMOND GRINDING MACHINERY,
SLATES SENSITIVE DRILLS,
BLISS POWER PRESSES,
MOSSBERG POWER PRESSES.

COMPLETE PLANTS EQUIPPED

FOR MAKING **ELECTRICAL GOODS, BICYCLES, FIRE ARMS, HARDWARE, ETC. . . .**

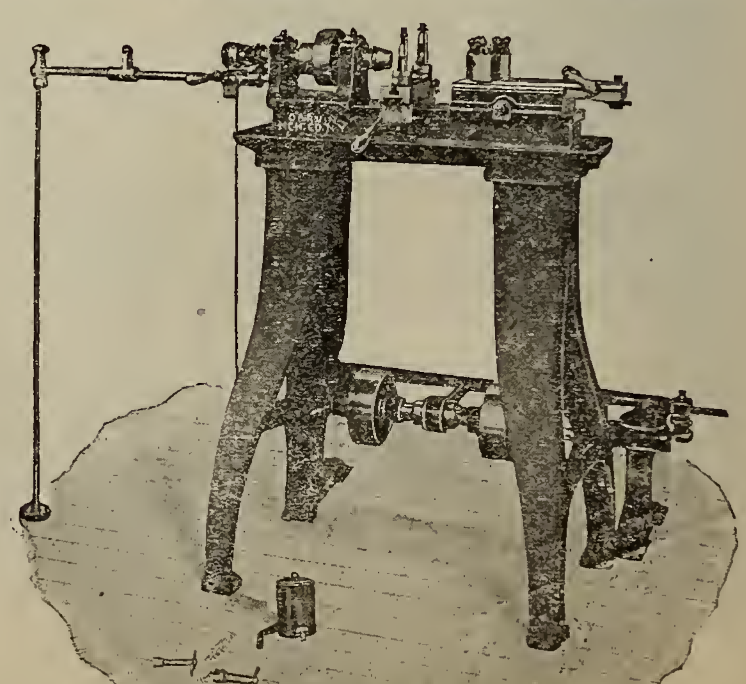
We have the Best Facilities for all kinds of Work, and can supply anything on short notice.

Second Hand Machinery

OF EVERY DESCRIPTION.

Large Stock. Immediate Delivery.

ENGLISH, FRENCH AND GERMAN CATALOGUES SENT ON APPLICATION.



No. 00 SCREW MACHINE (WIRE FEED).

The Electrical Age.

VOL. XXI—NO. 8 NEW YORK, FEBRUARY 19, 1898 WHOLE NO. 562

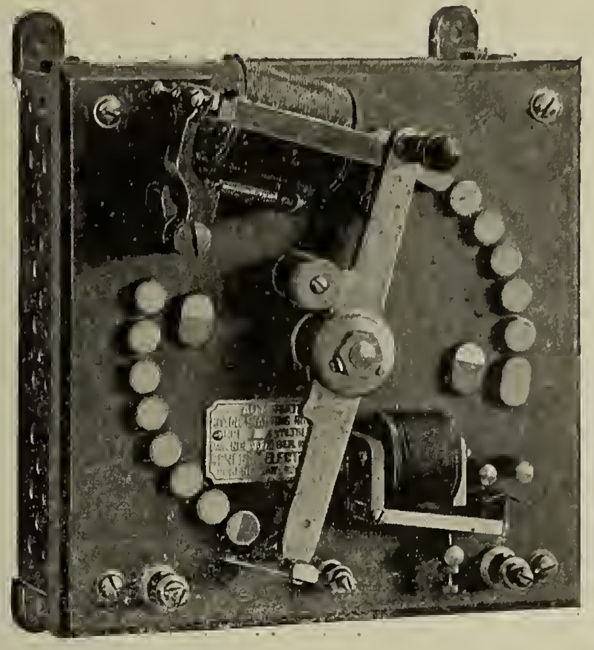


Fig. 4—Automatic Motor-starting Rheostat.

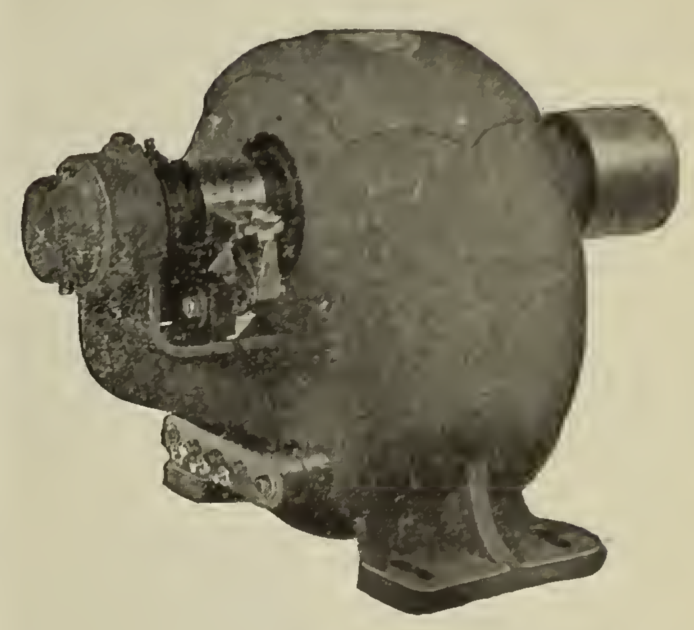


Fig. 1—Direct-current Station Motor, Type C. A, 1 H.P.

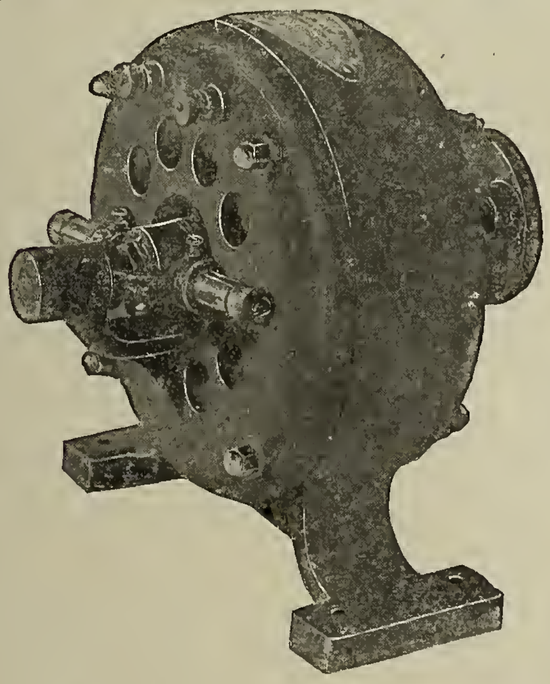


Fig. 3—Direct-current Station Motor, Type C. A, 1/8 H.P.

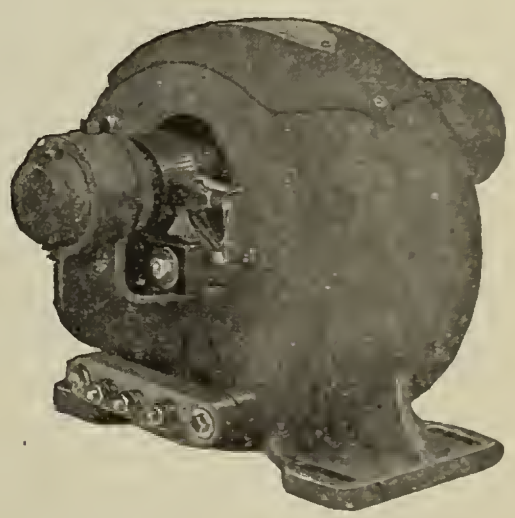


Fig 2—Direct-current Station Motor, Type C. A, 1/2 H.P.

GENERAL ELECTRIC MOTORS.

The General Electric Company announces in a recent bulletin a new line of well-designed and thoroughly constructed direct-current motors of small capacity adapted to the direct application of power to small machines of all kinds. They have been given the designation of "type A," and in their design the production of an efficient motor, sufficiently light and compact to allow of installation in cases where space is limited and absolutely rigid support is unobtainable, has been kept constantly in view. A magnetic circuit, therefore, entirely of laminated iron has been adopted, and greater lightness and compactness thus secured than would have been possible with cast iron. Furthermore, by the use of laminated iron a uniform magnetic circuit is ensured.

High grade material is used exclusively throughout these motors, and the workmanship is the best. The construction of the armature, commutator and field coils follows closely that in the standard General Electric railway motors. Indeed, every feature of excellence of the latter has been retained in the wound "C A" type. The laminated armature core is toothed and wound with the Eickemeyer type of coil. The leads from the armature are soldered directly into slots in the segments, and field coils are thoroughly taped and mounted on laminated pole-pieces. The armature can be withdrawn after taking off the pulley and bearing, and the field coils removed through an opening in the frame. In the larger machines the shaft is mounted on two similar swivel bearings each self-oiling. The brush-holders are adjustable radially, and may be revolved around the commutator if required. The neutral point is very wide, however, and no adjustment of the brush-holder is necessary. These motors are enclosed and thoroughly protected from mechanical injury, but thorough ventilation is provided by holes in the bottom of the case and around the commutator end of the armature. Should these motors be used in places where flying dust necessitates extra protection, the commutator and brush-holders may also be encased.

The speeds are lower than usual with motors of small capacity; better provision for overload is thus given and losses are not so great. The regulation, efficiency and disposition of the material in the "C A" motors also combine to give them a continued high economy. Heating tests show that they will run continuously with but slight increase in temperature, and even with a momentary overload of 100 per cent. little or no sparking is noticeable. In cases where a number of these motors are required to meet special conditions, the standard construction and wiring is susceptible of modification.

No rails are necessary with this motor. The belt is tightened by moving the motor on the lag screws, which pass through elongated holes in the feet of the frame and hold the motor in place.

One feature of advantage which this motor has over others is the possibility of placing it in almost any position with no greater change than the turning of the bearings to suit the position selected. The "C A" motor may be installed on the floor or be suspended from the ceiling, be set on a shelf or attached to a wall. In every case the oil cellar is at the bottom of the bearing.

The one H. P. and ½ H. P. C. A. motors are designed for 115, 230 and 500 volt circuits; the ⅛ H. P. for 115 volt circuits. The floor space for the first named is only 22⅛ inches by 16½ inches, and for the ½ H. P. motor 18¾ inches by 13 inches. The motors are finished in black with brush-holders and small parts nickeled and polished.

For use with the two larger sizes a new type of rheostat has been developed. It is provided with an automatic switch, which breaks the circuit in case of overload and effectually protects the motor armature. The smaller sizes are series wound and require no rheostat.

ELECTRICAL SHOW EXHIBITORS.

Electrical Age Publishing Co.,
World Bldg., Park Row, New York City.

Gentlemen: We beg to hand you herewith for publication a partial list of exhibitors who have contracted for space to date.

Would call your especial attention to the number of companies who have already secured space. This is over five times as many as we had secured at corresponding date before the last show.

Very truly yours,
Electrical Exhibition Company,
Marcus Nathan, Gen'l Mgr.

Partial List of Exhibitors, Electrical and Kindred Industries Exhibition, Madison Square Garden, New York, May 2d to 31st, 1898.

Armorite Interior Conduit Co............Pittsburg, Pa.
American Rheostat Co..................Milwaukee, Wis.
American Electric Cold Supply Co......Brooklyn, N. Y.
American Pulley Co.................. Philadelphia, Pa.
American Watchman's Time Detector.234 Broadway, N.Y.
American Engine Co...............Bound Brook, N. J.
Adams-Bagnall Electric Co...........Cleveland, Ohio
Armington & Sims Co.................Providence, R. I.
American Electrician Co....................New York
American Elec'l & Maintenance Co.,
451–453 Greenwich street, N. Y.
American Electrical Works...........Providence, R. I.
Bullock Electric Co................St. Paul Bldg., N. Y.
Bossert Electric Construction Co..........Utica, N. Y.
Baylis Co., The.................99 Cedar street, N. Y.
Bernard, E. G...............................Troy, N. Y.
Borne, Scrymser Co.............80 South street, N. Y.
Belknap Motor Co........................Portland, Me.
Brewster Engineering Co.......27 Thames street, N. Y.
Crocker-Wheeler Electric Co..39 Cortlandt street, N. Y.
C. & C. Electric Co...........143 Liberty street, N. Y.
Corey, R. B..................26 Cortlandt street N. Y.
Coho & Co. H. B.,...............220 Broadway, N. Y.
Christensen Air Brake Co.............Milwaukee, Wis.
Card Electric Co.......................Mansfield, Ohio
Cleveland Twist Drill Co..............Cleveland, Ohio
Crouse-Tremaine Carbon Co............Fostoria, Ohio
Connecticut Telephone & Electric Co....Meriden, Conn.
Crown Woven Wire Brush Co...............Salem, Mass.
Cook's Sons, Adam...............313 West street, N. Y.
Campbell Underground Trolley Co......Tonawanda, Pa.
Camp Co., H. B.........................Aultman, Ohio
De La Vergne Refrigerator Co.
(Hornsby-Akroyd Oil Engine),
138th street & East River, N. Y.
Diamond Electric Co.......................Peoria, Ill.
Diesel Motor Co. of America........11 Broadway, N. Y.
Edison, Thomas A.......................Orange, N. J.
Edison Electric Illuminating Co.,
Duane & Elm streets, N. Y.
Eddy Electric Mfg. Co...................Windsor, Conn.
Electric Storage Battery Co.............Philadelphia, Pa.
Excelsior Electric Co....................Brooklyn, N. Y.
Edison Mfg. Co..............................Orange, N. J.
Edison, Jr., Thomas A............96 Broadway, N. Y.
Electrical Engineer...........................New York
Electrical Review.............................New York
Electrical Age Publishing Co..................New York
Electricity Newspaper Co......................New York
Fisher Foundry & Machine Co...........Pittsburg, Pa.
Fort Wayne Electric Corporation......Fort Wayne, Ind.
Fuel Economizer Co...................Matteawan, N. Y.
Fostoria Incandescent Lamp Co..........Fostoria, Ohio
Fiberite Co.......................Mechanicsville, N. J.
Fairchild & Summer.........39 Cortlandt street, N. Y.
Gold Car Heating Co. ..Cliff & Frankfort streets, N. Y.
Harrison Safety Boiler Works,
Germantown Junction, Phila., Pa.
Highland Chemical Co..............Connellsville, Pa.
Haines Co., Wm. S..................Philadelphia, Pa.
Haring Steam Plant Equipment Co.,
26 Cortlandt street, N. Y.
Ideal Electric Corporation .13th & Hudson street, N. Y.
Imperial Porcelain Works.................Trenton, N. J.
India Rubber & Gutta Percha Insulating Co.,
Glenwood, N. Y.
Jones & Son, J..............69 Cortlandt street, N. Y.
Johnson Co., W. J............................New York
Keuffel & Esser Co............127 Fulton street, N. Y.
Kelley & Sons, B. F...........91 Liberty street, N. Y.
Keystone Electrical Instrument Co....Philadelphia, Pa.
Lawrence Machine Co.................Lawrence, Mass.
Lewis Tool Co................44 Barclay street, N. Y.
Lynn Incandescent.........................Lynn, Mass.
Morris, Elmer P.............15 Cortlandt street, N. Y.
Machado & Roller.................203 Broadway, N. Y.
Mowrey & Co., P. M...............318 Broadway, N. Y.
Niles Tool Works Co......Hamilton, O., and New York
National Meter Co..................118 Chambers street
Nowotny Electric Co...................Cincinnati, Ohio
National Carbon Co....................Cleveland, Ohio
Nash Gas Engine Co.............99 Cedar street, N. Y.
New Britain Machinery Co..........New Britain, Conn.
New York Safety Steam Power Co.,
30 Cortlandt street, N. Y.
Oswego Boiler Works.....................Oswego, N. Y.
Otis Electric Co.....................38 Park Row, N. Y.
Onondaga Dynamo Co ....Syracuse, N. Y.
Paragon Arc Lamp Co.....................Boston, Mass.
Peru Electric Mfg. Co.........................Peru, Ind.
Peckham Motor Truck & Wheel Co.,
26 Cortlandt street, N. Y.
Partrick, Carter & Wilkins............Philadelphia, Pa.
Paragon Motor Co............39 Cortlandt street, N. Y.
Porter & Remsen............39 Cortlandt street, N. Y.
Roebling's Sons' Co., Jno. A............Trenton, N. J.
Safety Insulated Wire & Cable Co.,
229 W. 28th street, N. Y.
Stephenson Co., Ltd., John ....47 E. 27th street, N. Y.
Silex Insulation Co...........39 Cortlandt street, N. Y.
Sprague Electric Co..............20 Broad street, N. Y.
Simonds Mfg. Co.........................Pittsburgh, Pa.
Sinclair, D. J..............................Caledonia, N. Y.
Street Railway Journal Co.....................New York
Translucent Fabric Co.....................Quincy, Mass.
Thomas & Sons, Co., R...........East Liverpool, Ohio
United States Electric & Supply Co.,
141 East 25th street, N. Y.
Vacuum Oil Co.,.........................Rochester, N. Y.
Van Horne, Burger & Co...................Dayton, Ohio
Worthington, Henry R.........................New York
Walker Co.................................Cleveland, Ohio

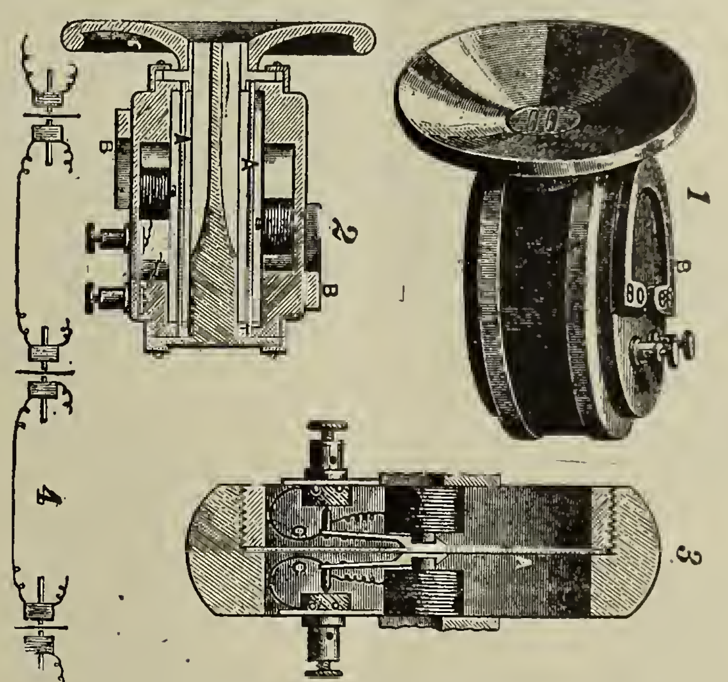
THE TELEPHONE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

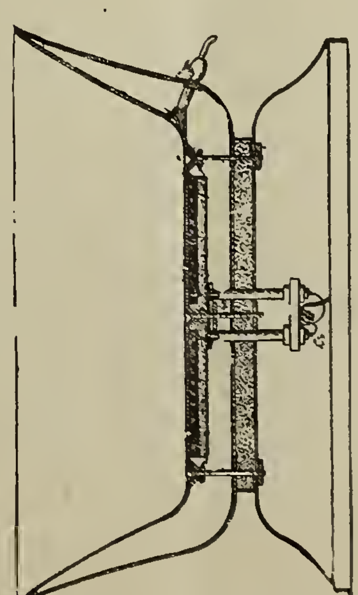
BY NEWTON HARRISON, E. E.

The Receiver.—The invention of the telephone has added greatly to the comforts of civilization by making communication rapid and easy and facilitating business transactions to an extent previously unattainable.

The simple principle of its action has been a source of surprise to the novitiate, and the ingenious methods by which it is possible to throw in and out subscriber after subscriber from a telephone switchboard is truly admirable.



A Double Diaphragm on the Bell Principle.



A Telephone Transmitter.

The most prominent figure in the field of telephony is Graham Bell. After him follow the names of Berliner and Edison, as inventors of valuable additions to the original idea. A vibrating diaphragm is the basis of most acoustic instruments. The purely acoustic telephone consists of a piece of stretched membrane across a hollow drum with a cord or wire connecting both. The vibrations of the voice striking the diaphragm are transmitted along the wire to the other receiver and there distinguished. The parts constituting a system are, therefore, the

Transmitter,
Receiver,
Line.

In the ordinary form of Bell telephone the parts composing the whole are three, namely:

Permanent magnet,
Coil of wire,
Diaphragm of iron.

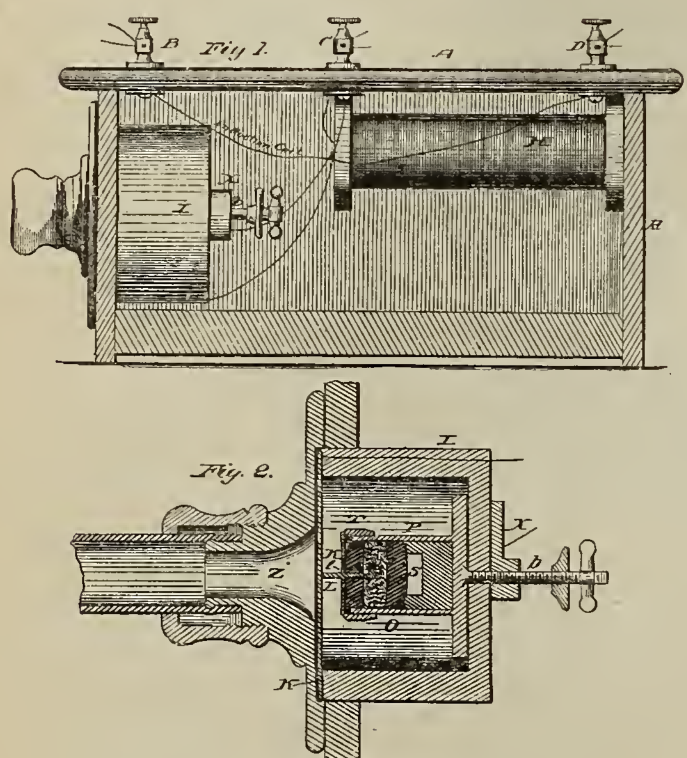
The rod of magnetized steel is placed in a convenient receptacle and a coil of fine wire slipped on one end. The diaphragm is mounted in front in close proximity to the end of the magnet, and a mouth-piece placed so as to focus the sound on it. There is little difficulty in transmitting speech over several miles distance by such a system. In the practice of telephony the Bell telephone is simply used as a receiver for the sound and a somewhat different device used as a transmitter. Reference will be made to this shortly. The receiver, such as it has been described, depends for its action upon a very simple principle. The vibrating diaphragm disturbs the magnetization of the permanent magnet, as follows: When moving nearer to the magnet it increases the permeability of the field and in a corresponding manner decreases it when it moves away. The field is therefore varied in a corresponding manner, and to so definite an extent as to cause these changes to affect the coil surrounding the magnet. It may be stated at once as a fact in science that the movement of a magnet in the neighborhood of a coil has an immediate effect upon it, developing an E.M.F. in its furns. This physical fact is the basis of the action in a telephone.

The vibrating diaphragm varies the magnetic field of the magnet, the coil placed on its end is at once affected and very small currents are set up in the convolutions.

The instrument at the other end is perfectly similar in construction and reproduces the vibrations again in its diaphragm, due to the fact that its coil connects with the other coil and all currents set up in the first at once affect the second, attracting and releasing its soft iron in perfect accord with the other.

There is in this simple principle the basis for an investment of twenty-five millions of dollars, which today represents the capital of the Bell Telephone Co. While the delicacy of the Bell receiver cannot be doubted, it is not effective over a long line.

De la Rue estimates the current as not exceeding that which would be produced by one Daniell's cell in a circuit of copper wire one-sixth of an inch in diameter, of a length sufficient to go 290 times around the earth.



Gillett's Granulated Carbon Transmitter.

Siemens, a distinguished electrician of Germany, does not think that more than $\frac{1}{10000}$ of the entire sound the transmitter receives is reproduced by the receiving instrument, and Roentgen concludes that no less than 24,000 currents are transmitted in one second by the instrument.

The extreme delicacy of the device employed needs no further discussion here, yet it is at times surpassed in this respect by the unequalled sensitiveness of the line itself to external influences of an electrical nature. The diaphragm can be dispensed with and a clear sound heard through the remaining parts.

This is simply cited as an experiment, not as the usual practice.

A rod of soft iron can be used instead of steel for the core of the coil. This necessitates the use of a battery in circuit, which would otherwise be dispensed with.

There is no doubt that the telephone is extraordinarily sensitive, and may be used for the detection of currents which would otherwise escape notice.

Contrary to the expectation of practical men the telephone works best with a diaphragm of ferrotype iron instead of very thin iron. The extreme susceptibility of the receiver places it in excellence far beyond any of the acoustic inventions of the age.

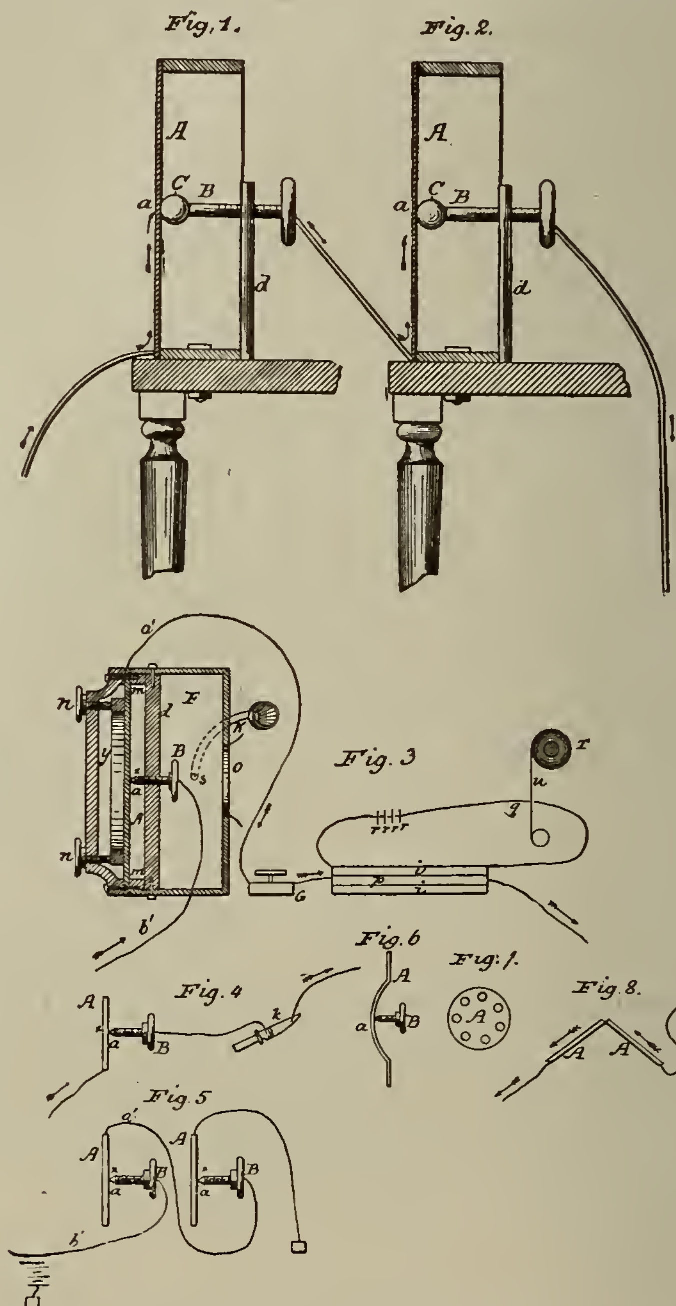
The Microphone.—Before explaining the details of construction of the modern transmitter it is necessary to understand the principle of the microphone, of which the transmitter is simply a development.

This peculiar piece of apparatus was invented by Prof. Hughes, and depends for its action upon the change of resistance in two pieces of carbon placed loosely in contact, and forming part of an electric circuit in which is included a Bell telephone receiver.

Two blocks of carbon are slightly hollowed out to receive between them an upright piece of carbon pointed at each end.

The Telephone and Line.

This is in circuit with a receiver and a battery. If the carbon attachment be mounted on a well-built sounding



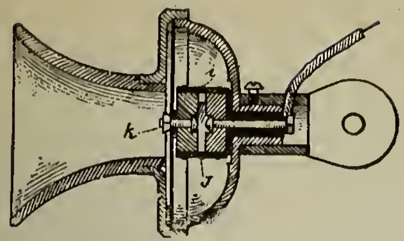
Original Berliner Transmitter.

board, the least vibration affects it at once and causes the carbon pieces to jar together, causing a harsh, crushing sound to be heard in the telephone, greatly magnified, and giving the impression of a large body dragged over rough gravel. The ticking of a watch sounds like the heavy blows of a sledge-hammer, and the walking of a fly approaches in loudness the stamp of a horse.

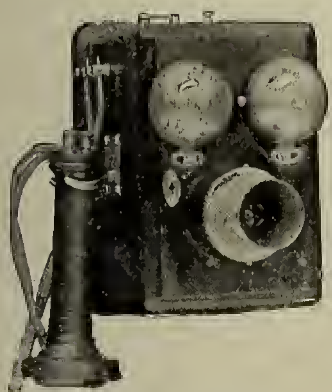
The tap of a finger on the board, scratching of the nail or beating of the pulse, has been heard by means of this contrivance miles away. It is on this principle the transmitter of a telephone has been constructed, and its application is due to the combined efforts of Emile Berliner and Thomas A. Edison.

The compression of the carbon by these slight vibrations allows the current to increase or decrease an imperceptible amount. To the telephone, however, this minute change in resistance means a variation in current that at once produces the extraordinary effects above described.

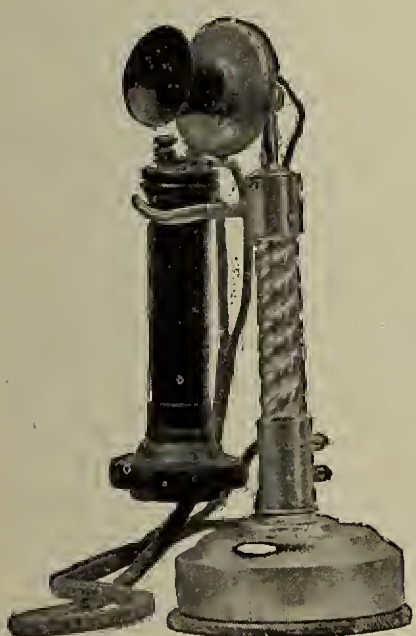
Transmitter.—The wonderful delicacy of the microphone has therefore been the basis for the construction of a most easily affected piece of apparatus susceptible to sounds otherwise lost. It is, perhaps, the only apparatus by



Sutton Microphone.

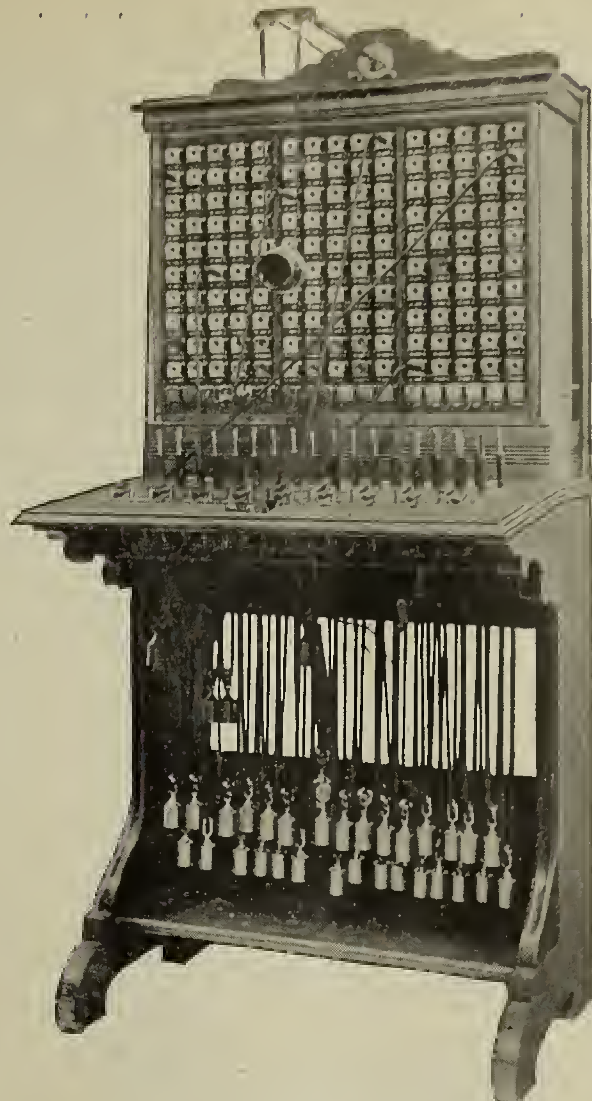


Transmitter.

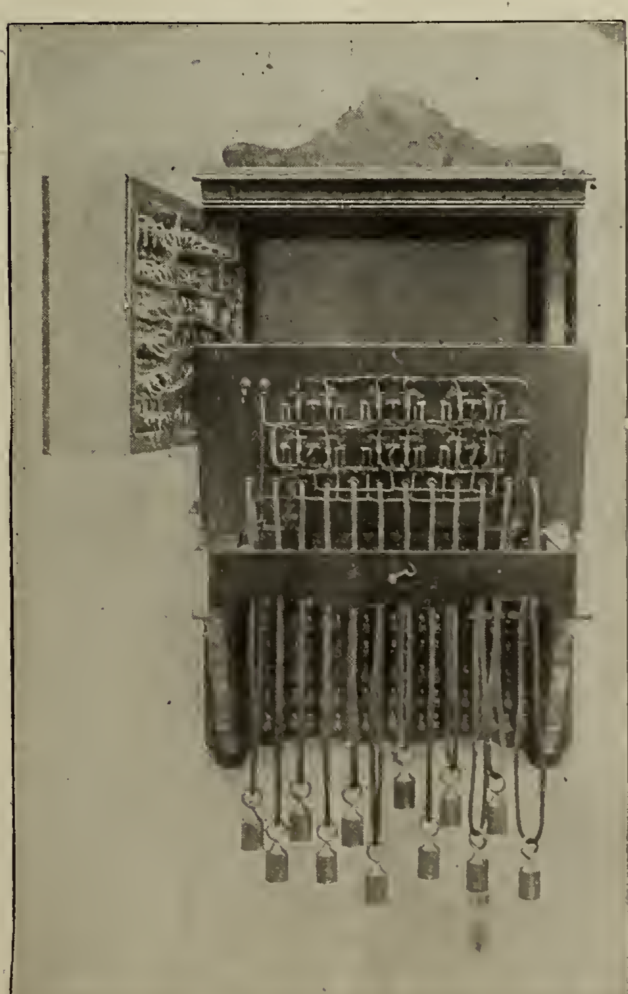


Desk Set.

Complete Telephone Outfit.

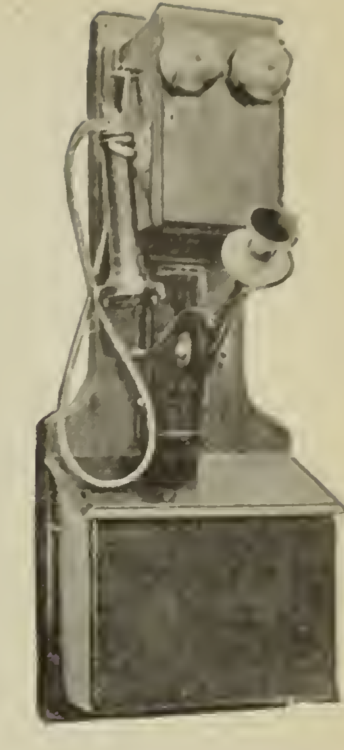


150 Drop Switchboard with Stand.
Self-restoring Drops.
Each Drop and Jack occupy a space of 1½ ins. square.

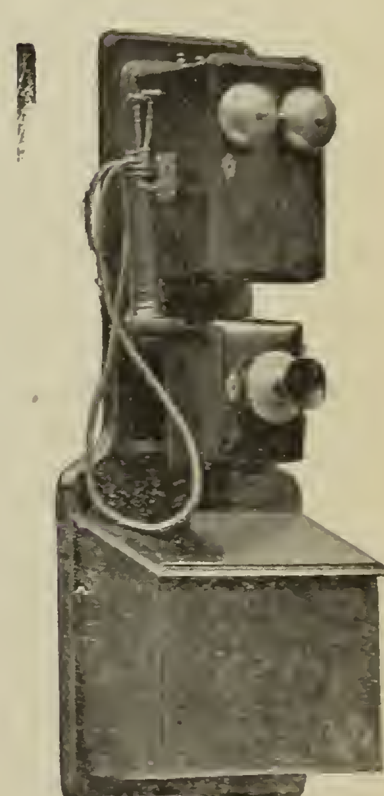


50 Drop Switchboard without Staed.
Thrown Back on Hinges, showing Jacks and Magnets.
Table thrown up, showing Switching Movements.

MODERN TELEPHONIC APPARATUS.



Regular City Outfit.



Transmitter, Receiver and Magneto.

Complete Telephone Outfit.

which the voice could be heard over a long distance; and its ready application to telephone practice has been the means of saving the system from other than local use, allowing its extension over hundreds of miles—with the possibility in tne future of its further use for transatlantic communications.

The outgrowth of the transmitter from the microphone has been most effective in developing telephony to an extent otherwise inconceivable.

The transmitter, which renders speech clearer than any other piece of mechanism at the other end, is a direct duplication of the microphone. The sounding-board is not necessary, because the minute changes of current experienced by the transmitter at once affect the receiver and cause it to repeat acoustically and instantaneously the uttered sounds.

Principle of Transmitters.—The grating of the carbon pieces upon eaeh other varies the resistance of the contact. A decrease in resistance occurs when the carbons are compressed and an increase to the normal status when the pressure is relaxed.

Many forms of telephone transmitters may be built on this basis. A contact which varies with the vibrations of the voice is the means by which a telephonic system may be constructed. The pieces whose resistance is supposed to vary and thus change the current need not necessarily be made of carbon. Many compounds have been used for this purpose of a metallic nature. The changes which occur and shake the enclosed particles are sufficient at times to pack or compress them to so great an extent as to render the transmitter insensitive to delicate vibrations and consequently useless for long distances. The varying contact and diaphragm are the subject of much thought by inventive minds.

The diaphragm sounds which fall ineffectively against the diaphragm are lost, and the timbre of the voice with them, for they constitute the distinguishing feature between voice and voice and the most characteristic tones of the ordinary speech.

The carbon contact may be in the form of a tube with a carbon block at each end. The tube is filled with granulated carbon and varies in resistance as the blocks at each end compress the particles within. As remarked before, the degeneration of the transmitter is heralded from the time the carbon begins to pack. Alloys of high resistance metals have been used ground into powder with no success.

Diaphragms made up of laminæ have appeared on the market, but the delicacy of the instrument has not appreciably increased by their use over a long line, and the overtones do not leave their impression on the receiver. A large transmitter is equally ineffective and impracticable, by conveying the sound in greater volume but with corresponding deficiencies in tone and evenness.

Carbon Button.—The carbon button upon which Edison's invention rests is attached to a strip of metal, and the vibrations of the diaphragm reach it through the medium of a double-pointed attachment touching the diaphragm and the button. In circuit with the transmitter is a battery and coil of wire. When the transmitter is used, the changes of current vary the magnetism of the coil by increasing and decreasing it. A coil of fine wire wound around the first responds to these changes and sends the minute pulsations over the line to which it is connected.

Lines.—Lines are made either of copper or iron. The usefulness of a line as an efficient means of communication between two distant points depends upon its conductivity and insulation; with good insulation and bad conductivity, or poor insulation and excellent conductivity the fault is equally reprehensible.

A relation between the conductivity of the line and its insulation resistance should exist and, if possible, be preserved in practice.

Long lines for either telegraphic or telephonic purposes are necessarily subjected to more leakage, because of the increased number of poles, than short lines. Yet short lines may be very defective, having high resistance in themselves and a character of insulation which compels criticism. Long lines have their insulation pulled down because the many glass insulators to which they are attached each allow a slight leakage to occur and thus in total create quite a flow of electricity to the earth. A relay at the end of a telegraphic line in such a case may be affected or lose its sensitiveness, and a telephone system fall in many respects, by leaving itself open to accident from other power-bearing lines in the vicinity.

Mianas Electric Company Ear-Piece.

QUESTIONS FOR REVIEW.

(1) What is a receiver ?

(2) Of what does a telephonic system consist ?

(3) How many parts are there to a Bell telephone ?

(4) What is a microphone ?

(5) Upon what principle is a transmitter constructed ?

(6) Why is leakage present in a long line to a noticeable degree ?

OBERG & BLUMBERG.

We beg to advise you that we have severed our connections with the Alexander-Chamberlain Electric Co., and have opened offices at No. 853 Broadway (corner 14th street, with full facilities for executing contracts for electrical work of every description.

Trusting that you will favor us with the opportunity of figuring on any work that you may have at your command, we are,

Respectfully yours,
Oberg & Blumberg.

Winnsboro, Tex.—W. G. Ragley Lumber Company may give information concerning establishment of electric light plant.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, FEBRUARY 19, 1898.

CONTENTS.

COOKING AND HEATING BY GAS AND ELECTRICITY.

The opinion of the public on the subject of electricity and gas for heating and cooking is certainly one that cannot be dispensed with because of the fact that they un consciously institute a demand for these things and certainly aid the sale of apparatus used by their application. In Manchester, England, the Northern Society of Electical Engineers held a meeting January 24th. A paper was read by Mr. W. P. Adams, called "A Survey of the possibilities of Electric Cooking and Heating." His opinions in relation to the above subject were unique and interesting. A belief was expressed by him that electricity would soon be used more for heating than for lighting. He admitted that the higher efficiency and cleanliness of electrical apparatus used for culinary purposes placed it on a higher plane than such types as burnt gas. He gave some figures relating to the cost of both electricity and gas when used for cooking. The case referred to was one in which the household consisted of five people and the expense respectively of gas and electricity was, according to his figures, $1.25 per week for electricity and only .92 for gas. It seems, however, that his conclusions were not accepted with any degree of satisfaction by manufacturers of electric heating apparatus, and we include within this editorial the opinion of one that begs to disagree:

"As a member of a firm who are manufacturers of electrical heating appliances, and naturally interested in their success, I feel sure that such statements as those of Mr. Adams can only injure and disgrace an industry which fills well a certain limited space. In the infancy of the gas-heating appliance trade, the same method of exaggeration was carried on, but not to a tithe of the extent. Such as it was, it discredited the whole industry, and created an army of unbelievers who acted as a drag on it for many years. It is to be hoped that history will not repeat itself as regards electrical heating.

"I believe that one electrical unit is equal to 1,000 watt hours, or 3,440 British thermal units, which latter is equal to the heating power of 5 cubic feet of coal gas. 1,620 thermal units will, in theory, raise 1 gallon of water from 50° to 212° F.; in practice, with gas, in small kettles, double this is required. Taking gas at 60 cents per 1,000 cubic feet, the cost of this is 2 cents for 6 gallons. If all the electrical energy is used and no waste occurs (a practical impossibility), at the usual 10 cents per Board of Trade unit, it will cost 31 cents to boil 6 gallons of water. It would appear that Mr. Adams ignores the water-heating in the electrical arrangement, as the total current expended would not heat half the water required, to say nothing of any cooking. Allowing for one-half the gas being wasted, 300 cubic feet would do the same work as the $1.25 worth of electricity (at 4 cents per unit) if none of the latter were wasted, which is impossible; and in addition to the 150 cubic feet of gas allowed for waste, another 940 cubic feet must have been thrown away if Mr. Adams' figures are correct. It would be interesting to know the retail cost of a complete electrical cooking apparatus which would do the work of the gas cooking ranges hired out by the gas companies at a few shillings per annum, say one capable of cooking a complete dinner for ten persons; also the average cost per annum for repairs and renewals, and who is to be paid for these."

The reader may judge, from the nature of this communication, whether such sentiments are not free from bias and the figures contained in the above nearer to the mark than those put forth by Mr. Adams. As a nation of progressive men we can certainly feel assured of the fact that, despite the trials and tribulations that electric heater men and salesmen of electric cooking apparatus may pass through in introducing their goods; they will, in the end, triumph over the prejudices inspired by those whose interests lie in an opposite direction. Electric heating and cooking will be universal when the cost of electricity brings it into the home of the poor as well as the middle class. It is so safe, clean and economical that there is hardly any doubt of its ultimate success. The public believe electric heating to be the *ne plus ultra* of any known method, and as the future of its broader introduction rests with them, manufacturers of these goods can feel confident that ultimately their sale will be rapid and extensive.

FUN WITH THE UNDER TROLLEY.

The small boy of this town has discovered that there are possibilities for fun in the new under trolley conduits of the street car roads, just as he found the cable roads a source of illegitimate pleasure when they were first built. He can't get a free ride or set kites flying down the lines as he did on the cable roads, but he has found that the under trolley conduits contain no end of means for producing electrical fireworks.

One small boy was seen the other day poking a tin toy sword down into the slot. Presently he succeeded in bending the end of the sword so that it made a connection from one current-bearing rail below to the other, and then there came a snapping and crackling, accompanied by a great flash of colored light. Part of the current ran up the sword and gave the boy's arm a wrench. He dropped the sword with a yell and went scudding away with a scared expression on his face.

Other boys have taken to dropping bits of wire into the slot. When a piece of wire falls so that it touches both electric rails at the same time there is a great flash of light as the current darts across the wire from one rail to the other. When such a thing happens, a man in the power-house knows it at once, for at that moment one of the automatic circuit breakers which he watches pops out with a bang, and if it is at night the lights on the cars go out. The watcher pops the circuit breaker back and everything is all right again.

It is not safe for the boys to play with the electric currents passing through the hidden rails, for they might easily get a serious shock and burns. A story comes from the West which may not be true, but is possible, and illustrates the danger of fooling with the electric currents. This story relates to a long line over which a current of 20,000 volts is passed. The line has two copper wires, one for the positive and the other for the return. The two wires are carried on poles, side by side, and not very far apart. One day the line broke and the repair men found both wires melted in two at the same point. From the indications formed the men decided that the trouble had been caused by the quarrel of two eagles. One eagle had lit upon one of the wires and the other had lit opposite him on the other wire. As long as they sat thus apart no harm came to them, but they first looked askance at each other and then struck at each other with their beaks. The moment the beaks came in contact there was a flash of lightning, a puff of smoke, and the main part of the eagles vanished and the wires melted. What led to this theory was the fact that directly under where the wires were melted were enough claws and eagle feathers to indicate that the two birds had been on the wires.—Ex.

A PERSONAL EXHIBIT BY PROF. S. H. SHORT.

In addition to the superb exhibit which will be made of all its modern apparatus for the generation and use of electricity by the Walker Co., of Cleveland, Prof. S. H. Short, its electrical engineer, well known as one of the most distinguished and successful pioneers in the electric railway field, will make a personal exhibit. For some fifteen years Prof. Short has been actively engaged in railway design and invention, and as far back as 1885 organized a company in Denver, which laid and operated a slotted conduit railway. His work will now be interestingly and richly illustrated by pictures, relics, models, old apparatus, etc., and will constitute one of the features of the show and will attract wide attention and help secure for Prof. Short the recognition which certainly is his due.

INVENTION OF LAMPS.

The invention of lamps is ascribed to the Egyptians. In the British Museum are two colored glazed tiles which were fixed in the centre of the ceiling; each has a large knob pierced through the base to receive a cord for suspending a lamp; around the base of each is an inscription stating that it formed part of the decoration of the Temple of Kammuri at Calah Nimrod in the time of Assuru-Abla, 885 B. C. What the lamps were made of cannot now be ascertained, but there is plenty of contemporaneous glass which has been discovered in the neighborhood.

The sacred lamps in Greek temples, whose undying flames were perpetually watched by vestas, were probably of metal, and the wick formed of asbestos.

In the public baths at Pompeii two lamps were used, each to light two rooms. These lamps were protected by circular convex glasses, fragments of which were found on the spot.

The marvellous accounts by mediæval authors of perpetually burning lamps found in ancient tombs seem too numerous and too well attested to be altogether fabulous. When the tomb of Pallas, son of Evander, who is mentioned by Virgil, was discovered about the 12th century by a countryman digging near Rome, it is said a lighted lamp was still burning over his head, which must have been lighted more than 2,000 years, and might be called eternal.

Baptista Porta, in his treatise on Natural Magic, relates that about 1550 a marble sepulchre of the Roman period was discovered in an island near Naples, and on opening the tomb was found a phial containing a burning lamp. This light became extinct on breaking the phial and exposing the flame to the open air. It was supposed that this lamp had been concealed before the Christian era, and those who saw it reported that the lamp emitted a splendid flame.

In 1550 a remarkable lamp was found near Atestes, Padua, by a rustic digging, who unearthed a terra-cotta urn containing another urn, in which was a lamp placed between two cylindrical vessels, one of gold and the other silver, each of which was full of a very pure liquid, by whose virtue the lamp had been kept shining upward of 1,500 years. This curious lamp was not meant to scare away evil spirits from a tomb, but was an attempt to perpetuate the profound knowledge of Maximus Olybius, who effected this wonder by his extraordinary skill in chemical art.

St. Augustine says a lamp was found in the Temple of Venus, exposed always to the open weather, and which could never be extinguished. Ludovicus Fives mentions another lamp, which was found a little before his time, that had continued burning for 1,050 years.

Licetus is of the opinion that the perpetuity of these lamps was owing to the consummate tenacity of the unctuous matter with which the flame was united being so proportioned to the strength of the fire that, like the radical heat and natural moisture in animals, neither of them could conquer or destroy the other. In order to preserve this equality of proportion these lamps were hid in caverns or closed monuments. On opening these tombs, the admission of fresh air has produced so great an inequality between the flame and the oil that they have become extinguished. In Henry VIII's time a lamp was found in a monastic tomb that had been burning for 1,200 years.—The World of Progress.

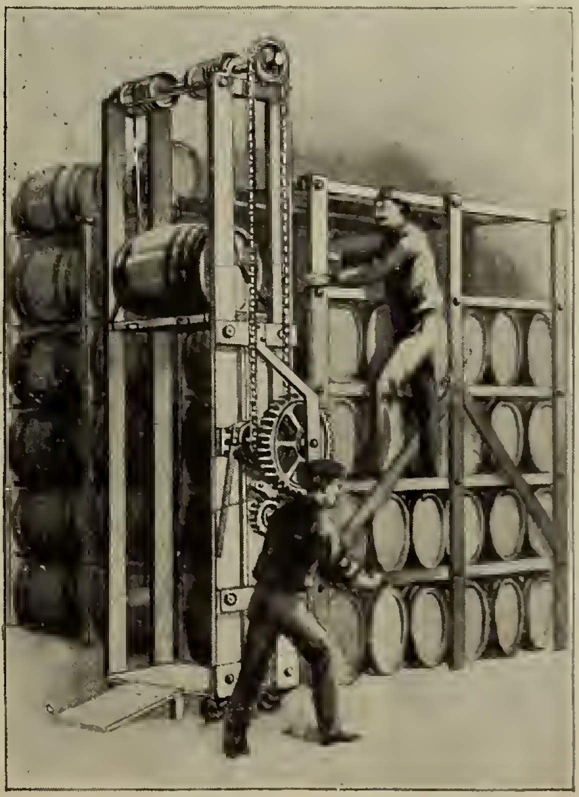
PORTABLE ELEVATORS AND RACKS.

(Patented May 22, 1894.)

Live and learn is a very old adage. The last three or four years have taught us that we have to fight to live, but the strain of the battle is greatly mitigated by having our eyes ever open and our minds receptive for new methods of economy. The warehouseman, wholesale grocer, wine association, glucose manufacturer, molasses manufacturer, hotel man, brewer and a host of lesser lights straining for the almighty dollar, while onlv making a scant profit of the small savings accruing by economy, are not wasting time by giving careful study to the improved methods offered for racking goods, and learning what there is to be said on the subject. The old dunnage system has been in vogue for a long time and millions of feet of lumber have been purchased to form the runner, on which successive tiers of barrels rest, later to be knocked about here and there, seared, broken or lost, as the case may be, never at hand when wanted and always in the way when not wanted, a source of constant expense and worriment; are we never to get a more improved method ? The Dunnage system requiring care, expense of handling and limited tiering shall we keep it for old friendship's sake? The leaking, weeping barrel of glucose, whiskey, wine or molasses groans under a weight of two or three tiers and absolutely refuses to sustain a greater weight on its sides, thus leaving many cubic feet of space above to be filled by the atmosphere. But even with the burdens put upon it by man the barrel will weep at times, and its tears must be quenched, otherwise it will waste itself away. The easy-going companions on the top tiers must be removed one by one until the sufferer can be reached and its open sides treated by the cooper's snrgery. But this is expensive; is there not a way for doing away with all this? The pork barrel has its vulnerable points, and has to be turned from time to time or rust will work havoc. Inconvenience, excessive cost for handling, partial use of storage room, leakage, etc., are all drawbacks of the dunnage system, and the question is, can they be wholly or partially bettered, and that wlth small investment?

Old Method.

The Fox Elevator & Rack Company, 120 Liberty street, New York City, offers a new system which has been tried by some of the largest companies and has their endorsement. The rack is self-contained, needing neither nails nor screws, being made up of timber spaced by iron spacers and bound together by steel bolts. They can be made of any size and put up or taken down in a very short space of time, by the use of wrenches, in the hands of a common laborer. These racks can be built from floor to ceiling, thus giving maximum capacity, and of any width,



New Method-

although it is often advisable not to have them over two barrels wide so as to allow of thorough inspection. The barrels are rolled in place, each tier separate from the one above and below, and every barrel having simply to sustain its own weight, thus reducing leakage to a minimum. Should cooperage, however, be needed, only one tier at the most would have to be removed. The labor item is greatly reduced by the use of the portable elevator, as only two men are needed instead of three, not to speak of the saving of tearing down and putting up when leakage occurs.

The elevator is of very simple construction, good for years of hard usage without cost of repair. It runs very easily on the floor and when placed in front of any particular rack one man can easily raise a barrel to the height required, when it is rolled on the rack. By means of one lever he can free the ratchet on the elevator, and by a second lever control the drop of the platform. While it is true that this system is patented—patented appliances usually are expensive—the company can easily demonstrate that they can install their system at a less cost than for home-made fixed racks, and, besides, give to their customers an article that can be valued on the books—which cannot be said of fixed racks, as the law makes them the property of the owner of the building. The cuts are reproduced from photographs taken from actual working conditions.

New York, N. Y.—Steps are being taken to build an electric railroad from Philadelphia to Jersey City.

AMERICAN COMPETITION IN EUROPE.

(Continued from page 94.)

Another expert, who has travelled through the Atlantic States to find the secret of the superior quality and cheapness of American factory-made shoes, brings back the surprising statement that, in a certain Massachusetts shoe factory which he visited, the average wage earned by all classes of operatives was $15 per week, and the net labor cost per pair of shoes produced 40 cents, whereas in German shoe factories, where the average earnings of operatives are only 16 marks ($3.80) per week, the labor cost for shoes of similar grade is 58 cents per pair. Facts like these have produced, during the past year, a noticeable change in the attitude of technical journals and the more intelligent European manufacturers toward the growing danger from beyond the sea.

Hitherto they have found it comparatively easy to persuade themselves that, but for the American tariff, which could be only a temporary measure, the United States might be held permanently to its function of growing food and raw materials for European operatives and manufacturers who would supply the world, our own country included, with manufactured products. But it is now seen that it is something besides tariff that has made the cost of producing Bessemer pig iron 10s. to 15s. ($2.43 to $3.65) per ton less in the United States than Great Britain, has enabled the steel makers of Pennsylvania to underbid those of England for the rails and other supplies of the London Underground Railway, and to place an order for 8,000 tons of steel rails with the British East Indian Government. Neither has any trick of fiscal legislation enabled the machinists of Philadelphia, Pittsburg and Chicago to sell locomotives, mining and electrical machinery, street-railway outfits, bridges, and architectural iron under the noses of British, German and Belgian agents in South America, Australia, and the Cape of Good Hope.

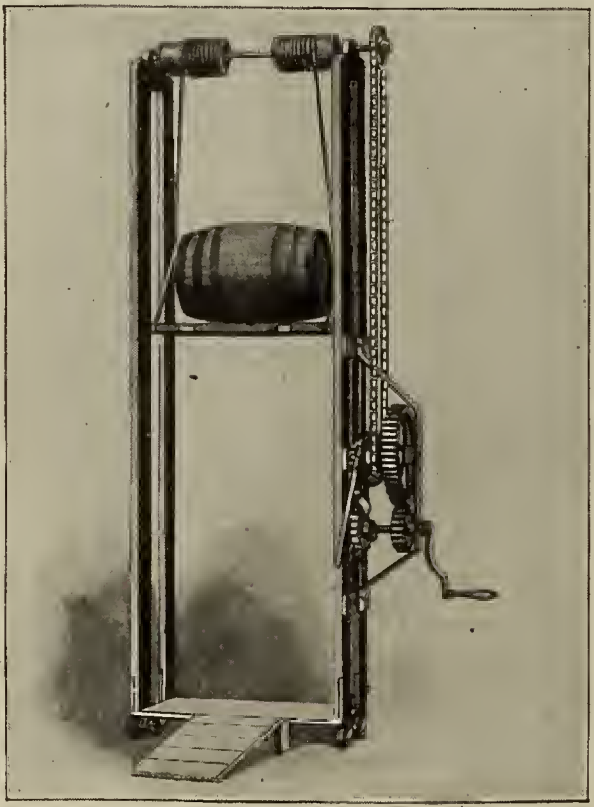
Three years ago German manufacturers honestly believed that, but for the import duty, they and their English rivals could monopolize the American market for bicycles and sewing machines. Since then the American-made bicycle has invaded successfully every important European market, and not only in quality, but in price, has made the competition in Germany so keen that the local makers now demand the imposition of a special high duty on American wheels as essential to their future existence. The steel-bridge builders of Belgium and Great Britain have been surprised to find themselves underbid for the construction of an important bridge in Holland by a company in Philadelphia, and the leading makers of electrical machinery in the United States have set a standard of cheapness, prompt delivery, efficiency and economy of service, especially in electrical railway plants, with which their European rivals find it difficult to compete.

It is but natural that, these facts once recognized, the utmost use should be made of them in these older countries as arguments in favor of concessions and privileges which have hitherto been generally withheld. Throughout the prolonged strike of machinists in England, the most effective plea of the employers has been that without the concessions that they demand from their employees, future competition with American engineers will be impossible, and the supremacy of Great Britain in that field irretrievably lost. In Vienna the Imperial Minister of Foreign Affairs has called upon all Europe to combine against what he calls "the crushing competition of transatlantic nations." At Berlin, a council of specialists has been recently in session to consider international tariff relations, with special reference to Great Britain and the United States. German economists point to the 18,000,000 tons of freight which pass annually through the single lock at the Sault Ste. Marie Canal as an argument in favor of the further improvement and extension of German waterways, and to the unexampled economy and efficiency of American railway freights as an appeal against the inert, exorbitant rates of the State railroads in Germany. Said director Schrodter at the convention of iron and steel producers at Cologne:

"The German iron and steel industry may claim that, in respect to technical capacity, it is not behind that of the great American plants, and as we must not resort to wage reduction, except in the last extremity, the only means of relief is in lower freights. Without substantial help by this means, the German iron and steel industry will not much longer be able to maintain its export trade as it at present exists, much less to increase it."

Expert officials have been sent over to study the construction, equipment, and manangement of American railroads, and the result thus far has been the 60-feet-long vestibule passenger car, mounted on pinion trucks; but the old four-wheeled, 10-ton freight car still maintains its placid sway.

It is not improbable that these appeals will have, in the near future, a more or less important effect. Already,



Elevator.

the freight rates for ship-building materials on the State railways between Westphalia and the shipyards of Stettin, Hamburg and other coast cities have been greatly reduced, and important improvements in the water route from Berlin to Stettin and the projected waterway from Berlin to Rostock via the Mecklenburg lakes are movements in the same direction.

(To be continued.)

EXTRACT OF ARTICLE ON SPARKING.

By Thorburn Reid.

Now consider how the current should vary during the period of commutation, so that the energy of commutation will be developed equally over every part of the contact surface, and so that the amount of energy developed shall be a minimum.

First consider the variation of the current which will satisfy the first of these conditions. This condition will be fulfilled if the current density in every section remains constant as long as the area of contact is changing; for every part of the segment remains in contact with the brush for the same length of time, that is, the time required for that part to pass from the heel to the toe of the brush. Therefore, since every part is receiving energy at the same rate and for the same length of time, the energy developed in each part is equal. While the whole segment is covered, any change in the current density will affect every section equally, so that the current may vary in any way during that period, without causing unequal distribution of energy.

Consider how the current should change so as to develop the least energy. That is, how the current must be distributed between the contact surface of the segments so as to develop the least possible amount of energy.

Let R_1 and R_2 be the resistance of the two segments, and C_1 and C_2 the corresponding currents, C being the total current flowing. Then we have for the rate at which energy is being developed at any period:

$$W = C_1^2 R_1 + (C-C_1)^2 R_2 \qquad (1)$$

Differentiating and equating to zero, we have

$$C_1 = \frac{R_2}{R_1 + R_2} C \qquad (2)$$

To determine whether this gives a maximum or minimum value, substitute in equation (1) for C_1 the values $C=0$ and $C_1 = C$ and we get for $C_1 = 0$, $W = C^2 R_2$ and for $C_1 = C$, $W = C_2 R$. Both these values are higher than that obtained by substituting from equation (2) in equation (1), namely:

$$W = \frac{R_1 R_2}{R_1 + R_2} C_2$$

Therefore that value of C_1 makes W a minimum.

This means that for each position of the brush, the energy developed at the contact surface will be a minimum when the current divides between the segments under the brush in the ratio of their areas of contact. It is seen that under these conditions, the current density remains constant, and that therefore the requirements of equal distribution of energy are also fulfilled.

Perfect commutation may now be defined as a complete reversal of the current in the coil under commutation, in such a manner that the portions of the current flowing through the two segments to which ends of the coil are connected shall be proportional to the respective contact areas of the segments.

It was shown above that $C_2R_2 = C_1 R_1 + CR$ drop in the coil plus the inductance E in the coil plus the reversal E. If, therefore, the sum of the CR drop of the coil plus its inductance E were always equal and opposite to the reversal E, $C_1 R_1$ would be equal to $C_2 R_2$, which is the condition for perfect commutation as defined above.

To sum up, the deleterious effects of sparking are due to excessive local heating of the commutator contact surface, causing the copper to melt, and an arc to be drawn, the segments being thus disintegrated.

The causes of deleterious sparking are either too great a departure from perfect commutation, or too high a current density.

Perfect commutation can only be practically secured by making the impedance of the coil negligible as compared with the contact resistance. A comparison of the sparking constants of a large number of machines was made before this theory of commutation was evolved.

It has been found to explain many cases of sparking which had before been unexplained.

It has been found difficult to determine definite safe working constants, on account of the small number of tests that have been made to determine accurately the inductance of the coil under commutation and the effect on each other of two or more coils commutating at the same time.

NOTES.

Orlando, Fla.—B. C. Abernathy and others will probably construct an electric light plant.

Waukegan, Ill.—The Bluff City Electric Railway will resume construction.

Atlanta, Ga.—The Atlanta Water Power Company applied for charter, with Henry B. Wilson, Emerson McMillan, R. H. Smith and C. Emerson, to manufacture electricity, etc. The company has options on lands valued at $175,000, including three shoals, which will develop 11,000 horse-power.

Toccoa, Ga.—The Toccoa Telephone Company has been incorporated by John McJunkin, C. H. Dance, L. P. Cook and others, for constructing and operating telephone systems. Capital stock, $5,000.

New Orleans, La.—The People's Telephone Company will construct and operate a telephone system, the wires of which are to be laid underground in conduits.

Elkin, N. C.—The Elkin Electric Light and Power Company has been incorporated by Alex. M. Smith, Gilvin T. Roth, and Hugh G. Cheatham, for erecting and operating an electric light and power system. Capital stock, $2,000.

Knoxville, Tenn.—The Knoxville Street Railway Company will make improvements to its electric power house and railway, etc.

Beaumont, Tex.—The Southwestern Telephone and Telegraph Company has been granted franchise, and will establish a telephone system and exchange.

Washington, D. C.—The Capital Traction Company has obtained permission to make several extensions to its electric line in the city.

Baltimore, Md.—The Consolidated Railroad Company has decided to construct several extensions of its electric lines on Schroeder street, and in the southwestern suburbs.

Gatesville, Tex.—Gatesville Electric Light Company is reported to have asked for receiver.

Baxter Springs, Kan.—The Baxter Springs Light and Power Company is succeeded by the Metropolitan Light and Power Company.

Rock Rapids, Iowa.—An electric lighting system has just been completed.

Chicago, Ill.—Fischer Equipment Company has been incorporated by Andrew J. Hirschi, William A. Rogan, Edgar R. Hart, to supply electrical equipment. Capital stock, $2,400.

Wallace, Idaho.—The Montana Telephone lines are to be extended to this city, which will give a through line to Oregon and California.

Greenville, Mich.—Greenville Telephone Exchange has been incorporated with a capital stock of $15,000.

Dickson, Tenn.—Captain John Adams may be addressed concerning establishment of an electric lighting plant.

Marion, N. C.—J. W. Kirby and B. B. Price will put in a telephone system for Marion.

Seymour, Tex.—The Haskell and Throckmorton Telegraph and Telephone Company has been incorporated by T. H. C. Peery, G. P. Barber and G. C. Plants, to construct, operate and maintain a public telegraph and telephone line and system between the towns of Seymour and Haskell. Capital stock, $3,000.

Ventura, Cal.—The Ventura Land and Power Company plant was destroyed by fire; fully insured.

Lexington Va.—A bill has been introduced in the Legislature at Richmond, applying for a charter for the building of an electric street railway in this city. J. R. Williams and Augustine Royall, of Richmond, are interested.

Chicago, Ill.—Calkas Light Manufacturing Company has been incorporated by Edward J. Ryan, Henry C. Marston, Thomas D. Shannon, to manufacture lamps and lighting appliances. Capital stock, $100,000.

New York, N. Y.—Bernstein Electric Company, of Boston, attachment issued against them from Steuben County, N. Y., for $1,459 in favor of the Corning Glass Works.

Missoula, Mont.—The Rocky Mountain Bell Telephone Company manager has been ordered to extend line to Wallace, Idaho.

Springfield, Ill.—The Chicago and Desplaines Valley Electric Railway Company has been incorporated by Henry G. Foreman, Clayton E. Crafts, Charles D. Evans, Philip H. Gray and William M. Hulbert, to construct and operate an electric railway from a point in the town of Wheeling to some point in the town of Lemont. Capital stock, $1,000,000.

Hagerstown, Md.—The Washington County Electric Power Company are preparing articles of incorporation, for the purpose of establishing an electric plant in this city, to compete with the plant owned by Powell Evans, who is negotiating with Williamsport, Pa., capitalists for the sale of his plant. Evans has the contract to light Hagerstown until 1901.

ELECTRIC FIRES.

F. H. Wentworth is of the opinion that many cities are so slack in their methods of controlling their systems of wiring that it is only by sheer luck that there are not twice as many electrical fires as are on record. When an outside overhead wire, carrying current of either high or low potential, comes in contact with an ordinary signal wire, the latter, in case of poor or defective insulation, is immediately charged with the heavy current, and carries it into any building into which it happens to run. Fires from this cause are of daily occurrence and are responsible for over one-seventh of the annual electrical fire destruction.

Mr. Wentworth maintains that one source of this trouble is the cheap, incompetent hands which, under the name of electricians, are intrusted with details of an installation which require both skill and experience. For instance, most fuses are made of soft metals, principally lead and tin, in the proportion of three to one, making a composition which melts at a temperature of less than 300 centigrades. Copper requires a temperature of over 1,000 degrees before it will melt. Mr. Wentworth says: "I frequently find copper wire in fuse boxes put there by men whom their employers call electricians. This is analogous to hanging a millstone on the safety-valve of a steam boiler. A never-failing way to correctly estimate the intelligence of the man in charge of an electrical equipment is to examine his cut-outs and fuse boxes. If they are manifestly overfused, or contain copper wire, he may be set down as either grossly careless or lamentably ignorant. Flexible cord used as line wires in lighting show windows is a constant source of fire, and it is tempting Providence to wrap up incandescent lamps in cloth, cotton, straw and every variety of inflammable material as some storekeepers do in decorating their windows. Merchants hang arc lamps without spark arresters immediately over inflammable goods, and see the hot particles of copper and carbon thrown off by the arc with no appreciation of the danger. Wires are run on pipes, structural iron work, metal columns and other conductors and in this department of electrical work there is a great deal of practice which is slovenly and dangerous."

Mr. Wentworth cites these facts for the purpose of impressing upon every municipality that it should provide for a rigorous inspection wherever electricity is used in any form.—The Tradesman.

THE CENTRALIZATION OF POWER STATIONS.

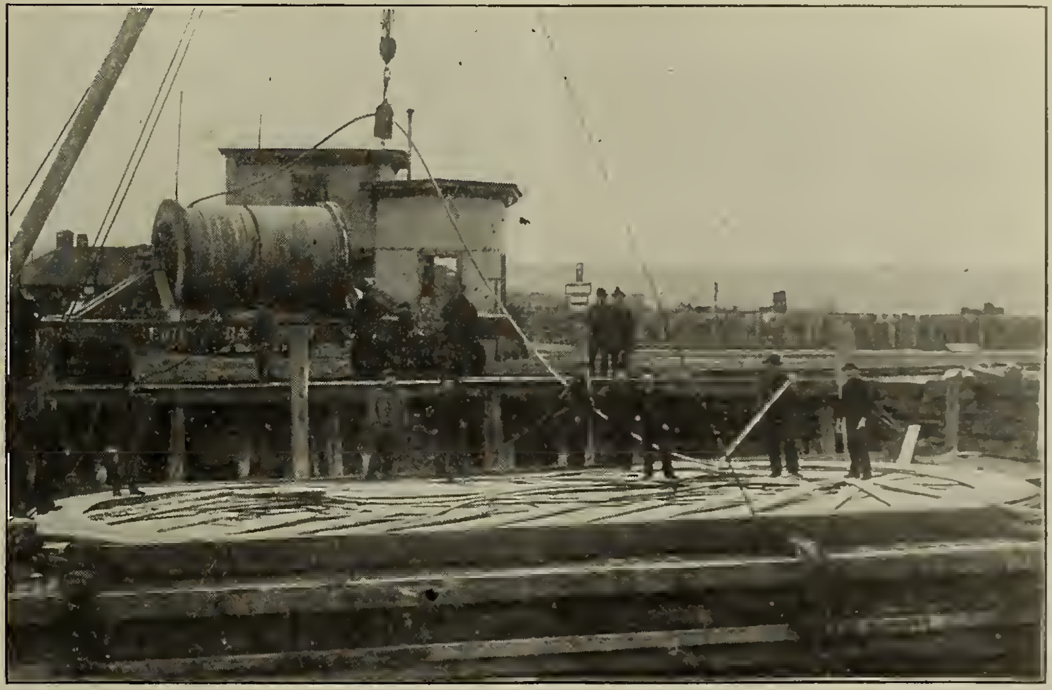
The future tendency of electrical engineering is toward the centralization of power stations. It will pay, in a very large city, to erect a single station where coal and water can be had the cheapest, and generate current there on the high-pressure basis, 6,000 or 7,000 volts being about the figure demanded by the present state of the science. Then, send the small current to the stations now used as power houses, and there transform the high tension small current into that called for by the service it has to meet.

In this way the very highest possible efficiency may be realized in the steam plant, also in the transmission, which in a large city must cover many square miles of territory. A multiplicity of small stationary engines and boilers, with their great expense, will be avoided, and the only machinery needed at the sub-stations will be the transforming machinery necessary to change the high tension current into the desired form.—The Tradesman.

The Electrical Age.

VOL. XXI—No. 9 NEW YORK, FEBRUARY 26, 1898 WHOLE No. 563

Paying Out the Cable Across Great South Bay.



Transferring the Cable from the Reels to the Deck of the Wrecking Scow.

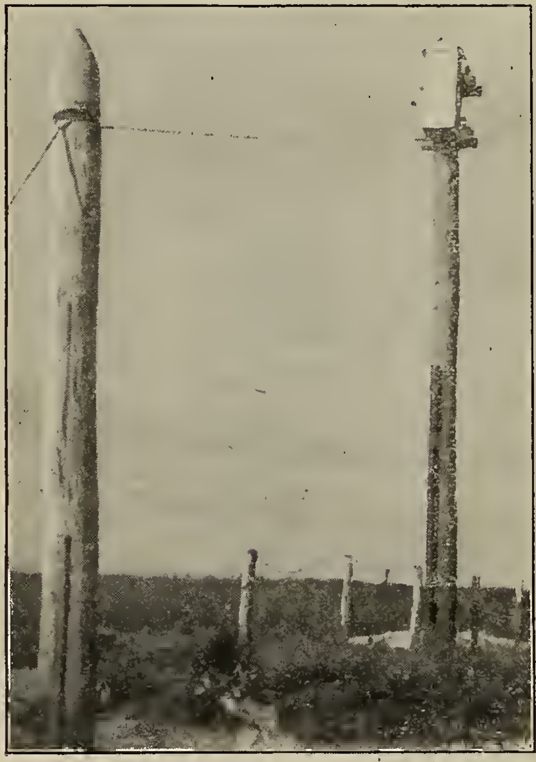
THE LAYING OF A SUBMARINE CABLE.

Landing the Shore End of the Cable at Fire Island.

According to the report of the International Bureau of Telegraph Administration, received in 1890, at least 120,070 nautical miles of submarine cable are in actual use. Of this mileage at least 100,000 is the property of private corporations; the balance belongs to the government, or some company connected with them in an administrative capacity. In 1890, the estimated value of the cables in use reached the figure of $200,000,000. The public well appreciate the advantage of having the globe encircled with a belt of electric cables. News is instantly flashed from point to point thousands of miles apart and the distant Transvaal is as near to us, telegraphically, as the shore of Coney Island, or the Capitol at Washington. There is no work more arduous or requiring so much skill and care as the laying of a submarine cable. A huge factory is required for its manufacture and a great ocean steamer, carrying a corps of able and experienced engineers must be added to the requirements. Possibly what may be considered a most difficult undertaking has been successfully completed by The Okonite Company, Limited, 253 Broadway, New York City. The work was done by them for the Postal-Telegraph Cable Company on January 25, and concerned the laying of a submarine cable in Great South Bay, between Fire Island and Conklin's Point. The character of the sea bed of the Great South Bay is well appreciated by fishermen and yachtsmen. It is full of shoals and sandbars and the constant variations occurring beneath and changes in the character of the bottom necessitate on any occasion the services of an experienced and iron-nerved pilot.

The Okonite Company, Limited, manufactured and laid the cable for the Postal-Telegraph Cable Company so successfully that no cause for complaint has arisen or is expected to arise in connection with this work. The cable is six miles long and completes a line already made and in use at present for marine service. The entrance of ocean greyhounds is instantly telegraphed from an observation tower to the steamship companies in New York. A line runs from this observatory to the coast line of the island, washed by the bay and there connects with the cable proper.

The bay is crossed by the cable and the other extremity of it connects at Conklin's Point with a well erected overhead line. The overhead line is in itself worthy of note on account of the strength, efficiency and general excellence of it as an installation. It consists of two copper wires, averaging two hundred and ten pounds per mile. This line stretches northward to the tracks of the Long Island Railroad, then continues along an old line, following the main roads until the Borough of Brooklyn is approached. An underground cable then completes the circuit to No. 4 Court street, Brooklyn. Greater New York is thus reached, but not its pulsating centre, Manhattan Borough. In order to reach this, the line is continued along the elevated railway over the great Brooklyn Bridge and underground to the Postal-Telegraph Cable Company's offices, in the building bearing their name.



Cable Terminal Pole at Conklin's Point.

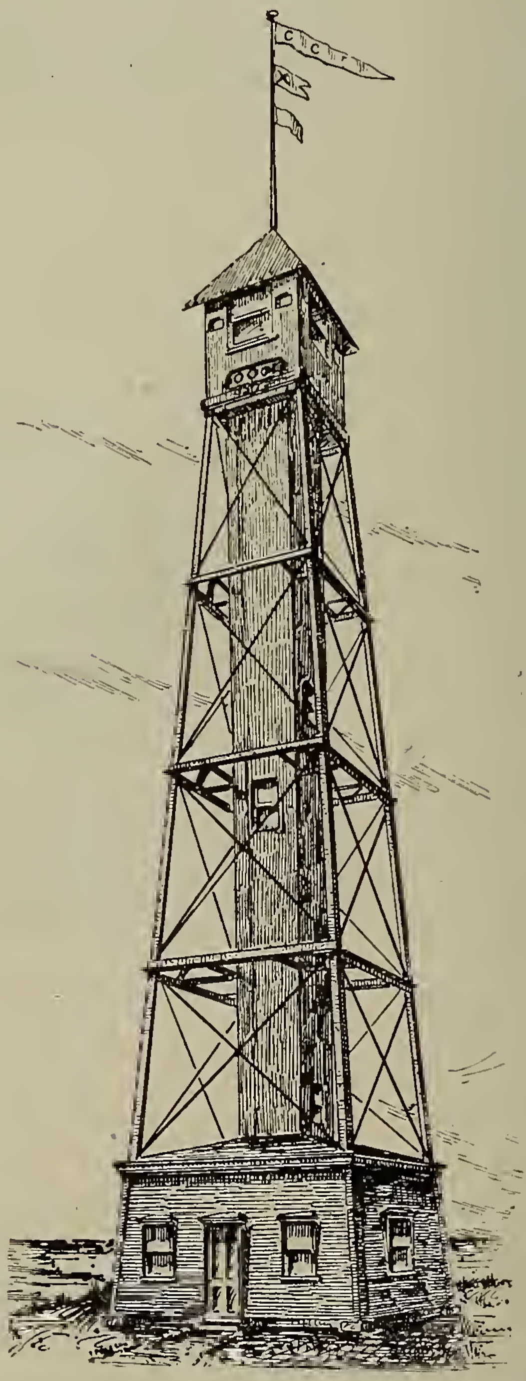
The cable in its completed condition weighs sixty-five tons, is six miles long, one inch and three-quarters in diameter and is built up of six Okonite wires in pairs. The exterior of the cable is protected from injury by galvanized iron wire of unusual strength and thickness. An ordinary ocean cable is not as strongly made as this particular length, the one being described weighing four pounds to the foot; an ocean cable weighing less than twenty per cent. of this.

The testing of a cable of this size was successfully performed at the Okonite factory, at which may be found a huge testing tank, one of the most capacious in the country. It was carefully tested for insulation resistance and put through a "break down" test of thousands of volts. The care with which these tests were made add to the confidence already felt by those concerned with its installation and future operation.

The test being completed, the cable was wound upon giant reels, the reels being turned by a belt reaching out beyond the walls of the factory. After filling each of the three great reels before the end of the cable was reached, each was respectively mounted upon a railroad car, used to carry this great strand from Passaic to New London, Conn. Here they were coiled upon the deck of a large scow, the cable being run out in a flat, oval-shaped spiral.

The difficulty of handling the cable thus far was somewhat increased on account of the long and circuitous path it had to travel, reaching New London. It was necessary to go that distance, however, in order to employ a large enough scow of the draft required. The one employed was of very light draft, and thereby lessened the risk to which all crafts are exposed when traversing the waters of the Great South Bay. Although the scow was eighty-five feet long and thirty-five feet broad it only drew three feet of water when loaded with the sixty-five tons of cable.

The well-known wrecker of New London, Captain T.



Postal Telegraph-Cable Company's Marine Observatory at Fire Island.

A. Scott, managed the shipping of the cable, which, to say the least, was a rather difficult job. When coiled on the deck of the scow, the cable rested in six layers, occupying comparatively little space.

Its transportation, when in this condition, was exceedingly easy and represented a departure from the regular routine followed, of a highly interesting nature, nothing having been heretofore attempted in relation to the shipping of the cable of a similar description. A large tug, built for rough weather, took the scow down the Sound to within a short distance of Staten Island and there they anchored on account of stormy weather. The next day the scow was brought from Rockaway Inlet to Fire Island and anchored off Fire Island shore. The end of the cable was then tied to a rope and the rope wound up by a steam winch on the Fire Island Shore and there made fast. Another tug was then employed drawing but little water, which towed the scow across the bosom of Great South Bay and the cable began to unwind. It was at this point that considerable skill was exercised for the purpose of preventing accidents, not only to the cable, but to the scow and tug, the shoals and sand bars causing those in charge constant uneasiness. Another fact to be noted was the freezing of the waters, which added to the risk undertaken by the Okonite Company, Limited.

Had the scow grounded or even run foul of a shoal for but a short while, the chances are that the fast congealing waters of the bay would have prevented headway from being made for hours or possibly days to come. Capt. George Saxton guided the tug through hidden but tortuous channels and thereby greatly ensured the success of the expedition. It took but four hours to lay the cable, which was gradually moved over the stern end of the scow as required. The rate at which the cable was paid out was controlled by a rough brake, and a guiding block prevented it from getting into kinks and snarls.

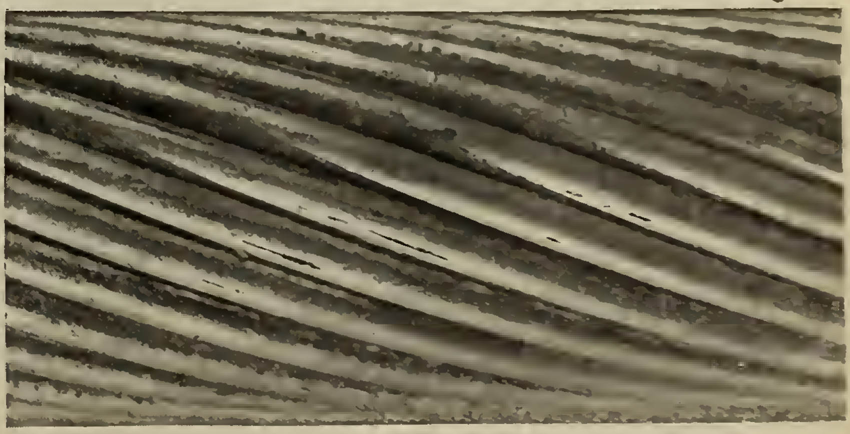
This difficult, though highly interesting achievement was perfectly successful through the additional efforts of another gentlemen, Mr. R. D. Blish, cable expert of the Southern New England Telephone Company, who helped in the shipping and laying of the cable; Mr. E. B. Baker, general superintendent of the Southern New England Telephone Company; Mr. E. G. Cochrane, general superintendent of construction for the Eastern division of the Postal-Telegraph Cable Company, Capt. Willard L. Candee, and Geo. T. Manson, of the Okonite Company, Limited, were also present at the laying of the cable.

The illustrations provided with this article will give the reader an idea of how this work is conducted and lead him to a further appreciation of the care and skill exercised by those intrusted with so important a mission.

The Okonite Company, Limited, have shown great enterprise in all their undertakings, and have, by their careful attention to lesser details frequently achieved success where others have failed. They are one of the oldest and best known of wire companies, and have completed some of the most important contracts ever given to manufacturers of wires and cables.

Method of Guiding Cable while Paying Out from the Scow.

Winding the Cable on One of the Reels for Shipment from the Okonite Factory.



Full Size End and Side Views of the Okonite Submarine Cable Laid in Great South Bay for the Postal Company.

BROOKLYN FOOD SHOW, Armory Building, Flatbush avenue and Hanson Place, contains some brilliant electrical effects in connection with the large array of beautiful booths. The exhibitors seem to have vied with each other in designing their booths. Eskays Food Co. exhibited a very handsome sign over their booth. It was made in white ground and studded with small incandescent lamps in pearl, purple and variegated red colors, richly blended together. Fleischman, the great yeast cake firm, have a very ornamanted booth of arches studded with lamps.

We could go on and enumerate the beauties of all the booths with their tasteful electric effects. We advise our readers who desire to secure ideas for the coming Electric Show and Health Exhibition to pay the Food Show a visit. It was very noticeable how the people flocked around the brilliantly lighted booths.

Wm. Boies & Co., electrical contractors, had charge of the electrical work.

Great credit is due to Mr. J. H. Meyers, general agent of the United Retail Grocers' Association, of Brooklyn, for the success of the Food Show.

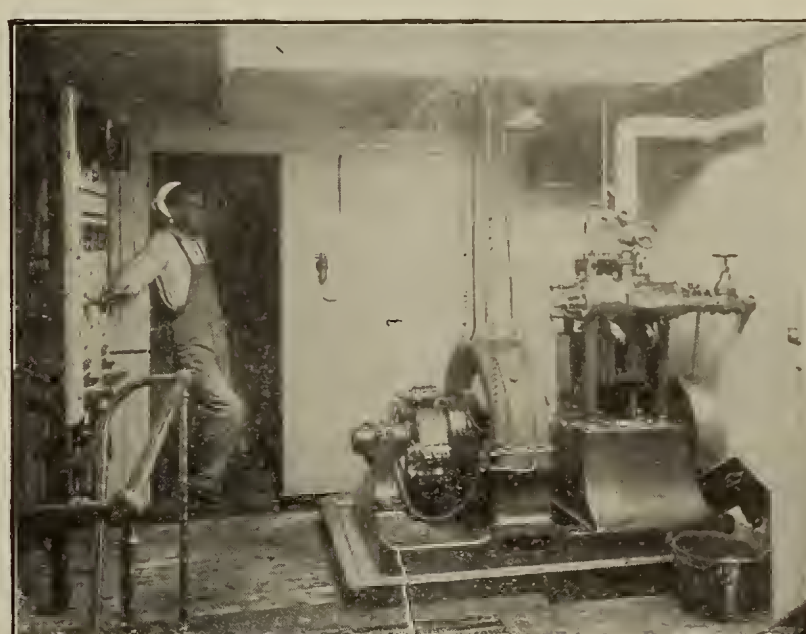
J. H. Wildey attracted unusual attention with his Electrical Engraving Machine. The Food Show closes March 5; our readers have only a few days to get ideas for the coming electrical show.

DIAMOND SHOAL LIGHT SHIP.

Lightship No. 69 has now been anchored on the dangerous Diamond Shoal off Cape Hatteras in 30 fathoms for three months, and having ridden through the gales that prevail off that perilous spot in the Atlantic in entire safety during the roughest weather, has proved to the satisfaction of the Lighthouse Board that a light vessel can be safely maintained there. The captains have now become familiar with the light and until the ship is replaced by a lighthouse, as originally intended, she will be a beacon to be carefully watched for and avoided.

Diamond Shoal Light Ship.

Nos. 68 and 69 are sister steamships built at the yards of the Bath Iron Works, at Bath, Me. No. 68 is the lightship off Fire Island. Both 68 and 69 are unusually powerful composite vessels, 122 ft. 10 in. long over all, 29 ft. ft. 6 in. extreme beam and 22 ft. moulded depth. They are provided with propelling machinery to enable them to steam to their stations, and, also, in case of necessity, to steam away from their dangerous positions. The engines are simple condensing vertical, with a cylinder 20 in. in diameter and 22 in. stroke, developing 350 H. P. at 150 revolutions. Steam is furnished at 100 lbs. pressure by a steel Scotch boiler 12 ft. 2 in. in diameter and 11 ft. long. Two vertical donkey boilers furnish steam for the electric lighting plant, windlass, pumps, fog signals and for heat-


Diamond Shoal Light Ship Plant.

ing. The vessels are also fitted with steam steering gear, bells, a steam winch and full equipment of anchors and chain cables.

The two masts are of steel; each, exclusive of the flag pole, 64½ feet high. The electric lights are suspended at the mast heads, and are surrounded by a gallery for day signals.

To avoid chance of breakdown the electric plant on each vessel is in duplicate. Each plant consists of two marine generating sets with dynamo and engine both built by the General Electric Company, of Schenectady, N. Y. The four-pole dynamos are 8-kilowatt, 350 revolution machines, directly connected to 4½x4 in. double cylinder engines. The switchboards are of Vermont marble and the wiring appliances used throughout are of the type approved by the United States Naval Board of Inspection. The dynamos furnish 100-volt current to eight 100-candle power lamps, four at each mast head, and forty 16-candle power lamps throughout the vessel. The mast head lights are each enclosed in a lens lantern, three being used and the fourth held in reserve. Connected in circuit to the mast head lights is a device making and breaking the circuit and lighting and extinguishing the lamps at regular intervals. A fixed white light shows for twelve seconds and is followed by an eclipse of three seconds. The focal plane of the lights is 57 feet above the sea, and they will be visible 13 nautical miles away in clear weather. Great reliance is placed on the electric plants, and in their construction more than ordinary care has been taken on account of possible consequences of a breakdown through accident.

(We are indebted to the courtesy of the New York Tribune for the photographs from which the illustrations were made.

FALLS WILL LIGHT BUFFALO.

Niagara power will, it is now expected, be used to light the city of Buffalo by August 1st. The Buffalo General Electric Company, which at present has a contract of 3,000 horse-power from the Falls, and which will contract for more as it is needed, has decided to build a new power-house at once, and as soon as this is completed and the new machinery installed, the present plant of the company, on Court street, will be given up, and steam power, so far as the Buffalo General Electric Company is concerned, will be a thing of the past.

The new power-house will probably be located on Wilkeson street, where the company now owns a very valuable site. Three sites were seriously considered at the recent meeting of the directors the latter part of last month. These were the one on which the present plant is located, a site not owned by the company and the Wilkeson street property. The sentiment of the directors was in favor of the latter, and there is little doubt that it will be selected by the committee in whose hands the matter was left for final decision.

Ground for the structure will be broken at once. The new plant will be one of the most modern in every way in the country. The machinery alone will cost $160,000, exclusive of the eleven step-down transformers, which are being built by the General Electric Company of Schenectady, and which will be furnished by the Cataract Power and Conduit Company.

The power will be received in the eleven transformers, and will be transmitted through two rotary converters to four frequency-changers, which will change the frequency of the current from 25 cycles, in which it is sent from the falls, to 60 cycles. From the frequency-changers the current will be distributed among fifteen motors. Each motor will drive two arc machines, one on either side, making thirty arc machines in all.

There will be a total horse-power of 5,900. The 30 arc machines will have 3,000 horse-power, the incandescent machines 2,400 horse-power and the power-circuit motors 500 horse-power for distribution to small motors such as house-fans or shop-motors. There will be a 50 per cent. reserve of the incandescent lighting and power circuit and 25 per cent. reserve of the arc lighting.

With the apparatus already ordered, the new plant will light 3,000 arc lights and 24,000 incandescent lights and will be able to run about 600 horse-power of motors. When the demand exceeds this, the apparatus will be increased, as there will be room for three times the apparatus ordered. The company now lights 2,862 arc lights, 2,000 on the east and the rest on the west side.

The Buffalo General Electric Company expects to complete the new plant and light the city from end to end inside of six months' time.—Greater Buffalo.

LEGAL NOTE.

Cement-Lined Pipe Patents Sustained.—In the Circuit Court of the United States for the District of Connecticut, Judge William K. Townsend has just handed down an interlocutory decree in the case of the suit brought by the National Conduit Manufacturing Company against the Connecticut Pipe Manufacturing Company. This case was brought by the National Conduit Manufacturing Company against the defendant company for infringements of patents on the well-known cement-lined iron pipes for electrical subways, all of the patents on which are owned by the plaintiff company.

The patents in question cover broadly the use of cement-lined iron pipes for electrical subways. The decision in favor of the National Conduit Manufacturing Company enjoins the defendant company perpetually from the manufacture, sale or use of such cement-lined pipe, and the construction of such subways. The decree further orders that the defendant must compensate the plaintiff for all profits, gains or advantages which it has obtained by reason of all infringements heretofore, and appoints a referee, with full power, to examine into the business of the defendant to ascertain and assess the amount of damages. The National Conduit Manufacturing Company is now proceeding against the receiver of the defendant company, in order to get damages for the infringements in question, in accordance with the decree of court above mentioned, and prevent him from disposing of the pipe, etc., which came into his possession under the receivership.

MUNICIPAL ELECTRIC LIGHT AND POWER IN GERMANY.

In the following cities in the German Empire the municipal authorities own and manage the electric works that supply light and power: Bremen, Barmen, Cassel, Darmstadt, Düsseldorf, Elberfeld, Hanover, Cologne, Königsburg, Lübeck. and Pforzheim. All of these cities, with the exception of Hanover, also own the gas works. The following cities have constructed the electric works for the purposes of light and power, but have leased the management of the same to private operators: Aix la Chapelle, Chemnitz, Frankfort, Strasburg, and Stuttgart, all of which, with the exception of Chemnitz, are cities where the gas works are under the management of private corporations. In the following cities, private companies have established electric works with the agreement that, under certain conditions, the municipal authorities shall have the privilege of securing absolute control and ownership by purchase: Altoona, Dessau, Gera, Hagen, Heilbronn, Leipsic, Mülhausen, Stettin, and Zwickau. Of these cities, the gas works are under private control in Dessau, Hagen, Mülhausen and Zwickau.

James T. DuBois,
Consul-General.

St. Gall, Jan. 28, 1898.

ERECTION OF TELEGRAPH AND TELEPHONE LINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The Line.—The consideration of a line from certain standpoints makes the subject one of deep interest and importance to the earnest reader. A line is merely a conductor supported at frequent intervals by insulators. Its utility and efficiency depends entirely upon the excellence of these supports and its own conductivity. The material of the line merits the closest attention, and its resistance as compared with that of its supports provides a means of estimating the loss or gain by any specific change in either. Usually conductors are of either iron or copper for line work.

The insulators are usually of glass, although those used indoors are made of hard rubber. To give an idea of the extraordinary difference between a good conductor and an insulator a comparison made by Fleeming Jenkin might be recalled.

"The difference between a copper conductor and a gutta-percha insulator is about as great as the difference between the velocity of light and that of a body moving through one foot in 6,700 years." The following table gives a list of conductors in the order of their conducting power, also showing the decreasing insulating property of various materials:

Conductors.	Insulators.
Silver	Air
Copper	Glass
Zinc	Hard Rubber
Platinum	Shellac
Iron	Gutta-percha
Carbon	India Rubber
Acids	Porcelain
Salt Solution	Earth
Water	Ice
Wood (damp)	Oxides

A copper conductor is used as a basis for estimating the resistance of wires of other metals. In a table given by Franklin Leonard Pope a means of arriving at this fact by a simple calculation is shown:

For brass,	multiply	copper	resistance	by	4.5
" German silver,	"	"	"	"	12.9
" iron,	"	"	"	"	5.9
" platinoid,	"	"	"	"	19.5
" platinum,	"	"	"	"	14.8

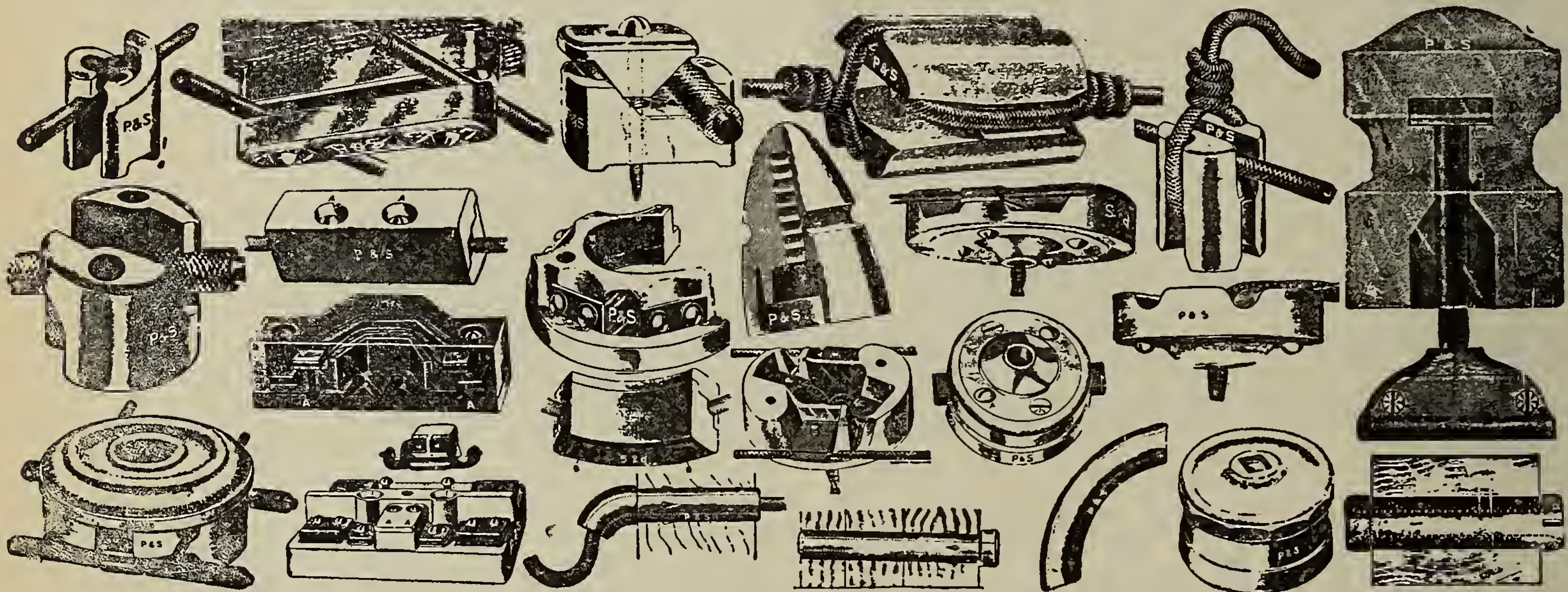
This valuable little table will prove very useful when wires of the same length and diameter are compared, and equally so should their diameters vary, because two wires of the same material and same length have a resistance inversely proportional to the square of their diameters. For such purposes a mil foot of each would show the desired relationship in an easy manner. A mil foot is one foot of the metal .001 of an inch in diameter.

The line in telegraphic practice is gradually being changed from galvanized iron wire to copper. This is an advantage in every respect, but means a heavy expense to the company. The leaks that occur from the line to the earth, due to the following—

Grounds,
Crosses,
Poor insulation,

are at times very bad, draining the system of its current and thereby destroying its effectiveness to a great extent.

The insulators may be covered with a film of rain water, the poles may decay and get soaked, and floating dust settling upon both insulator and line may provide a path to earth. In comparison with pure copper, clean rain water has 40,653,723 times the resistance. When mixed with foreign matter its conductivity greatly increases.



Insulation, etc., Used in Erection of Lines.

The earth in telegraphy acts as a return circuit; the extremities of the line being grounded by means of a large plate, either of copper or iron. This is set into the earth and from it the signals either extend forward or return through the instruments at each end. The earth, if very dry or sandy, will be a poor return circuit and the line suffer in consequence; therefore moist earth is the best material in which to ground the line. In a city the gas or water-pipe system is sufficient.

The resistance of an earth return is practically negligible, and is therefore lightly considered when tests are made.

Its specific resistance is very high, but the enormous cross section is ample enough to secure an almost complete reduction in resistance.

The ground plates, if made of copper, are about $\frac{1}{16}$-inch thick and about 4x4-feet in area. A galvanized iron plate is very much cheaper and just as serviceable. Contact is made with the connecting wire by soldering it, and the joint is protected by a non-corrosive substance from electrolysis and chemical action. If the soil is very dry a pit should be dug and the plate laid in it, surrounded by coke or charcoal, or other refuse equally applicable. A granitic district would probably develop some such a peculiarity.

Posts—The poles will last long if their ends are creosoted or soaked in some silicic or protecting compound. In moist soil the decay quickly commences, and when

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2 50
One Copy, six months,	1 25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, FEBRUARY 26, 1898.

CONTENTS.

LIGHTNING AND TALL BUILDINGS.

During the period of thunder-storms the people living in large cities are oppressed with a sense of dread at the brilliant flashes of lightning and deep reverberations that follow. Many that work in tall office buildings are frequently affected with a feeling of awe and occasionally with despair when the storm approaches a climax. Investigations will probably show that the majority of tall buildings built with steel frame-works are particularly exempt from the danger and destruction that are apt to follow upon the heels of a high potential discharge. There are reasons for this immunity from danger that are particularly interesting in the case of steel structures.

To begin with, a flash of lightning is a static discharge which may occur between two clouds, or a tall building and a cloud overhead. The presence of a charged body of vapor above inductively affects all bodies in its vicinity, the taller office buildings more than any other. It is just as probable, and in fact almost a certainty, that the discharge leaps from the tall office building into the cloud as much as the supposed downward thrust from the cloud above. A positively charged cloud will develop a strong negative charge in the building or buildings below; but however great the potential of this discharge may be, even if it be measured in millions of volts, those within enjoy the most perfect freedom from danger and are better protected as they are than in the fancied security of the ground floor of the ordinary old-fashioned structure.

Those who remember the experiments of Faraday as described by him will realize that a metal cylinder or cage will not, when charged even to a very high potential, show the least sign of electrical influence within. A tall building is no more and no less than a great steel cage, and a stroke of lightning would not, unless under the most extraordinary circumstances, possibly affect the interior, and cause within it the destruction so popularly feared. In fact, it is very likely, on account of the increasing number of steel structures in large cities, that storms of an electrical character do not assume the same rage and fury that they might if the buildings were not present.

A great deal of the impendiug charge is dissipated, that is, neutralized, by the leakage from tall buildings into the moist atmosphere. It would probably take a very severe storm and an unusual electric pressure to cause any evil effects; but if the severity of the storm is such as to cause actual damage, it would probably be found that the damage had been done by the discharge leaping from the framework of metal to some other point on the exterior of the building.

Protection in a steel structure is very great, possibly the best that could be practically imagined, but it is not an absolute safeguard in a scientific sense because a highly oscillatory discharge, occurring between the building and the cloud might, in the light of our present knowledge, leap from point to point through several air-gaps, choosing what is technically described as an "alternative path."

Yet, in general, a tall office building is like a huge lightning-rod of colossal proportion which will, in the majority of cases, form an efficient protecting shield to those working within its confines and trusting to its wholesome security. The fact must not be forgotten, however, that the discharge bursts from the building at as high a pressure as it is received from the aqueous mass above.

FOUR THOUSAND HORSE-POWER AT ELEVEN THOUSAND VOLTS.

The illumination of Buffalo by electricity generated at Niagara Falls marks an important epoch in the history of power transmission and electric lighting. The Buffalo General Electric Company have decided to equip a new station at Niagara, and with the power developed there oparate their lines in the city of Buffalo. It would be more exact to say that the Cataract Power and Conduit Company will supply current to the station, which will, with the aid of eleven static transformers raise the pressure to the desired point and send it over the line. Each transformer is of three hundred horse-power size or four thousand horse-power in total.

Eleven thousand volts will be received by them to be transformed down to three hundred and sixty-two volts. Two special cables will feed current to the transformers, each cable heavy enough to carry full load. When the three hundred and fifty-volt current is received, it will be spread among various machines to be supplied for either of the three purposes: high tension, direct currents for street lighting; low tension, direct current for small power motors, and high tension, alternating for inside arc lighting, etc.

The new plant will therefore be made large enough to contain twelve two hundred and fifty-light units, in addition to some frequency changers. The functions of these large machines will be that of changing the current received from twenty-five cycles a minute to sixty-two and a half cycles a second. The frequency changer may be understood as being merely a motor generator, which, receiving power, operates a motor and thereby rotates the armature of an alternator to which it is directly connected. The various features of this highly interesting lighting, power and transmission plant represent the direct application of the most modern engineering appliances, as well as a degree of enterprise that speaks well for the directors of the Buffalo General Electric Company.

aided by the burrowing of insects rapidly weakens the structure. A pole when wet falls quite considerably in resistance. As a rule the comparison is made between the resistance of the pole and that of the insulator and arm.

$$\frac{\text{resistance of pole}}{\text{resistance of arm} + \text{resistance of insulator.}}$$

This expresses the ratio between the two in a simple manner.

Cross-arms.—When the cross-arms of a pole are dry the resistance is about 100,000 ohms, but when wet this may fall as low as 4,000 ohms.

If left exposed to the air without even a coat of paint, the fall in resistance is very noticeable. The least resistance a cross-arm will have is about 1,000 ohms, that has not been absolutely soaked in water.

Treating the poles and arms to a preparation that does not absorb moisture would enhance the excellence of them as insulators quite considerably. The supporting power of a pole and its resistance in ohms are two entirely different and unproportionate qualifications, though they may bear a slight relation to each other.

Insulators.—The common form of insulator for line use is the single petticoat glass insulator so familiar to all. This is not a very excellent device for the purpose, as it is hygroscopic and brittle; but its cheapness and convenience make it a most popular article of use. The floating dust and begriming smoke soon impair their insulating property in the city or its suburbs. The maximum resistance per mile is about 60,000 to 100,000 ohms, depending upon the humidity of the air and their cleanliness. This may fall as low as 25,000 ohms per mile, if damp and dirty.

Varley, in his report to the Western Union Telegraph Company, states that the cleansing of insulators almost triples their resistance.

The improvement of a line depends greatly upon the insulators used, German porcelain are about the best. The glass insulator is about 5 megohms in resistance, while German porcelain insulators are over 15 and sometimes 20 megohms in resistance (1 megohm = 1,000,000 ohms). It is generally cheaper to improve the insulation of the line than to use a copper line. It costs about four times as much to increase the conductivity by the use of copper as to use new insulators of high resistance.

The ratio between the conductivity of the line and that of the insulators is 1 : 10,000 with a No. 9 iron wire (Pope) of 15 ohms per mile, mounted on glass insulators of 4.5 megohms a piece, and 30 poles to the mile. This is generally about the average condition of a line, and any increase in this ratio means a gain in current.

QUESTIONS FOR REVIEW.

(1) What is a line?

(2) What difference exists between an insulator and conductor?

(3) State the causes of leaks.

(4) Why do insulators cause leakage?

(5) How is a ground return made?

(6) What preparation is used to protect posts?

(7) By what means is the resistance of insulators increased?

(8) What causes a depreciation in the resistance of insulators?

THE REVOLUTION IN POWER ENGINES.

It is well known that the steam-engine after its inestimable work during the past century and with the improvements it has undergone during recent years, is still an incorrigibly wasteful and imperfect motor. Not only does it utilize but a very small percentage of the energy stored in the fuel which it consumes, but it also becomes burdensome through its inseparable companions, smoke and soot.

With the discovery of any new motor it was expected that the smoke-stacks would be doomed; many expected this when the first electrical motor was introduced, but alas, the steam engines and smoke-stacks became still more evident instead, as the generation of electricity depends yet to a great extent on steam power.

A recent invention by R. Diesel, Munich, who has been working on the problem for the last fifteen years, claims to create a complete revolution in the production of power—a revolution such as has probably not been experienced before in human history. Diesel's caloric motor, which is no longer an experimeut but an established commercial factor, pretends to nothing less than to finally supersede the steam-engine.

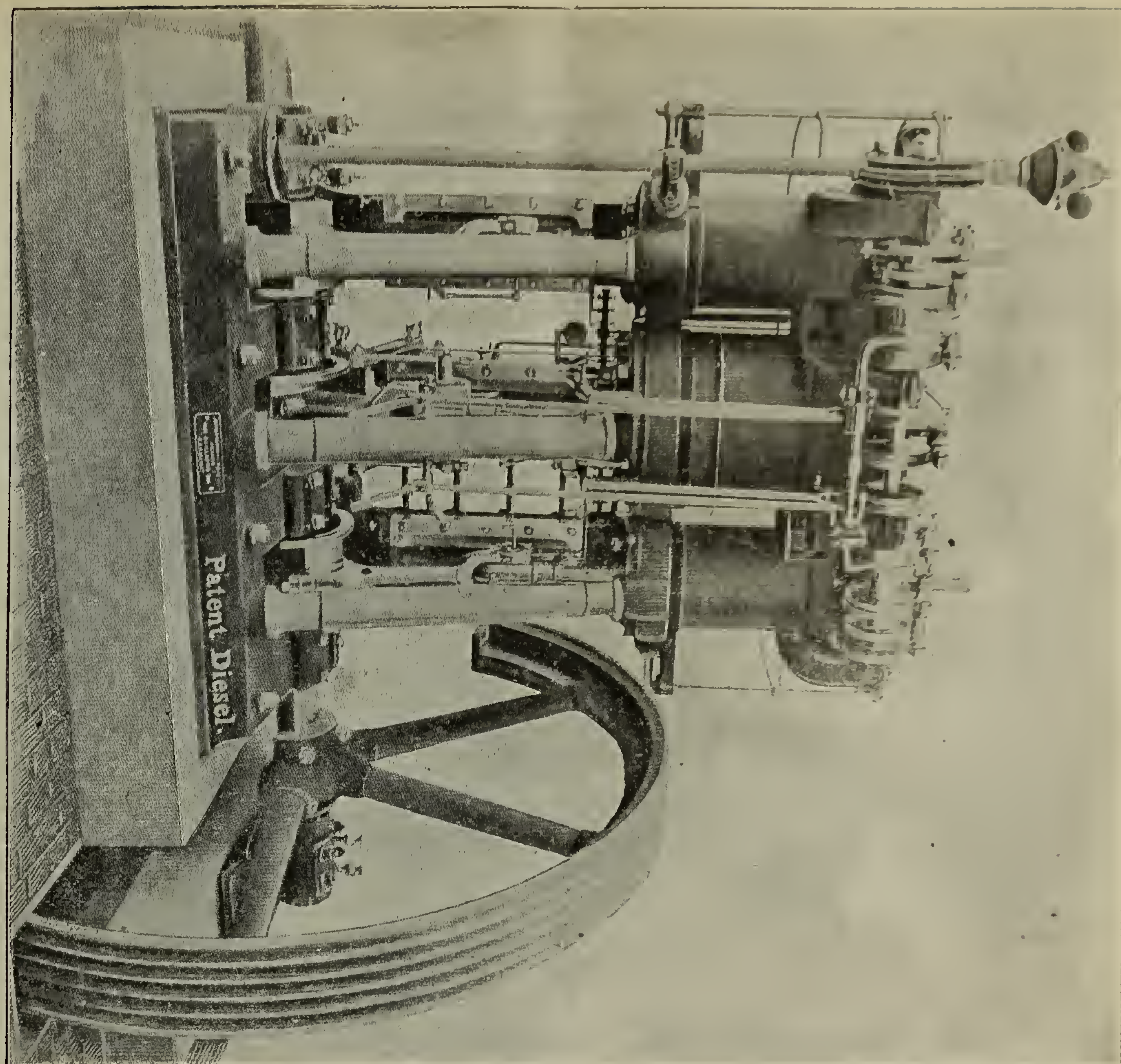
As aforesaid, the steam-engine, to say the least, is not an ideal machine, and there is no prospect that it can be much more improved in the future, since from a scientific standpoint, the method on which it acts has inherent faults beyond the control of the mechanic.

To erect and equip one of our modern marine engines for a large steamer or man-of-war requires an iron mine; to operate it, a coal mine.

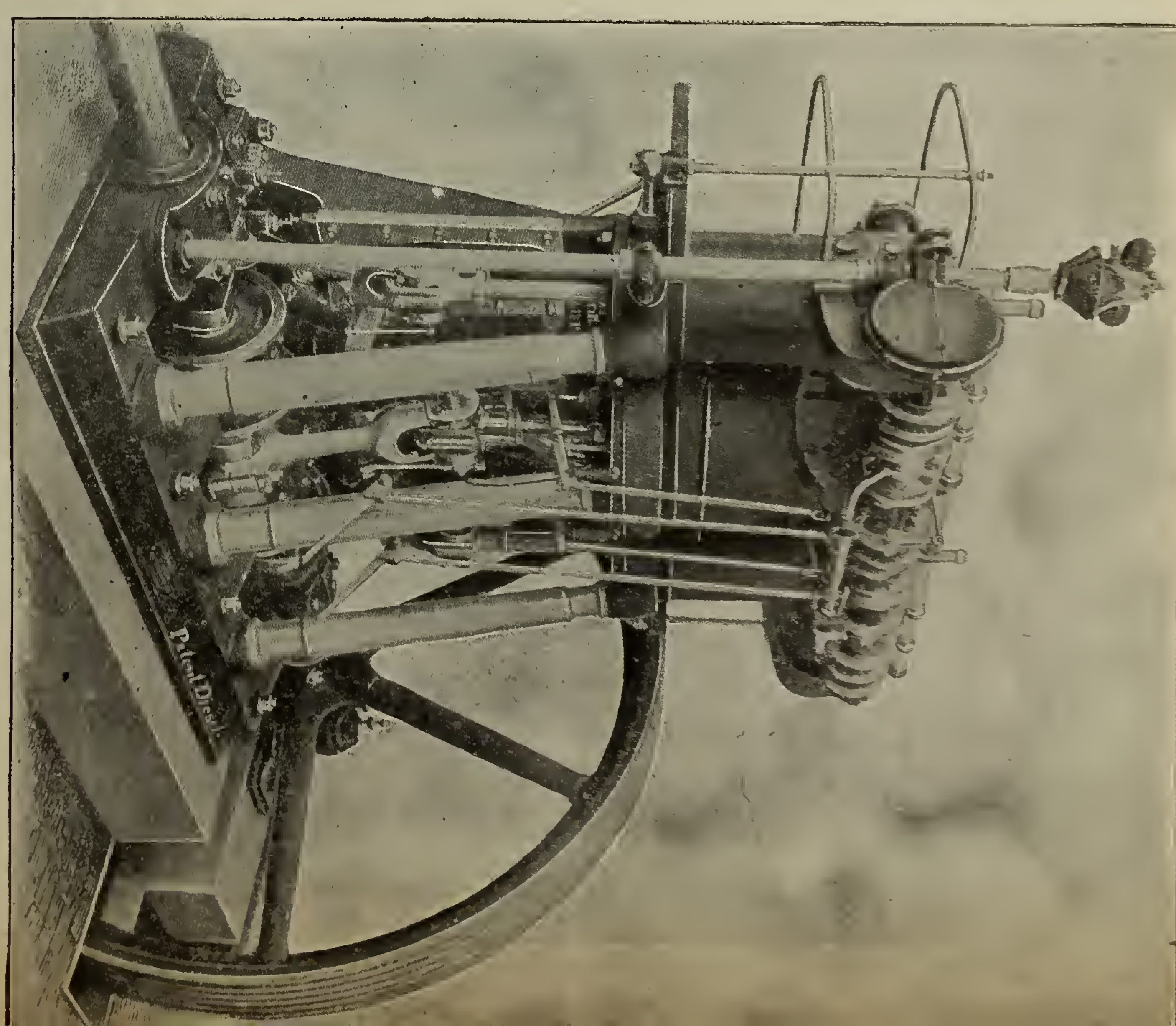
It will astonish a great many people to learn that one of our ordinary high-pressure steam engines utilizes only four per cent. of the energy stored in the coal consumed, a Corliss engine of the best modern type may reach eight per cent. while a triple expansion engine of 1,000 H. P. or more, with condenser and perfected cut-off, does not surpass 12 to 13 per cent. as the maximum achievement of the best steam-engine at its present state of development. The question naturally arises, what becomes of the remaining 87 per cent. to 96 per cent. of the coal consumed? In the first instance, 20 to 25 per cent. are partly lost in the furnace and partly in creating draft in the smoke-stack, incidentally also causing the smoke nuisance which is becoming more annoying from day to day, especially in large cities, and against which the boards of health are powerless. The remaining 70 per cent. are lost through radiation at every point and by the costly evaporation of water, for, while the heat created under the boiler may reach 2,500 to 3,000 deg. F., the steam created will, at the very highest pressure used, have a temperature of only 390 deg F., which means a dead loss by conversion and recondensation of two-thirds of the heat, leaving available for work only 24 to 26 per cent. To improve upon this the inventor of the Diesel motor conceived the following plan: Pure air is compressed in the cylinder of this motor, thus generating a temperature of about 600 deg. C. The fuel to be used, such as gas, petroleum or powdered coal is thereafter injected into the compressed air where it is gradually and completely burned up at a much lower temperature than ever before accomplished. During combustion and during the sncceeding expansion, it is entirely turned into work. The injection and combustion of the fuel takes place as the piston in the cylinder begins its return stroke. It ceases when it has reached about one-eighth or one-sixteenth of its way back, and it is so regulated that the increase in the temperature created by the compression ef the air and subsequent combustion of the fuel, is reduced by the cooling off due to the work done during the succeeding expansion.

Thus, practically, there is no increase in sensible heat since the heat caused by the combustion of the fuel is immediately turned into power and the motive power thus gained is only reduced by the small amount required for the compression of the air.

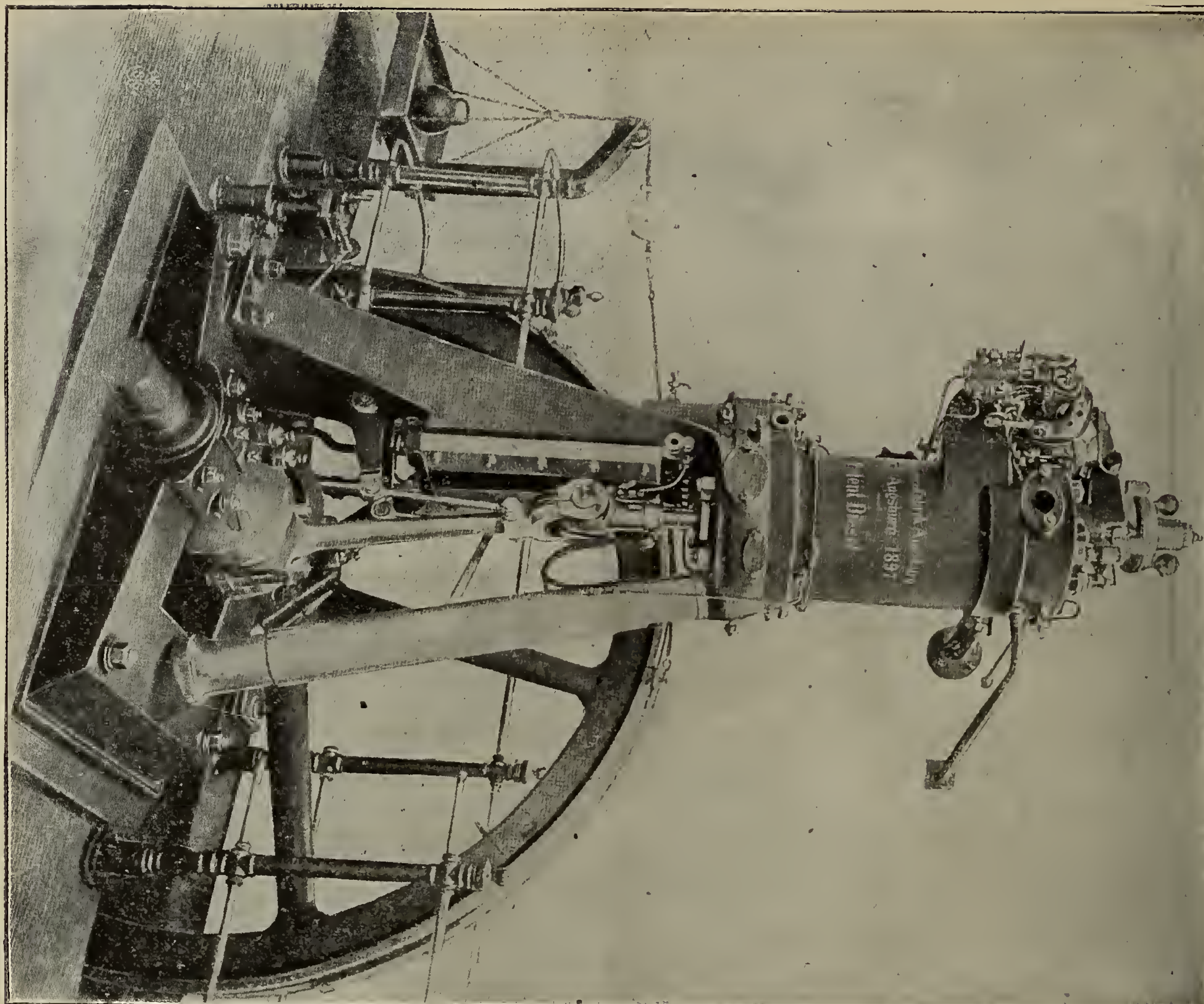
The practical operation of the Diesel motor during nine months shows that it can turn 26 per cent. of the heat units of the fuel consumed into mechanical power, which means an effect of 200 per cent. compared with the best steam-engine and 150 per cent. compared with the best gas and



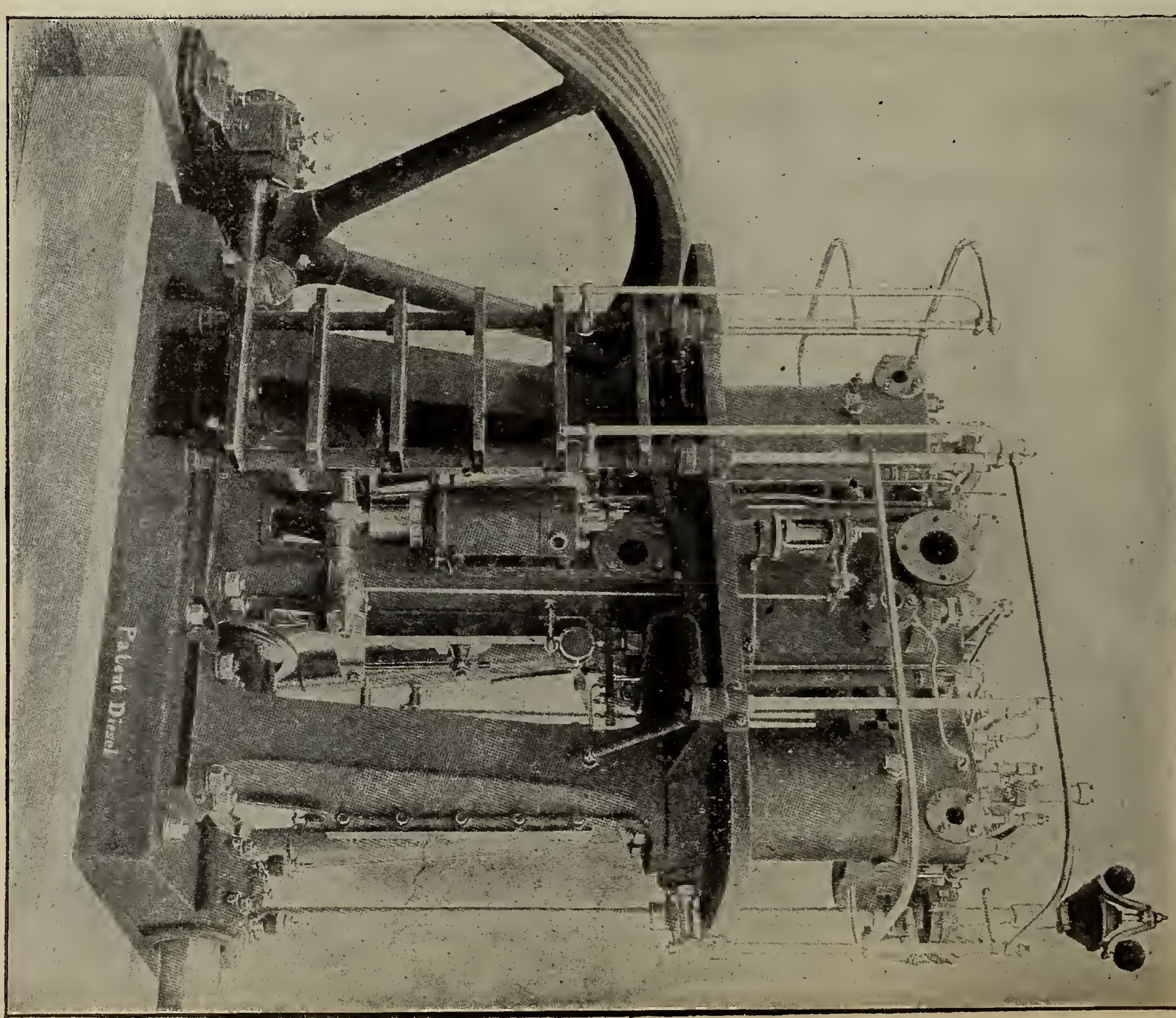
Three-Cylinder 150 Horse-Power Diesel Motor. Front View.



Three Cylinder 150 Horse-Power Diesel Motor in Perspective.



Single Cylinder 20 Horse-Power Diesel Motor.



Three Cylinder 150 Horse-Power Diesel Motor. Rear View.

oil engines. But other features of this remarkable motor, which has met the fundamental requirements of a perfect heat motor to a degree not hitherto attained by any other device, are not less important.

The Diesel motor will work with nearly equal economy at half as at full load, and in this it therefore excels even the best steam engines.

The construction of the Diesel motor is much simpler and therefore subject to less repairs, as, in comparison with the ordinary gas or oil engines, no igniter, gas atomizer or mixer is necessary, while compared with steam engines, no boiler, condenser or coal bunkers are required, an advantage which can hardly be over-estimated in steamship building.

The injection and combustion of the fuel can be regulated automatically according to the power required, and changes in the load of the motor are governed to a nicety.

The motor can be set to work without loss of time, since once operated it is again started by simply opening a valve admitting the stored compressed air into the cylinder. It runs almost noiselessly and without shock or jar, and in this differs materially from the best existing gas or oil engines.

The interior parts will not soil, as the fuel used is completely consumed, which is shown not only by a chemical analysis of the waste gases, but also by their absolutely odorless escape into the air.

Thus far the fuel used has been mainly petroleum, but it has been demonstrated that common illuminating gas is a perfect material for this purpose, and the use of producer gas at American prices would, it is estimated, furnish power at one-half the cost of the steam generated with coal.

Expert commissions from all civilized countries, including Japan and Australia, have been sent to Augsburg, where the motor has been in actual operation for fully a year, and their unanimous testimony gives the general verdict that its advent must be hailed as the beginning of a new chapter in the application of heat as motive power. The motor has been examined and warmly approved by the great scientists, among them by Lord Kelvin of Great Britain. It is expected that the suppression of boilers, coal bunkers and condensers, will revolutionize the machinery of torpedo boats and sea-going vessels.

At Nuremberg, Diesel's motors are being built at present for street cars and general railroad work.

Mirrlees, Watson & Yaryan, the world-renowned marine engine builders of Glasgow, are building reversible engines on the Diesel system, while European locomotive works are adapting the system for locomotives.

The Diesel motor has been patented in all countries where patents are granted for inventions, and the rights for United States and Canada have been acquired by a company since incorporated under the laws of New York State as the "Diesel Motor Company of America," with offices at No. 11 Broadway, N. Y.

THE GAS ENGINE IN ELECTRIC LIGHTING.

The late Mr. Denny Lane, of Cork, had a great idea o the future of the gas engine in connection with electric light installations, and believed that electricity could be generated in a comparatively small station in the immediate vicinity at a cheaper rate than it could be furnished from a central generating station at a distance. Or, in other words, that a moderately large user could supply himself with electricity at a cheaper rate than he could purchase it from a corporation or company. Mr. Lane went so far as to advise gas companies to take up the question of electricity supply by means of a comparatively large number of generating stations, say one in each street, using gas engines as a source of power. Unfortunately for the success of his plan, at that time gas engines were costly in the first place, and the running was not sufficiently steady.

I know of several small installations, using engines of three horse-power to fourteen horse-power nominal, that have been running for years with satisfactory results to the owners. But it is difficult to get sufficient data, either as to the cost of electricity per unit, or as to the actual lighting value obtained, to admit of a full comparative statement being prepared, so it is not possible to say accurately whether the gas engine, dynamo and electric plant are capable of developing a larger lighting value per cubic foot of gas used than would be obtainable by the direct agency of incandescent burners. Allowing that 20 cubic feet of gas are used per horse-power, and accepting the usual estimate that one horse-power is sufficient to supply 10 nominal 16-candle power lamps we get a duty of about eight candles per cubic foot of gas, or less than half that claimed for the incandescent burner. So that unless there are other special advantages it would appear that the latter system is by far the cheaper. A decided advance has, however, been noticeable in the introduction of gas engines specially suited for the generation of electricity. An installation of this kind at the Leicester railway station, belonging to the Midland Railway Company, includes six gas engines, four of 90 horsepower each and two of 50 horsepower. And the cost of the electricity produced is said to compare favorably with that at other stations belonging to the company where steam engines are used. The great advantages of the gas engine for this purpose is the fact that it can be stopped and started instantaneously without loss of time and expense in getting up steam, there is absolutely no working expense while it is lying idle and the consumption of fuel is proportioned to the actual power used.—English correspondence American Gas Light Journal.

A 108-MILE ELECTRIC TRANSMISSION PLANT is under consideration in Southern California. The undertaking involves the erection of a dam across the Kern river, in Kern county, Cal., and the construction of a line to convey the high-tension current to Los Angeles. The Kern river drains an area of some 2,345 square miles, and a total of about 12,000 horse-power can be obtained. A pressure of 30,000 volts is proposed for transmission. While this is exceptionally high, the dry atmosphere and infrequent rainfalls warrant its adoption. The dam already mentioned will form a storage reservoir, with a volume of about 13,721,400,000 gallons, or the equivalent of 42,000 acre-feet. Should the project be carried out, it would be by far the longest electric-power transmission line in the world.—Mfrs. Gazette.

NEW ELECTRICAL CORPORATIONS.

Merced, Cal.—Merced Falls Electric Co. has been incorporated by James G. Ruddle, E. D. N. Lehe, James T. Peck, J. D. Bradley and C. E. Green. Capital stock, $100,000.

Streator, Ill.—La Salle County Railway Co. has been incorporated by C. E. Rathbunn, W. H. Boys, W. H. Holcomb, to build and operate a street railway in the counties of Cook, La Salle, Grundy, Will, Kendall, Kane and Dupage. Capital stock, $500,000.

Pueblo, Col.—The Colorado Telephone Co. is about to erect a $10,000 building at Pueblo, and will complete its line from Pueblo to La Junta this year.

Belmont, Ill.—Belmont Gas and Electric Fixture Manufacturing Co. has been incorporated by S. H. Ales and Richard E. Burke, for manufacturing purposes. Capital stock, $2,500.

New York, N. Y. — The Knickerbocker Telephone and Telegraph Co. has been incorporated to operate a telephone and telegraph system. Capital stock, $7,500,000.

Bronxville, N. Y. — Ward Leonard Electric Co. has been incorporated by H. Ward Leonard, Charles E. Carpenter, Richard H. Mansfield, Jr., and Henry P. Bull, to manufacture electrical appliances. Capital stock, $100,000.

West Superior, Wis.—City Clerk may give information about new lighting plant.

Seguin, Tex. — The electric-light plant will probably be owned by the city.

Buffalo, N. Y.—The Buffalo Telephone Co. has been incorporated by G. K. Birge, D. N. Lockwood, L. B. Crocker, W. H. Kinch, James Kennedy, William B. Hoyt and R. J. Getz, to operate a telephone system in Western New York, Pennsylvania and Ohio. Capital stock, $500,000.

Thomasville, Ala.—The Noble gin plant has been purchased by W. I. Waller, of Nicholas, Ala., who will install an electric light plant.

Cumberland, Md. — The Maryland, Pennsylvania & West Virginia Telephone Co. has obtained franchise for telephone system, etc.

Cumberland, Md.—The Ambos Construction & Electric Co., of Cleveland, has been awarded contract for the erection of the $34,000 electric light plant at Cumberland, Md.

Ludington, Mich.—The Mason Telephone Pay Station Co. has been incorporated with a capital stock of $10,000.

Hagerstown, Md.—Powell Evans will construct a dam across the Potomac river near Hagerstown, for the development of water-power, and to erect an electric plant for transmission of power to factories, etc.

St. Louis, Mo.—The Mississipi Valley Electrical & Manufacturing Co. has been incorporated by D. H. Lohse, Edward Buder, A. F. Ittner, and Eugene Buder. Capital stock, $100,000.

Cape Girardeau, Mo.—The Jackson Telephone Co. has been incorporated by Samuel Hitt and others. Capital stock, $2,500.

Trenton, Mo.—The Trenton Light & Power Co. has been incorporated by C. O. Hoffman, E. M. Harber, W. O. Garvin and others. Capital stock, $30,000.

St. Louis, Mo.—The Moe & De Voll Incandescent Gas Co. has been incorporated by T. M. Moe, C. H. De Voll and H. E. Green. Capital stock, $250,000.

Bamberg, S. C.—The Mayor may be addressed concerning electric-light plant.

Dayton, Tenn.—Town Clerk may give information concerning establishment of plant for electric lighting.

Mt. Pleasant, Tenn.—Ambrose Lanier can give information concerning organization of company to install an electric-light plant.

Winchester, Tenn.—S. M. Alexander, M. N. Whitaker and George E. Banks are endeavoring to form a company to establish a telephone system.

ELECTRIC HEADLIGHTS.

The master mechanic of the Norfolk and Western Railroad put himself on record recently as being against the electric headlight for locomotives, because, as he asserted, the rays of the light were so strong that it was impossible to distinguish the color of the signal lamps. This statement was promptly challenged by the president of one of the electric headlight companies, and disproved in an actual test at Indianapolis, which was witnessed by several railroad officials.

Many locomotive engineers, however, strenuously object to the electric headlight on another ground—that "running against" it is very dangerous. That is, the stream of light from an approaching locomotive is so powerful that it is practically blinding, and the engineer who faces it cannot tell how far away the approaching locomotive is, or whether it is moving or stationary. Persons who have happened to face a searchlight will appreciate this objection, which becomes especially cogent in the case of single-track railroads.—Tradesman.

The most important use to which aluminum will be put will be for culinary and household utensils, it being practically incorrodible. It is free from every form of poison and will not taint food; it is light to handle, and is a better conductor of heat than other metals. The recent announcement that contracts had been signed for the delivery in England of 1,000 tons of crude aluminum of American manufacture, makes prominent the fact that this remarkably useful metal is now being produced in this country in large and constantly increasing quantities.

Ten years ago no pure aluminum was manufactured in the United States, and in Europe it was produced at a cost that rendered it valueless to the mechanical world. Today it is the rival, and the successful rival, of both copper and steel. In 1896 the United States alone produced 1,300,000 pounds of the crude metal, a third of the total output of the world. In 1886 the market price of the metal was $1 an ounce; today it is less than 50 cents a pound.

Aluminum is an exceedingly abundant element in nature. It is obtained in the form of an oxide of bauxite, of which there are large deposits in this country.—Power and Transmission.

THE SAFETY INSULATED WIRE AND CABLE Co., mfrs. of Seamless Insulated Wire and Cables, of 229 West 28th street, N. Y., have issued a new catalogue of their unrivalled goods. The catalogue is very handsome, and contains illustrations of plants using Safety wire as well as testimonials from prominent concerns. It is beautifully printed and is well worth preserving.

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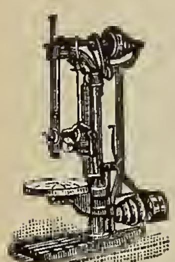

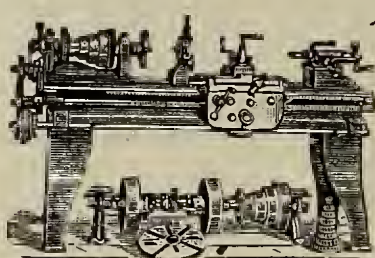

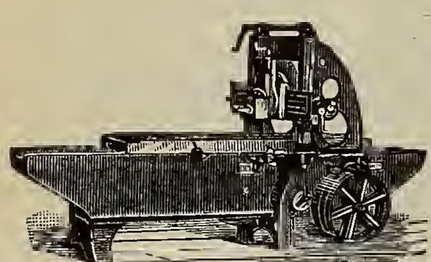

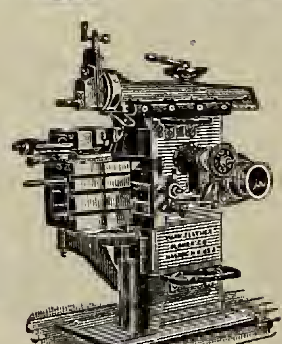

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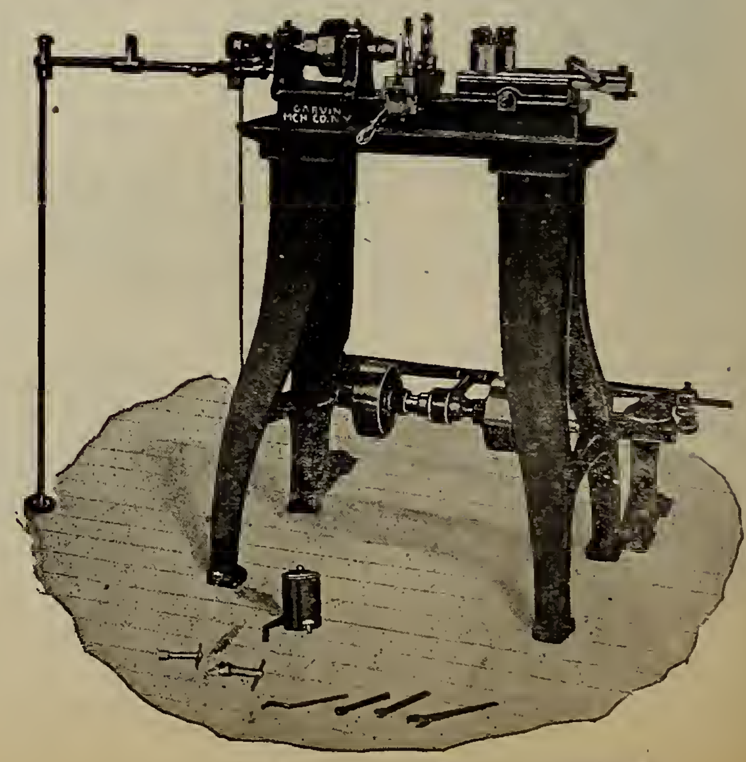
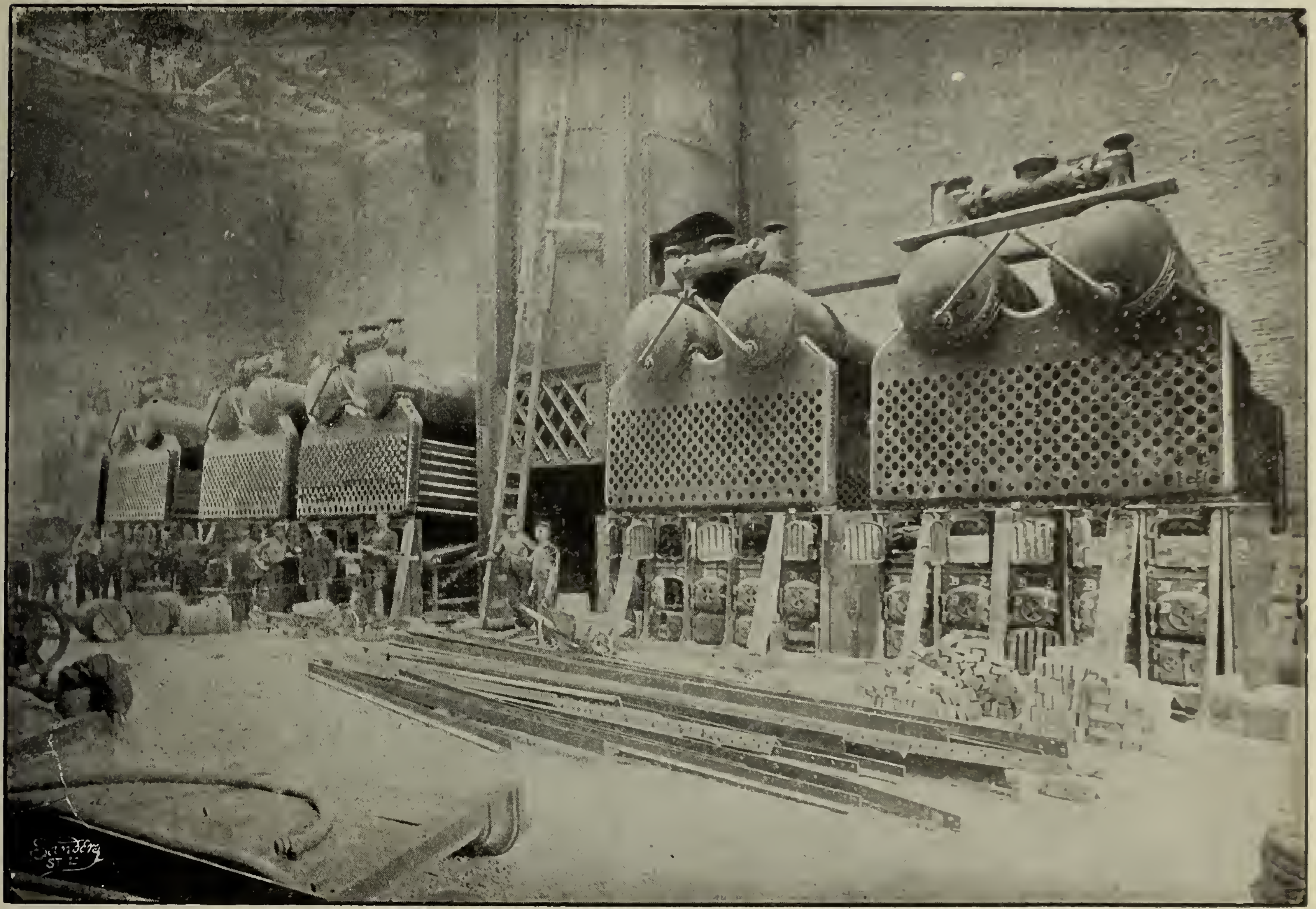


No. 00 SCREW MACHINE (WIRE FEED).

The Electrical Age.

Vol. XXI—No. 10 NEW YORK, MARCH 5, 1898 Whole No. 564



The Edison Company's Electric Light Plant. Installing the Down-Draft Furnace.

THE SMOKE PROBLEM.

The problem of burning any grade of bituminous coal and at the same time prevent the emission of soft-coal smoke from the chimneys, as required by the Sanitary Code, has often been brought to our attention by large steam plants where economy of fuel is the great consideration.

After a thorough and systematic investigation of the subject we find that there seems to be no device that will consume soft-coal smoke which has once been formed, or rather that soft-coal smoke, after it once escapes from the burning coals, cannot be consumed, consequently, to obtain the benefits and advantages of soft coal, and at the same time escape the evils of soft-coal smoke, the gases from the coal must necessarily be ignited and burned completely before the constituent elements which compose the smoke are formed.

The down-draft system of burning coals seems to be the only method known at the present time whereby the combustion can be made complete enough to prevent the creation or formation of smoke, and thereby make the burning of bituminous or soft coal practically smokeless.

After the inspection of a number of so-called "smoke consumers" our attention was called to a system in use in the Government Buildings.

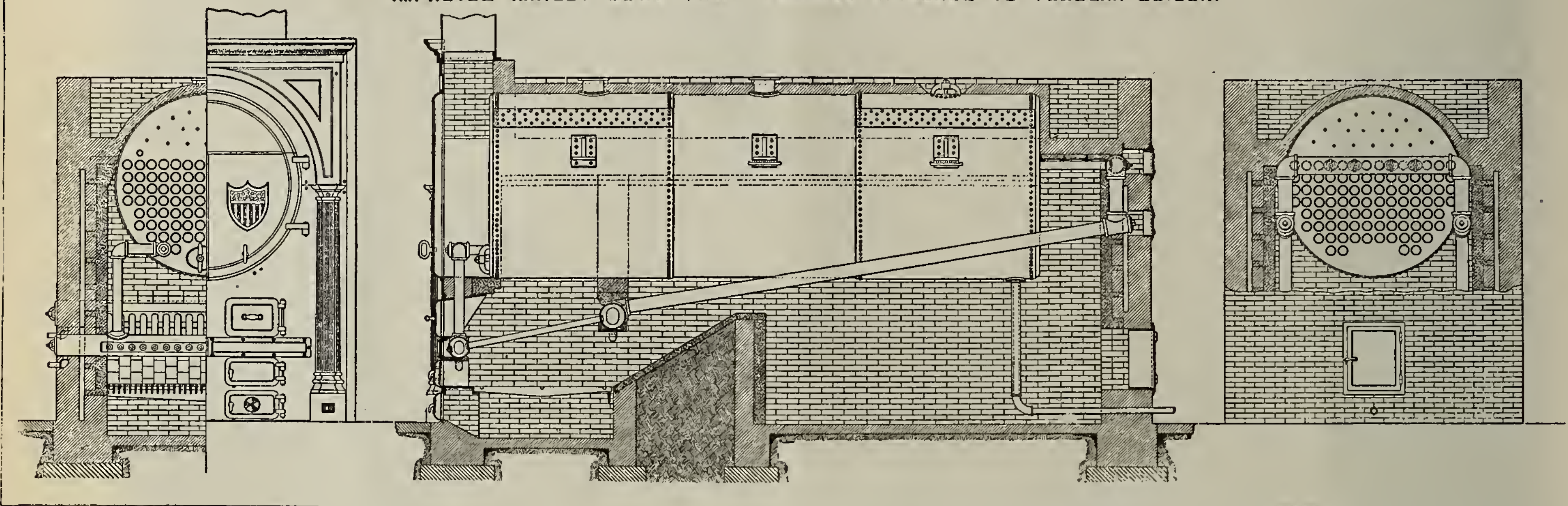
We visited the principal Federal Buildings in New York and in other cities where the suppression of smoke is a compulsion.

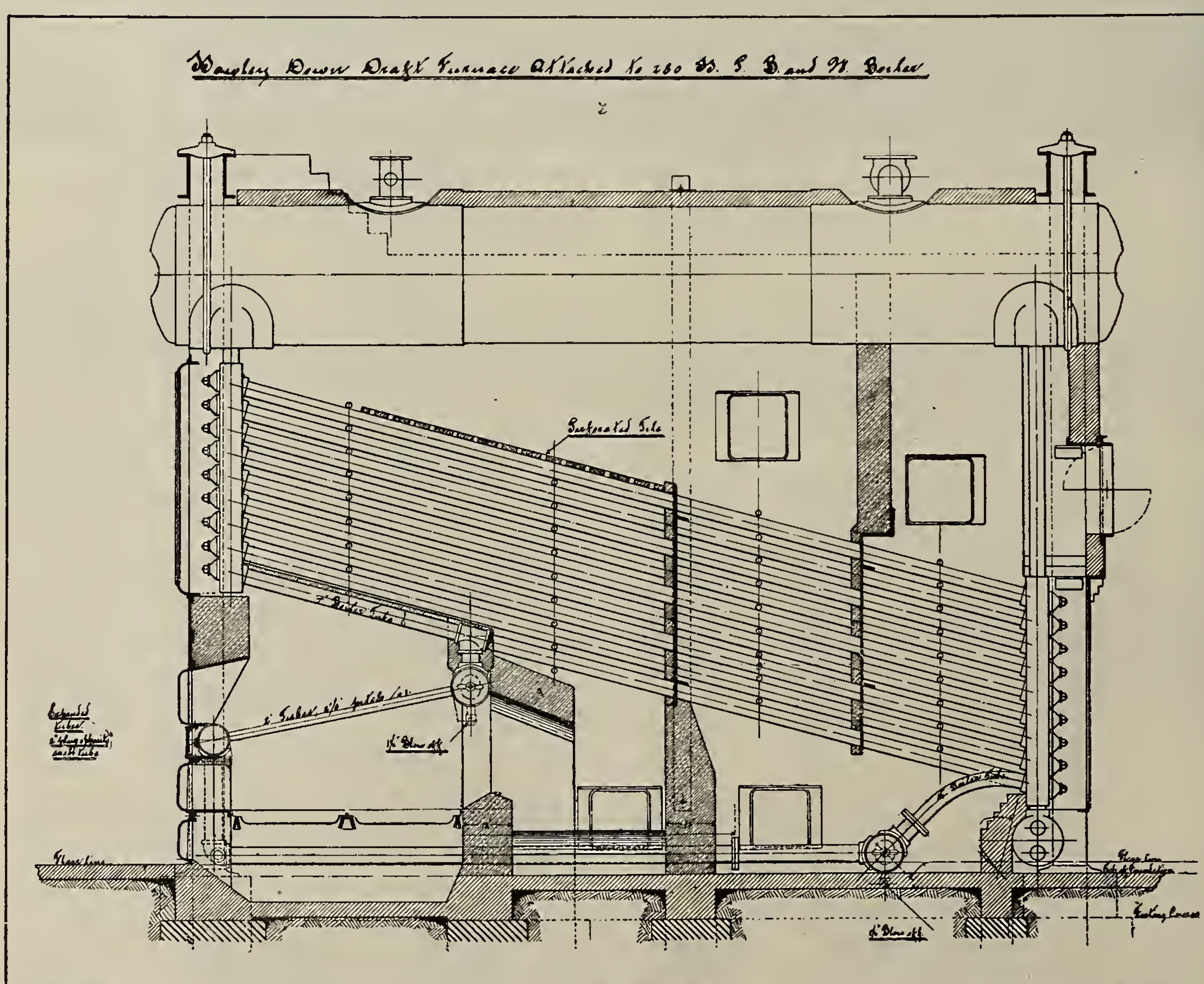
Our first visit was to the General Post-office, Broadway and Park Row. There we found eight horizontal fire-tube boilers equipped with a device known as the "Hawley down-draft furnace."

When we saw that they were burning soft coal we watched the chimneys for almost an hour. During that time we saw no emission of smoke, except once, when a light vapor, which might have been taken for a puff of steam, came from one of the chimneys and almost immediately disappeared. We then proceeded to inspect this furnace. Upon inspection we found it to consist of an inclined water grate composed of two steel drums about ten inches in diameter, one in the front and one in the back of the grate, their ends extending into and resting in the brick walls on both sides. These drums are connected by a staggered row of water tubes opening at both ends into them. The water grate is connected with the boiler by two water legs, one from the front and one from the back drum, so as to afford a full circulation of boiler water through the grate. Opposite the tubes in the front drum are openings with brass plugs in them, which can easily be removed for cleaning and inspection. About fifteen inches below the water grate is an ordinary cast iron grate. The front of the furnace has three tiers of doors; the upper tier, through which the coal is fed, has two sets of hinges. The space between the back drum and the bottom of the boiler is closed by fire brick, thus forcing the current of air or draft down through the water gate, thereby causing the gases from the coals to pass through a bed of fire, which appeared to us an incandescent mass of about six or eight inches in depth.

We then looked through the middle doors into the combustion chamber and saw a clear flame coming down through the upper grate, passing under the back drum along the bottom of the boiler and back through the

IMPROVED HAWLEY DOWN DRAFT FURNACE ATTACHED TO TUBULAR BOILER.





tubes in the usual way. Our informant told us that the smoke is prevented by the gases being ignited in passing through this incandescent mass of hot coals.

We then visited the United States Custom House on Wall street, where we found four Horizontal Fire Tube boilers also equipped with this system and the results the same. On further inquiry we learn that the "Hawley Down Draft" is very well known, and that there are over 4,000 in operation in the United States and Europe. Besides those in use in the principal government buildings we find them also in operation in nearly all the principal water works plants in the United States, and in nearly all of the largest breweries. Those we have communicated with have made most favorable comments, principally as to the material saving in fuel, which seems to be the main object.

The cuts show the water grate and how it is connected with various types of steam boilers.

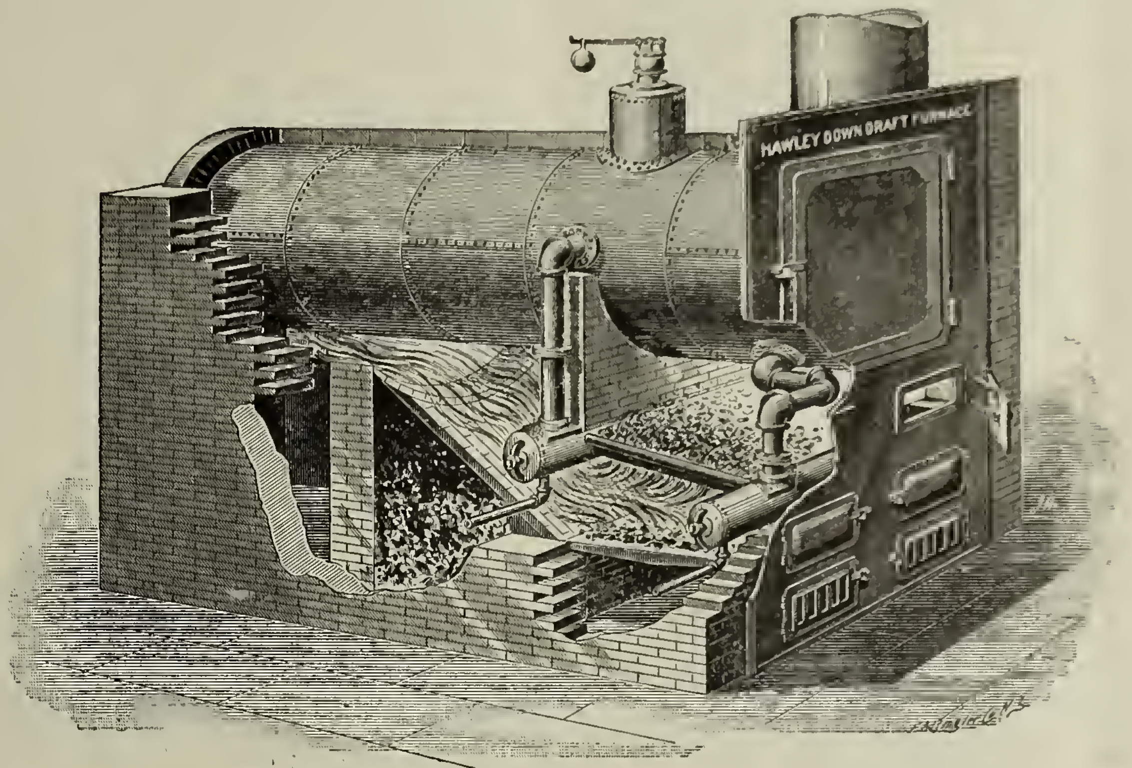
THE ELECTRICAL EXHIBITS AT THE TRANS-MISSISSIPPI EXPOSITION.

The progress made in electrical science as applied to the uses of commerce, industry, mechanics and the household, will be demonstrated at the Trans-Mississippi and International Exposition. The electrical section promises fully to exemplify the advancement of electrical science, and reveal the highest achievements of discovery yet attained by the genius of invention.

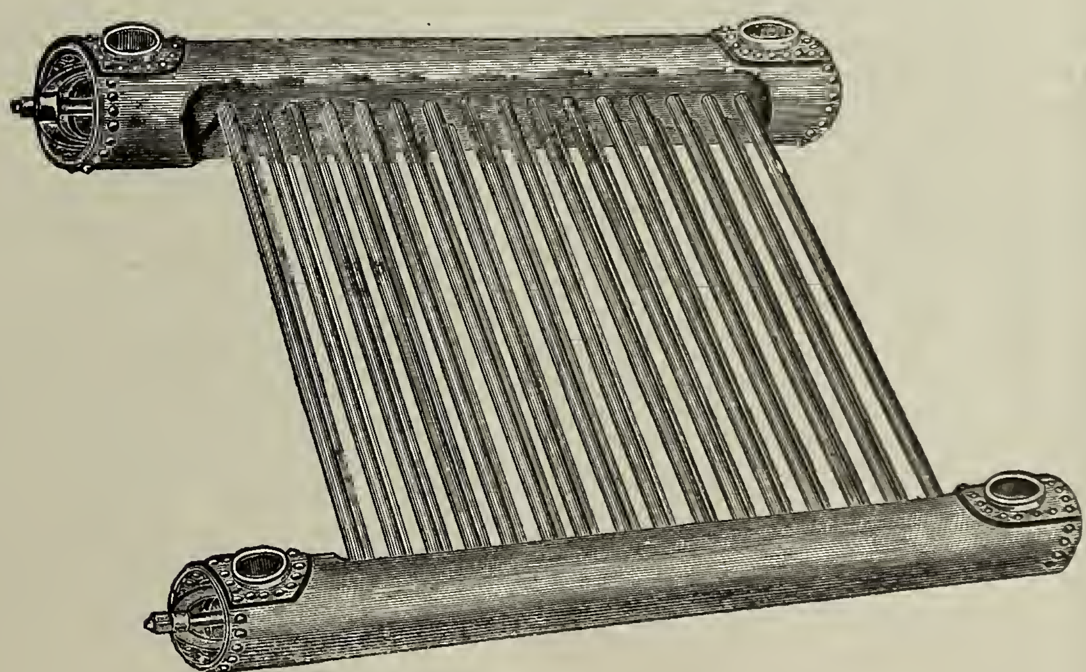
The importance of an exhibition at the Trans-Mississippi Exposition which would combine and practically demonstrate the latest applied uses of electricity was early suggested by the exposition management, which finally led to the creation of a bureau of electricity; Prof. R. B. Owens, of the Nebraska State University, director. The applications for space in this section now on file indicate that the field of electrical science will be of rare and wide-reaching interest.

THE INVENTIVE GENIUS OF THOMAS ALVA EDISON, the famed wizard of the electrical world, will be shown by a strictly "Edisonian exhibit," now being prepared in his laboratory at Orange, N. J., expressly for the Trans-Mississippi Exposition.

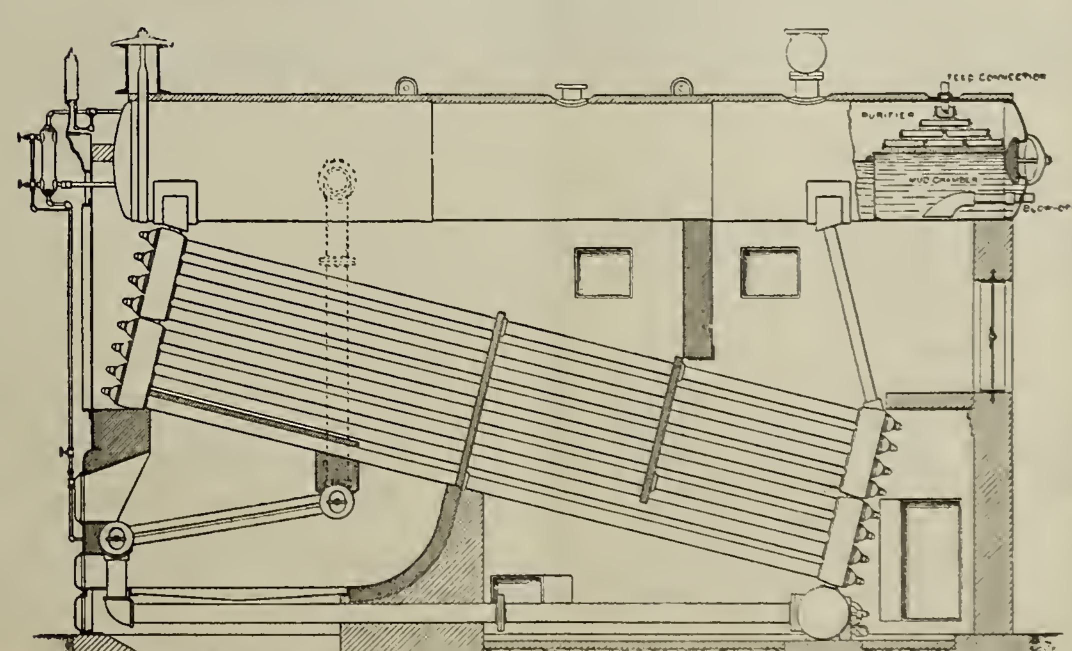
THE SYSTEM OF VACUUM TUBE LIGHTING will be demonstrated for use of collieries and other workings comparatively free from explosive gas. While electricity is a source of heat, this is the nearest approach to the solution of the problem of light without heat.



Showing Combustion in the Hawley Down-Draft Furnace.



The Hawley Water Grate.



Hawley Down-Draft Furnace Attached to Root Boiler.

LIEUT. GEORGE OWEN SQUIER, of the United States army, instructor of military telegraphy and electricity at Fortress Monroe, will exhibit his wonderful syncronograph, the new rapid telegraph system invented by Prof. Albert Cushing Crehore, assistant professor of physics at Dartmouth College, and Lieutenant Squier of the War Department. This invention was successfully tested by the inventors on the lines of the British government during the summer of 1897, a distance of 1,097 miles, the rate of speed attained by the syncronograph being three times faster than was indicated by the Wheatstone receiver and transmitter on any line. By the aid of the syncronograph the operator can transmit the contents of an ordinary newspaper inside of an hour's time. Lieutenant Squier will also demonstrate the workings of another of his inventions known as the synocronoscope, intended for the measurement of the velocity of projectiles.

ALL THE RECENTLY DISCOVERED APPLIANCES for use of the army will be shown and illustrated in a practical manner and also the system of military telephones which is calculated to aid the commanding general who directs the operations of an army corps in a future battle. By means of this apparatus, which has been perfected by Captain James Allen of the Signal corps, under the direction of General A. W. Greely, it will be possible to string a line of wire from point to point of an army's communications, and use the same wire for both telephoning and telegraphing.

NICOLA TESLA WILL EXHIBIT the results of several of his latest experiments in electrical science upon which he is now engaged. The abolition of the induction coil for the production of the Roentgen rays will afford ample scope for the exhibition of Mr. Tesla's new electrical oscillator, based upon a discovery made by him several years ago. Diagrams and designs will also be exhibited showing how the Roentgen rays are formed, photographs of wounded soldiers, taken at the seat of the Greek war, an exhibit showing the relation between the atomic weights of metals and their absorptive power, showing that some subtle connection remains to be discovered; a series of zoological subjects, an instrument for photographing solid bodies from two different points of view, which gives the location of the imbedded substance with millimetrical accuracy, together with special tubes, screens and outfits.

TELEGRAPHING AT SEA WITHOUT WIRES will be practically demonstrated by means of the apparatus of young Guzlielmo Marconi, the Italian electrician, who claims to be the inventor of the wireless telegraphy. The singular feature of this method of telegraphing is shown by a wire extended vertically in the air, connected to a radiator on the ground. Messages without wires have been sent a distance of twelve miles to a ship at sea. By simply increasing the height of the vertical wire the influence of the machine can be extended over a distance augmenting in a geometrical ratio to the increased height of the wire. The discovery is yet in its infancy, but it is believed that when completed it will revolutionize present day dispatching and prove of inestimable value.

THE THIRD RAIL SYSTEM, the invention of Captain J. M. Murphy, of Connecticut, will be exemplified by a working exhibit consisting of a line of railway 137 feet in length. By means of a third rail more safety in electric railroad and trolley travel is said to be assured. Cars operated by this system can be reversed under full headway, even on grades and curves, or they may be stopped within one-half of their length. It is entirely feasible under this system to attain a speed of a mile a minute, or sixty miles an hour. The cars in this system carry beneath the seats a series of small storage batteries supplied from the feed current. The cars are heated and lighted from the electricity thus stored.

A system for alternating the current of street railway motors will be shown.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 122d Meeting of the Institute was held at 12 West 31st street, February 23, and was called to order by President Crocker, at 8:30 p. m. About seventy-five members and guests were present. A paper on the "Single Phase Induction Motor" was read by Mr. Steinmetz and was discussed by Prof. W. S. Franklin, Dr. A. E. Kennelly, Messrs. E. E. Ries, Townsend, Wolcott and others.

At the meeting of the Executive Committee, in the afternoon, the following Associate Members were elected:

Frank Broili, electrical engineer, California Elec. Works; residence 823 Geary street, San Francisco, Cal.

Samuel Byington Libby, supt. N. Y. & S. I. Electric Co., West New Brighton, N. Y.

Otto T. Louis, manager of New York Branch, Queen & Co. inc.; residence, 340 East 119th street, New York City.

James A. Mortland, Prof. of Physics, Faculty State Normal School, 2502 Walnut street, Cedar Falls, Iowa.

Charles H. Schum, electrical engineer, Ideal Electric Corps, 216 Third avenue, New York City.

C. E. Sedgwick, agent at San Francisco office, General Electric Co., 15 First street; residence, Berkeley, Cal.

Mr. William Coltz, of Milwaukee, was transferred to full membership.

P. S.—Copies of Mr. Steinmetz's paper will be sent for publication upon request.

Respectfully,
Ralph W. Pope, Secretary.

NEW STANDARD OPEN CIRCUIT DRY BATTERY OFFERED TO SECRETARY LONG OF THE UNITED STATES NAVY.

Mr. William Roche, the expert dry-battery manufacturer of 259 Greenwich street, New York, offers the use of his standard dry batteries of special design to Secretary Long. The style of battery designed for naval or shore service is 2½ inches high, one and nine-sixteenths across the oval and one inch in thickness, and Mr. Roche guarantees 1.30-100 volts at four amperes discharge. The cell weighs about one-quarter of a pound, and fifty of these little cells are guaranteed to discharge any style or kind of bomb or mine. Secretary Long can have any quantity of these little cells he desires at short notice.

The Standard Dry Battery is the production of Mr. William Roche, of 259 Greenwich street, N. Y. Mr. Roche has made dry batteries for the past nine years and his ability to place upon the market a dry battery of exceptional quality is universally recognized. He claims the "Standard" is the strongest, quickest to recuperate and the most durable dry battery in the market.

Mr. Roche made the dry batteries that were sent to the World's Fair, and called the Exeter dry battery, and were made for the E. S. Greeley & Co., and selected as the best out of 200 exhibits by the board of 200 expert electrical engineers appointed by President Cleveland. It will be remembered that this dry battery was used in connection with a Victor key to open the World's Fair by President Cleveland.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS has decided by recent council action to meet in Omaha the coming summer. The institute numbers over a thousand members and is the representative electrical engineering organization in America.

TEST OF NASH GAS ENGINE, WITH DIRECT-CONNECTED DYNAMO.

Graduation Thesis, 1897, by Fred Ophuls, William I. Thompson and H. Donald Tiemann, at the Stevens Institute of Technology, Hoboken, N. J.

DESCRIPTION OF PLANT.

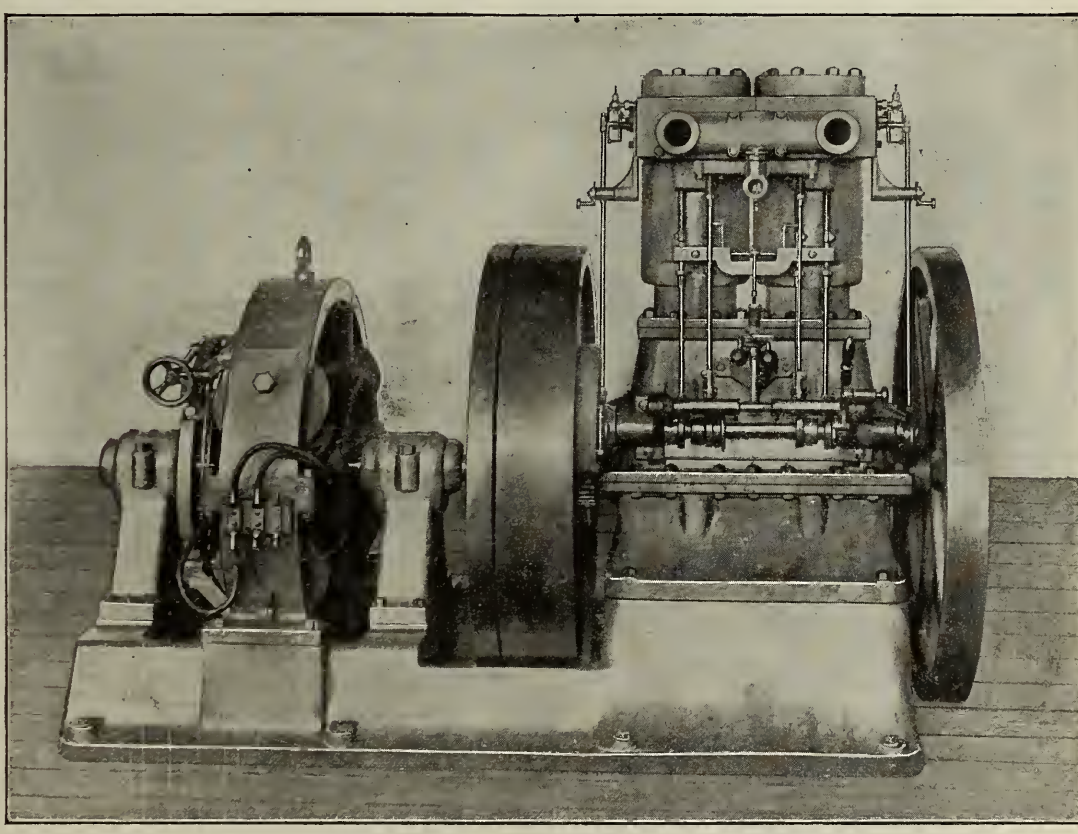
The plant tested is one that was presented to Stevens Institute of Technology by members of the Board of Trustees, the Faculty, and the class of '97. It is located in the Electrical Laboratory. It consists of a 20 h.-p. Nash Gas Engine, coupled by means of a friction clutch to a Riker dynamo. See Fig. 1.

The engine is of the vertical type. The base is a heavy casting, forming an enclosing case, in which are placed the crank shaft, bearings, and connecting rods, all of which are run in oil, and are accessible through a large door. There are two single-acting cylinders, entirely independent of each other, with cranks set at 180° apart, so that two explosions occur in alternate revolutions. The governor is a simple disengagement-governor, one rod being set slightly in advance of the other, thus allowing, at times, an admission in one cylinder only, which renders the governor more sensitive. The valves are of the plain poppet type and are actuated by hardened steel cams on a counter-shaft, making one-half the revolutions of the main shaft. On this counter-shaft are also the two eccentrics for operating the electric igniters, the time of explosion being regulated by the position of the eccentrics. Besides these there are hot-tube igniters, consisting of tubes heated red-hot by Bunsen burners.

The gas is admitted to the engine by an adjustable check valve. It passes up through a circular hole in the valve seat. over which rests a flat washer, which acts as a check to the return flow of the gas. As the gas passes through, it lifts the washer from its seat, the amount of lift being regulated by the screw-cap of the valve. The rim of this cap is indexed, so that its position may be noted, and the flow of gas regulated.

The dynamo is a six-pole compound-wound machine built by the Riker Electric Motor Company, of New York; it is rated at 125 volts, 120 amperes, and 300 revolutions.

In order to secure as nearly a uniform speed as possible for the dynamo, it is not fixed directly upon the shaft of the engine, but is coupled by means of a friction clutch. This consists of three separate wheels: the engine fly-wheel, upon the inner surface of which the friction shoes act; an intermediate fly-wheel, which is not fast to either shaft; and a smaller, inner wheel, which is fixed to the shaft of the dynamo. When the engine speeds up suddenly, the two shoes attached to the intermediate wheel are thrown off by the centrifugal force of two weights, thus allowing this wheel to lag. The lag, by a system of links, in turn loosens the four shoes connected to the dynamo wheel, thus disconnecting, to a degree, the dynamo from the engine. As the dynamo has less momentum than the intermediate fly-wheel, especially when running under a load, it will immediately tend to lag behind this wheel, the effect of which is to tighten the shoes of the dynamo wheel against the engine fly-wheel until its speed is brought up to that of the intermediate wheel again. As the intermediate wheel loses momentum its shoes again tighten to the engine wheel, and its momentum is restored. Thus the speed of the dynamo is controlled by the action of this intermediate wheel.



200-Light Direct-Connected Nash Engine and Dynamo. Fig. 1.

Synopsis of Tests.

A. Comparison of illuminating power obtained from
1. Most efficient conditions for running engines.
2. Tests of electric output.
3. Photometry.

B. Friction of engine and dynamo.
C. Prony brake test of engine.

Description and Arrangement of Apparatus.

The gas for the engine was measured by a 100-light meter, built by John J. Griffin & Company, of Philadelphia, and that for the igniters by a small 5-light meter, built by the American Meter Company, of Philadelphia.

The number of admissions of gas was registered by a recording ticker, electric contact being made every time either admission valve was raised. Samples of the tape are shown in Fig. 2.

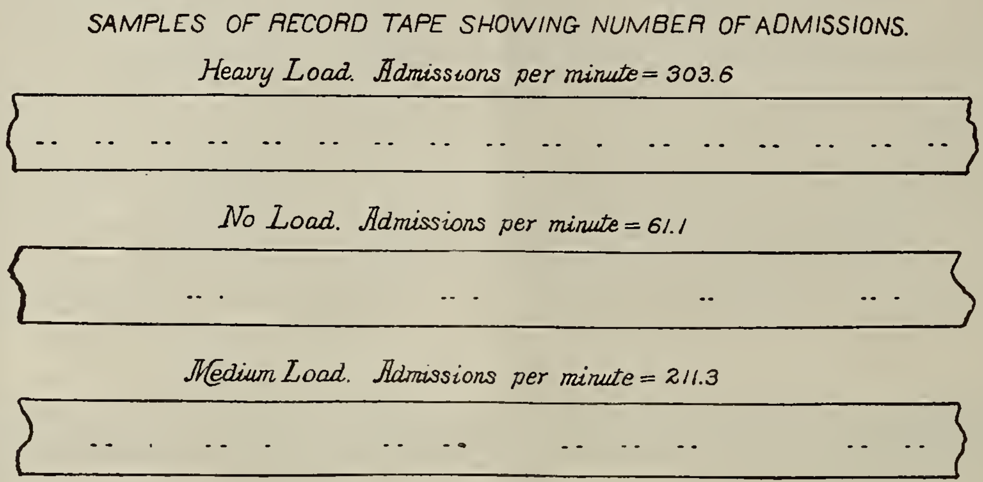


Fig. 2.

The revolutions of the engine and dynamo were recorded by box counters.

The jacket water was measured in two calibrated barrels.

Fig. 3 shows the general arrangement of the electric circuit. The power was distributed from two bus-bars, B, through fuse wires, part being absorbed by incandescent lamps and the remainder in a water rheostat, R. The external current was measured by an ammeter, A, and a dynamometer, D, in parallel, and the current in the shunt field by a dynamometer, D_1. The voltmeter, V, was so connected that the volts could be measured both across the brushes directly and across the terminals of the external circuit by changing the switch, S. The instruments, A, D and V, were placed about 20 feet from the dynamo so as to insure their being out of any field. The ammeter, A, showed no error, and the voltmeter, V, showed a possible error of 0.2%. The dynamometer, D, was not tested for field, but as its position was similar to the ammeter, A, it is fair to presume that it, also, was not affected. The dynamometer, D_1, was affected by a field to the extent of 4%. Since the instruments were always placed in the same positions, any errors due to field may be neglected in the comparative tests where the load is not very different.

The water rheostat was made of about 40 feet of No. 14 B. & S. German silver wire, wound upon a wooden frame and immersed in a barrel of running water. It absorbed between 9,000 and 10,000 watts.

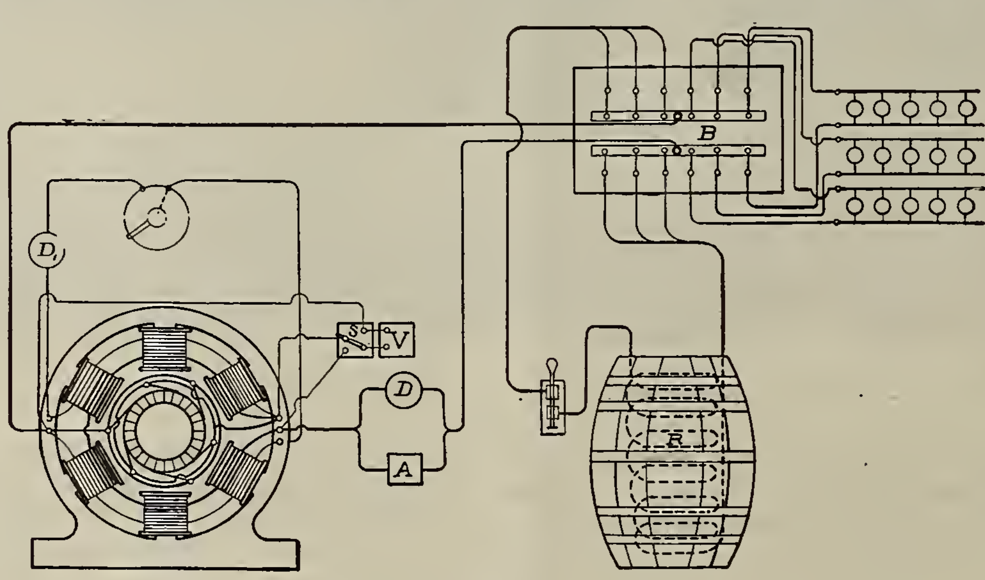


Fig. 3.

Description of Tests.—Test A.

1. Before comparing the illuminating power of the gas and electric light, it was of the greatest importance to ascertain the conditions under which the maximum output was obtainable for the least consumption of gas. The most natural element to vary with this end in view (after setting the brushes of the dynamo in the best position) is the amount of gas admitted with the air to each cylinder, which is regulated by the position of the gas valve, as before explained. The air pipe, as set up, was 21 feet long, with two bends, and ended directly over the two exhaust pots. Seven fifteen-minute tests and five one-hour tests were made with different positions of the gas valve. The results of these tests were so unsatisfactory that they led to the supposition that at times the exhaust gas was sucked into the air pipe. The pipe was therefore extended 18 feet horizontally in order to obtain pure air. With this arrangement, however, the engine could not get enough air to run under a load. The pipe was then shortened to 6½ feet, so that the air was taken from the room, and a short test made which gave a remarkable increase in the efficiency. It was decided to make tests for the best length of air pipe, varying the position of the valve for each length. Forty-three (43) twenty-minute and five (5) fifteen-minute tests were made. In all these tests the temperature of the jacket water was kept the same, as nearly as possible.

2. Having thus determined these two factors, two four-hour tests for the electric output were made, one with a medium load, the other with the greatest load the engine would carry.

The method of carrying out these tests was as follows: Readings were taken every 3 minutes in the fifteen-minute tests, every 4 minutes in the twenty-minute tests, and in the long four-hour tests, every 5 minutes. The readings taken regularly were:

Gas Meter.
Temperature of Gas.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables.) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, MARCH 5, 1898.

CONTENTS.

ELECTRICITY FOR ELEVATED RAILWAY SERVICE.

Many prominent engineers consider the elevated railway structures of New York and Brooklyn ideal places for the installation of an electric railway system. The fact that the tracks are raised above the street level to such an extent as to allow the installation of a third rail, block automatic or trolley system, means freedom from all possible sources of trouble generally met with in an ordinary street system of electric railroading. The great advantage of electricity as a motive power on elevated railways has been seriously considered by the Manhattan Railway Company, of New York, and the Brooklyn Elevated Railway Company, of Brooklyn. One of the daily newspapers in the Feb. 24th issue, makes note of the following: "contracts were let to the Sprague Electric and Walker Electric Companies yesterday, for an electric equipment of the Brooklyn elevated cars. . . . The contracts were let at a meeting of the Brooklyn Elevated directors yesterday, at which were present representatives of both the electric companies. The directors of the elevated company said they believed the adoption of the motors would be the salvation of the elevated roads and would in a measure solve the rapid transit problem, as it has been shown that the motors can attain fifty per cent. greater speed than the steam engines at much less expense. The cars are to be equipped with the Sprague system of multiple units control, recently adopted by the South Side Elevated Railway Company, in Chicago, and also with motors made by the Walker Company."

The above communication is interesting to the people of Greater New York, because the introduction and use of electric power on the elevated roads would mean a clean sweep and continuous circuit from the Harlem suburban district, over the bridge and out to Coney Island. Rapid transit would become an immediate possibility from any point in Brooklyn to any desired spot in New York. The above subject has been well treated by S. H. Short, in a pamphlet published by the Walker Company, of Cleveland, O., and the opening paragraph of his article reads: "the elevated railways of New York, Brooklyn and Chicago were built to satisfy a crying demand for rapid transit from the business centres to tne suburban districts of these great cities. . . . Since the trolley car has come into general use people have been educated to a still more rapid rate of travel and where the trolley car parallels the elevated railroad, as in Brooklyn and Chicago, the frequent speed and accessible surface car is by far the most popular. . . . In order to retain their traffic it will be necessary for elevated railways to move their trains more frequently and at a much greater rate of speed to compensate the travelling public for being obliged to walk some distance and climb those disagreeable stairs."

The heavy traffic which is met with in the Metropolitan district at six o'clock in the evening and eight in the morning would certainly necessitate the use of reliable apparatus. An examination of the starting periods of trains at stations seems to show that a great number of locomotives begin moving at the same time. The call for power upon a station would therefore be very heavy for a few moments, and possibly the power station would be very much larger than it would be were the times of starting coincident only to a slight degree. Such details as these, however, could be very well attended to by an able electrical engineer, and the load upon the station, even when the heaviest traffic prevails, so distributed as to prevent any sudden strain from occurring upon the central power plant. A third rail installation upon an elevated railway structure would certainly become part of an ideal system. There is no better place conceivable than on an elevated support, "far above the madding crowd," for the success of an electric system, the cars of which would be brilliantly illuminated, and whose rate of acceleration would mean the rapid transportation of passengers to their homes without delays, transfers and other disagreeable features of the present steam locomotive system.

With good light and high speed and a belt line reaching from the Atlantic Ocean to the Harlem River and beyond, the people of Greater New York would feel that their wants have at last been attended to and the misery of travelling back and forth at a snail's pace obviated. It may take sone time before the corporations controlling the elevated roads fully listen to the public demand, but that time is not far off, and then the use of steam locomotives within the city's limits, with their dirt, smoke and noise, will soon become a matter of history.

A FITTING EXHIBITION FOR THE CLOSING CENTURY.

The great development of electrical industries has brought people to the belief that the use of electricity plays an important part in the arts and manufacturing methods known at this present period. The exhibition about to be given in Madison Square Garden in May will include within its scope kindred industries as well as those electrical. It will show the general public what progress has been made in recent years and bring within their comprehension a little corner of each of its manifold branches.

Electrical industries have so magnified within late years that it has become necessary for those undertaking the management of this exhibition to select as large a place as possible in order to do full justice to the great list of exhibitors whose goods and electrical devices will be on view. The most novel types of mechanism, the most improved types of power generating machines and the most interesting application of electrical principles will be demonstrated and shown to the thousands marveling at the wonders around them.

The undertaking of the Electrical Exhibition Company is one of great responsibilities, and we congratulate them thus far upon the success that has attended their efforts.

Pressure of Gas.
Temperature of Room.
Field Current.
External Current.
Volts Across the Brushes.
External Volts.
Revolutions of Engine.
Revolutions of Dynamo.
Quantity of Jacket Water.
Temperature of Jacket Water.

The admissions were taken often enough to obtain a reliable average. The barometer readings were also taken.

The energy absorbed in the field was considered with the external output, before comparing the results of the preliminary tests.

All volumes of gas were reduced to 30 ins. Hg. and 60° F. by means of table Pg. 212, Vol. 13, of the Stevens indicator.

The calorific power of the gas was determined by means of the Junker calorimeter.

to 30 ins. Hg. and 60° F. by table Pg. 212, Vol. 13, of the Stevens indicator.

Test B.—Friction of Engine and Dynamo.

The method of finding the friction was to drive the engine and dynamo with no load by means of a separate motor belted to the engine pulley, and afterwards to calibrate the motor by a Prony Brake under the same electric conditions. The currents for the field and armature were supplied by separate machines, the field current remaining nearly constant during the tests. The mechanical friction of the engine could not be found with the cylinder heads on, for the engine acts as an air pump. One test was made with the heads on and two with the heads off, the revolutions of the engine being the same as when running itself.

Test C.—Prony Brake Test of Engine.

For this test the dynamo was disconnected and the consumption of gas per brake h.-p. was determined for the heaviest load.

TABLE I.

CANDLE POWER OF GAS.				CANDLE POWER OF ELECTRIC LAMPS.					
Kind of Burner.	Gas per hour, cu. ft.	Candle Power.	C.P. per cu. ft. per hour.	Condition of Electric Lamps.	Watts.	Candle Power.	Watts per C. Power.	Average.	C.P. per Kilowatt.
6	5.39	28.62	5.31	New..............	61.3	16.12	3.803		
4'	4.05	14.72	3.634	"	62.0	16.57	3.742	3.66	273.2
3'	2.94	9.08	3.088	"	59.4	17.27	3.44		
				Medium	49.6	10.45	4.75	4.77	209.6
Average = 4.01				"	58.1	12.15	4.78		
				Old	48	7.47	6.42	6.42	155.8

	Medium Load. Not including gas for igniting burners.	Medium Load. Including gas for igniting burners.	Heavy Load. Not including gas for igniting burners.	Heavy Load. Including gas for igniting burners.
1. Gas per Kilowatt per hour.—cu. ft............	33.12	33.99	30.26	30.84
2. C. P. of Gas required to produce 1 Kilowatt = (1) × 4.01..........	132.8	136.3	121.3	123.7
3. Ratio of light for same amount of gas consumed with flat flame gas burner.* = Electric / Gas: New electric lamp....	2.06	2.00	2.25	2.21
Medium " "	1.58	1.54	1.73	1.69
Old " "	1.17	1.14	1.28	1.26

3. The photometer used was a Bunsen photometer. In order to avoid any differences in the illuminating power of the gas, all the photometric measurements were made on one day. The gas flames and the electric lamps were each compared with an Argand burner, which was first standardized by means of spermaceti candles. In standardizing this burner, all tests were rejected in which the two candles did not burn at the rate of 40 grains in from 9½ to 10½ minutes. The candle-power of the standard burner did not affect the relative candle-powers of the lights compared. Therefore any error in finding the candle-power of the burner by means of the candle may be neglected.

The lights compared were: six electric lamps, and a 3-foot, 4-foot and 6-foot gas burner. They were measured at various angles, the average of these readings at each angle being taken. The gas was measured by a 5-light American gas meter, and the readings were reduced

In order to determine the most efficient air pipe length, and valve position, forty-one hour tests with a 21-foot pipe and forty-eight comparative tests on various air pipes and valve positions were made.

The best conditions were determined to be, 3-foot pipe and 7½ valve position, which are therefore used in all following tests.

Two four-hour tests were made to determine the gas consumption per kilowatt per hour, which was found to be, for a medium load:

33.12 cu. ft., not including gas for igniting burners, and

33.99 cu. ft. including gas for igniting burners; and for a heavy load:

30.25 cu. ft., not including gas for igniting burners, and

30.83 cu. ft., including gas for igniting burners.

Standardization of Argand Gas Burner With Edgerton Slit, Used for Measuring Candle-Power of Gas Flames and Electric Lights.

The candle-power of the candles was calculated by the formula:

$$\frac{\text{Candle-Power}}{2} = \frac{150 \text{ seconds}}{\text{Time required to burn 10 grains, in seconds}}$$

in which 150 seconds is the standard time for 2 candles to burn 10 grains when giving 1 candle-power each, which corresponds to one candle burning at the rate of 2 grains per minute.

x = distance in inches from standard Argand burner to screen.

$100 - x$ = distance in inches from candles or gas flame to screen.

The candle-power of the burner was calculated by the formula:

$$\frac{\text{Candle-power of Burner}}{\text{Candle-Power of Candles}} = \frac{x}{(100 - x)^2}$$

and was found to be 6.4.

The candle-powers of the gas flames were calculated by the formula:

$$\frac{\text{Candle-Power of Flame}}{6.4} = \frac{(100 - x)^2}{x^2}$$

The candle-power was measured for the flame in twelve positions 30° apart, the position when the flat side of the flame was toward the screen being called 0°.

(To be continued.)

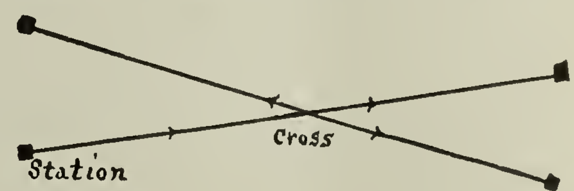
Eureka Springs, Ark.—The Citizens' Electric Co. has been incorporated by W. M. Duncan, president; A. R. Sayle and L. P. Badger, to operate plants for electric light, etc. Capital stock, $25,000.

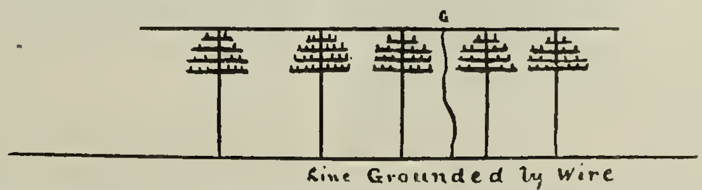
THE TESTING OF LINES.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

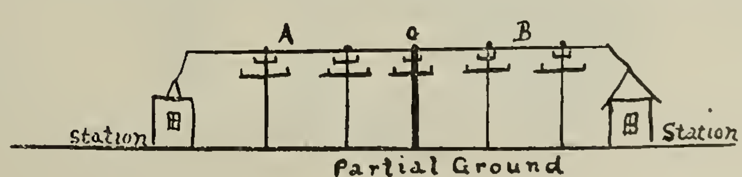
BY NEWTON HARRISON, E. E.

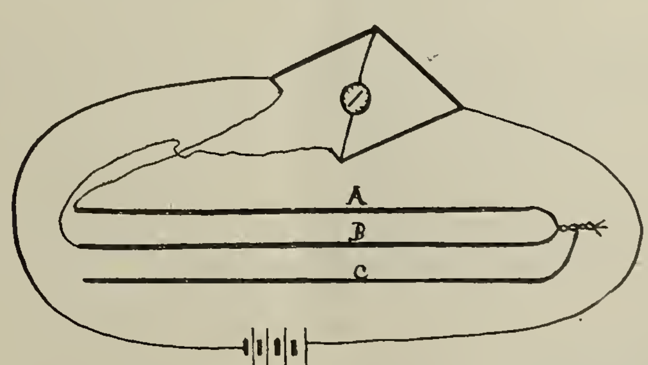
Entire freedom from crosses and grounds on a line is secured by constant attention, regular testing and inspection. When a line is crossed with another line the signals sent over the first do not reach their destination but affect the sounder of some other station not supposed to receive the impulse.





Crosses.—Not only may this occur but the current may return to a ground circuit, if the cross brings it into contact with such, and also become lost, as in the first case. Crosses therefore may be looked upon as causing a straying of signals, or possibly their complete disappearance. The location of a cross is made by testing the line. Should its resistance be greater or less than is usual the trouble is at once indicated, but not its nature. A ground is likely to assume the same appearance as a cross when superficially tested. A cross can therefore be discovered by the fact that the resistance of the line has changed, and also by a lack of signals at the other end. Each station has its own peculiar signal to receive when





communications are to begin with any other. A cross may thus create a disturbance in either one or more lines, and by a resistance test be located. When a difficulty of this kind occurs with an electric light line a set of fuses will blow and save it. A source of trouble that is very irritating to a telegrapher, and which fortunately occurs very infrequently, is the swinging of telegraph or telegraph or telephone lines. They may touch for a long while when the wind blows, or only occasionally, causing a temporary cross or ground which when looked for disappears to return at odd moments. Swinging crosses or grounds are best removed when the line is at rest; the early morning or evening, or whatever time allows for such investigation. The loss of conductivity in a line may be traced to several causes. One of the most common is poor connections, etc. If a line is free from all difficulties, length should represent a definite resistance when tested. The tests made for conductivity are simple; they differ from those made for insulation resistance in degree merely, in all other respects being identical.

Breaks.—A break in a line necessarily destroys all means of communication with the other end, unless the broken portion lands in a brook or on another line. If the ground connects the broken end, a test made of the resistance of the line will disclose the fact that it is incomplete. If the resistance of contact is high, the familiar features of partial ground manifest themselves without, however, any signals being received at the other end at all.

Grounds.—When the line falls into contact with the earth it is likely to do so in two ways; they are spoken of under the following heads:

Dead grounds,
Partial "

Dead grounds.—A dead ground is so called when the contact between the earth and the line is electrically good. A pole may be decayed inside, saturated with water and practically ground the line as well as if a plate were used. The pouring rain may stream down the pole, or a collection of them, and cause a dead ground. In this case the signals cannot possibly reach the other end, but return home through the faults. A wire hanging from the line to the earth and touching a grating or a cornice, or even piping of some description, produces this defect. Its location is found by measuring the resistance of the line. If, for instance, the normal line resistance = 100 ohms and the test shows only 80 ohms, the ground exists at a point $\frac{8}{10}$ of the distance from the station; this, remember, is based upon the supposition that the line is dead grounded at that point. In making the test, one end of the line is connected to the Wheatstone bridge and the other end leading from the ground plate also to the Wheatstone bridge. The circuit is now complete through the line, dead ground, earth and Wheatstone bridge. The resistance of that portion of the line in contact with the earth and between the ground and the station is thus found. Its resistance in ohms represents an equivalent in feet. It may be 10 ohms per mile or 100 ohms per mile; in any case, this data determines its position.

Partial grounds.—This common fault develops due to many cases, such as contact of the wire with a tree, or the leakage due to very poor insulation at any given point of the line.

In testing a line for a partial ground the position of the leak is determined by a double test. Calling one telegraph station A and the other B, the line between would be called A B. The ground G is of a resistance that in each test is included with the resistance of that part of the line from which the test is made. In measuring the resistance of the line from A, the circuit is opened at B. Therefore, the resistance measured is equal to that through A and G back to the station. This being done the line is opened at A and tested from B; the resistance is measured through the B portion of the line and C.

Test (1) resistance = A + G.
" (2) " = B + G.

The rule employed for finding the position of the ground from A and from B is as follows:

Resistance of A portion of line =

$$\frac{\text{Resistance of test (1) + resistance of (A + B) — resistance of test (2)}}{2}$$

or conversely the resistance of B portion of line =

$$\frac{\text{Resistance of test (2) + resistance of (A+B) — resistance of test (1)}}{2}$$

The resistance of the entire line is known either by its length in miles of a given size of wire, or by a resistance test.

Taking a case in practice as follows: A line is grounded and a test made from each end through the ground with this result:

Test (1) from A through ground = 1075 ohms.
" (2) " B " " = 1025 "

To find the number of ohms the ground occurs away from either A or B, the rules are applied and, when the ohms are known, the distance is understood.

If the line had 10 ohms to the mile its location would be (if the line has 100 ohms resistance)—

$$\text{From A} = \frac{1075 + 100 - 1025}{2} = 75 \text{ ohms.}$$

$$\text{From B} = \frac{1025 + 100 - 1075}{2} = 25 \text{ ohms.}$$

At 10 ohms to the mile the ground is

7.5 miles from A.
2.5 " " B.

This test applies equally well to telephone, telegraph and electric light lines.

The cross talk on telephone lines is due to the electromagnetic or electrostatic induction occurring.

The electrostatic seems to be the most effective in producing the trouble so familiar to all. The remedy for this is applied by twisting the wire; the inductive action being neutralized throughout by this means.

Covering the wire with an iron inductive coating of the best possible description will tend to reduce this difficulty to a great extent. At times the most novel practices are employed, such as surrounding the wire with crimped paper, etc. This is done to embody as much air as possible in the covering; air having a less inductive capacity than other matarials, and therefore prevents induction to a considerable extent.

The usual tests made of a line bear reference to its

Conductivity,
Insulation,
Capacity.

A sensitive galvanometer and a bridge will enable these tests to be successfully made.

Conductivity of one wire.—This is found by grounding one end and allowing the other to go to the arm of the bridge, measuring the unknown resistance, and then to the earth. The earth resistance being zero, the line may be measured.

Conductivity of a line by means of another.—If two lines lie side by side they may be measured without grounding, provided they be of equal gauge. Their extreme ends are twisted together and the other two ends connected to the bridge arm. The total resistance measured divided by two will equal the resistance of either.

To measure the conductivity of three lines.—If three lines of the same or unequal resistance are side by side, and the resistance of each respectively is to be found, three tests are essential by this method.

Calling the three lines A, B and C, the three tests take in the combined resistances of A and B, of B and C, and of A and C. This is obtained by joining their ends all together, leaving the three other ends free for the tests.

tests (1) resistance of A + B
" (2) " " B + C
" (3) " " A + C

The rule to be applied is then as follows:

$$\text{Resistance of A} = \frac{\text{test (1) + test (2) + test (3)}}{2} - \text{test (2)}$$

$$\text{Resistance of B} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (3)}$$

$$\text{Resistance of C} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (1)}$$

The last is not necessary, as C may be found by subtracting A and B from

$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2}$$

To illustrate this case

$$\text{test (1)} = 110 = A + B$$
$$\text{" (2)} = 130 = B + C$$
$$\text{" (3)} = 100 = A + C$$

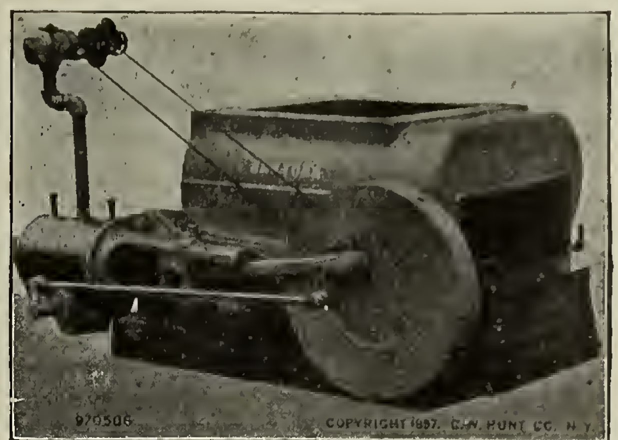
$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} = 170 \text{ ohms.}$$

Then $A = 170 - 130 = 40$
$B = 170 - 100 = 70$
$C = 170 - 110 = 60$

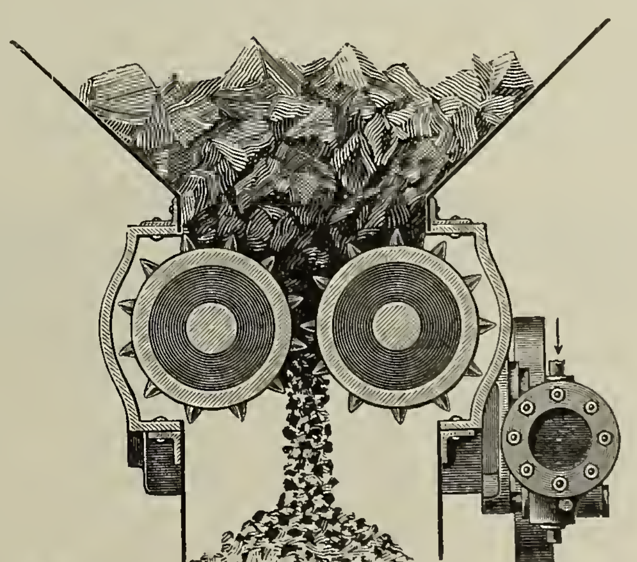
Thus the resistance of lines may be determined irrespective of their size by this method.

THE HUNT COAL CRACKER.

The Hunt coal cracker is designed for breaking the large lumps in run of mine of bituminous coal into smaller pieces that will feed through the automatic stokers used under the boilers of large steam generating plants. It is believed by many engineers who use hand firing, both in stationary and in locomotive boilers, that it is advantageous to break the larger lumps of coal into smaller sizes, both on account of the easier and more perfect distribution of the coal on the grates by the fireman and a more perfect combustion resulting from an evener fire.



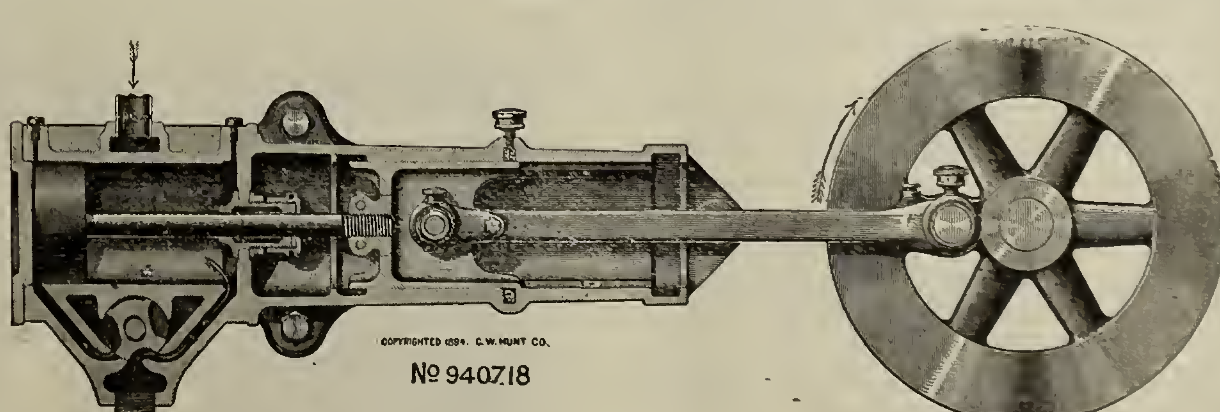
Cracker Driven by Direct-Connected Steam Engine.



Nº 9802 COPYRIGHT 1898 BY C.W. HUNT CO. N.Y.

The points on the rolls are made of tool steel with hardened points, especially designed to crack and not to crush the lumps of coal so that none of the advantages of lump coal are lost. The fine coal passes through the rolls unaltered.

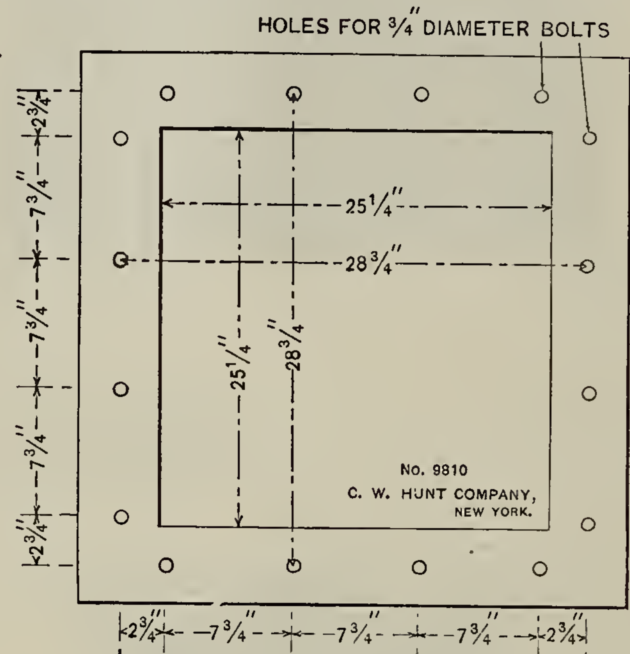
The cuts show the cracker driven by a direct-connected steam engine having the steam ports and passages all draining continuously downward, the steam entering at



the top of the cylinder and the exhaust passing out at the bottom, so that all condensed water is immediately drained off, and every drop of the water from cylinder condensation is swept out of both the cylinder and ports at each stroke of the piston, thus materially reducing the cylinder condensation. In starting there are no pockets of water to plunge forward and endanger the engine. There is no danger from frost, even in zero weather.

The cross-head bearing on the slide is made longer than the stroke of the piston (see cut No. 940718) so that it will not uncover a central oil well, packed with an elastic absorbent packing, that keeps the sliding surface constantly swabbed with oil. The bearing is unusually wide, so that the bearing on the slide is about four times the area generally used in commercial engines.

The rolls are made the proper diameter to break the coal to the size required, and are not adjustable in the frame, thus eliminating all elements that might be sources of weaknesses and delays. Both the gearing and the rolls are entirely enclosed, each in a separate compartment in a cast-iron frame. This prevents the coal dust from entering either the bearings of the machinery, the gear box, or the room in which the breaker is located. The gearing is easily accessible, but entirely inclosed and protected from dust while running. The gearing run in a bath of oil, that insures perfect lubrication. The vertical distance between the feeding hopper and the delivery spout is reduced to a minimum, as the space available for the cracker is usually limited. A horizontal spindle governor is adjusted in position and so located as not to interfere with the feeding hopper. The breaker may be placed below the hopper under the railway car track so that the coal feeds directly from the car through the rolls into a conveyor which transports it to the storage bins. When coal is hoisted from a vessel the breaker is usually put under the hopper into which the coal buckets dump.



Cut No. 9810 shows the exact distance of the bolt holes in both the top and the bottom flanges of the cracker, which are given here in order that engineers can design and construct the coal hoppers and spouts that will fit the cracker when ordered. The cracker can be bolted directly underneath the lower part of the hopper, or supported on the top of the spout or in any other manner that may be convenient.

While the average horse-power consumed by a coal breaker is small, the necessity for strong and perfect construction of the parts under stress must be evident. The axles in the rolls are of steel, large in diameter, and the frame is of massive construction to resist the great and sudden strains that may come upon it, especially when some foreign substance accidentally falls in the rolls while running.

These machines can be used to advantage for breaking other hard substances, the rolls in such cases being made to suit the work.

The breaker is self-contained and ready to run when placed in position, thus saving the framing and erecting expenses frequently required with machinery that is not so complete in itself.

The breakers are either in stock or in process of construction, and a prompt delivery can be made for standard sizes that break the coal to suit automatic stokers or hand firing. Rolls will be made to order for other sizes.

An electric motor or power from ordinary shafting can be used instead of the steam engine.

Shipping weight about 7,000 lbs.

Sold and manufactured by the C. W. Hunt Company, 45 Broadway, New York.

STREET CAR LINES SOLD.

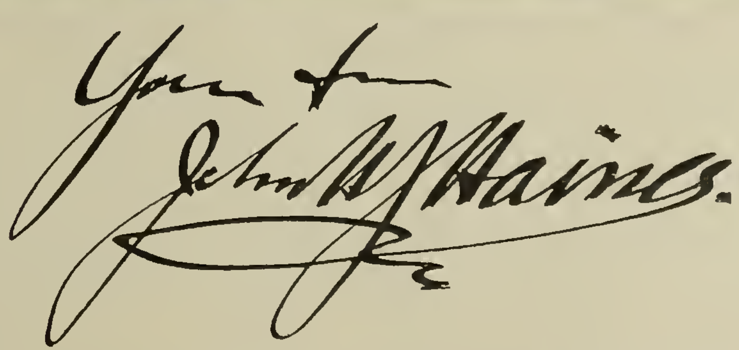
One of the biggest transfers of property ever recorded in Dallas was made recently when twenty-seven miles of street railway and equipment was sold by C. H. Alexander to the Dallas Consolidated Electric Street Railway Company, for $1,000,000. Mr. Alexander recently purchased and consolidated the property, which he sold, for about $300,000. The heaviest stockholders of the new company are Massachusetts capitalists, residents of Boston and Worcester. The new organization took charge at once.—Tradesman.

New York, N. Y.—The Knickerbocker Telephone & Telegraph Co. has been incorporated by Samuel B. Lawrence, Francis P. Lowery, John B. Summerfield, Henry M. Haviland and others; to operate lines in this city and New Jersey, with extensions to Ogdensburgh and Buffalo. Capital stock, $7,500,000.

Philadelphia, Pa. — The Germantown & Fairmount Park Street Railway Co. has been incorporated by Charles E. Morgan, W. Rotch Wister, William G. Warden, Josiah M. Bacon, Samuel T. Bodine, Richard Ashhurst, Joseph Bushnell and William Wharton, Jr. Capital stock, $80,000.

The Electrical Age.

VOL. XXI—No. 11 NEW YORK, MARCH 12, 1898 WHOLE No. 565



DAYLIGHT FROM VACUUM TUBES.

The subject of vacuum tube lighting has received a great deal of care and attention from Mr. John H. J. Haines, born April 27th, 1863, in Lansingburgh, N. Y., and raised in the capital of this state under circumstances that allowed him to give full swing to his inventive genius. One of the fairy dreams of modern science is the manufacture of daylight. Scientific men in England, Germany, France, Russia, Italy and even far away Japan, have endeavored to produce cold light which would not be the result of elaborate and expensive processes, but light produced with a reasonable commercial efficiency. Each day of our lives thousands and thousands of horse power are being wasted in the production of light. We may occupy civilized homes, supplied with every convenience that the mind of man can invent, but we must sadly realize that the savage with his flaming torch can well compare his source of illumination with the light diffused through the rooms of some great Fifth avenue mansion, so little removed is the efficiency of one from the other.

Although thousands of years have passed since mankind discovered and appreciated the value of artificial light, it is only within the last decade and even less that he has sought to imitate nature and produce the cold and uniform glow of daylight. It has often been found by quiet observers of the march of progress that a great discovery is frequently anticipated by scientific men, as shown by their discussions and references in the past. But as far as the practical crystallization of any idea is concerned the great majority fail to leave any impression behind them.

The problem of producing light without waste is one of gigantic proportions, because of the great innovation that its successful solution would institute. To merely produce a phosphorescent glow is not sufficient for the ordinary public; their requirements call for a practical and perfected system which can be readily installed and which will save them many of the dollars and cents they struggle so hard to obtain. Therefore the problem is no longer scientific, but purely commercial, and the honors rest with those that make it in this respect a successful achievement.

To give the reader an idea of the tremendous waste of energy occurring in each system of illumination, it may be said that the oil lamp wastes ninety-nine per cent. of its fuel in producing heat; the gas jet, ninety-eight and one-half; the incandescent lamp ninety-seven; the arc lamp, ninety to ninety-five, and the vacuum tube, theoretically, but five or ten per cent. In other words, if the electricity consumed by an incandescent lamp was sent through vacuum tubes, thirty times as much light would be produced, amounting in total to about five hundred candle-power. If the energy consumed in an electric light plant is considered from the coal to the glowing filament, it will be found that for every ton of coal consumed but twenty pounds are directly utilized as light. Prof. Lodge has remarked that as light producers we are like an organist, who in sounding certain high notes is compelled

The inventor, Mr. Haines, Testing his Outfit with Sixteen Tubes. (Photograph taken by Artificial Daylight.)

Mr. Haines and his Colleague Reading by Artificial Daylight. (Photograph taken by Artificial Daylight.)

to sweep through every note on the keyboard. It may be generally stated in considering light produced from the combustion of gas and light from electrical machinery, that about ninety-five per cent. of all the fuel consumed is absolutely wasted in producing non-luminous vibrations of the ether.

Waves of light are both visible and invisible. In all ether disturbances V = 30,000,000,000 centimetres per second; that is, a speed of 186,000 miles. Dr. Lodge calculates the ether waves of a micro-farad condenser to be 1,200 miles in length at 160 alternations per second, discharging through a coil of one Henry self-induction. A gallon Leyden jar of .003 micro-farad capacity discharged through about seventy-five feet of stout wire emits waves four hundred yards long, at a frequency of 1,000,000 per second. If a sphere two feet in diameter, which has received an electro-static charge, be in any way disturbed, ether waves a yard long will be emitted at the rate of 300,000,000 per second.

Lastly, electric charges on atomic bodies would lash the ether with oscillations of thousands of billions per second, thereby emitting the unseen light of combustion, the ultra-violet rays. It is therefore seen from the above that a short and infinitely rapid ether wave will affect the retina, producing the sensation of light. If an infinitesimal conductor, containing a charge, an atom, for instance, were discharged, oscillations of a tremendous frequency would result. Electro-magnetic waves of the length of light waves would bring to the eye the crowning sensation of visible light.

In a vacuum tube, each particle of gas collides with its neighbor or may possibly undergo the changes above described, but in either case the result obtained is that of a white, uniform glow, pleasant beyond description to an onlooker.

Mr. Haines began experimenting in 1890. His first experiments were crude and unsatisfactory. He realized that a high frequency discharge through the tubes in his possession would be the only means of satisfactorily solving this problem. He followed the work of Crookes, J. J. Thomson, and Hertz, for the purpose of keeping in touch with their experiments.

The apparatus he has devised, and with which he produced vacuum tube lighting of pure whiteness, is unique in every respect. His tubes run perfectly cold and will stand a ten-hour test. With the watt-meter recording two hundred watts in the line he kept sixteen tubes five feet long and two and a half inches in diameter brilliantly illuminated. The photographs contained in this article were taken in a room, having no reflecting screens, with a forty-second exposure, at a distance of from six to eight feet from the source of illumination. One of the important features of Mr. Haine's apparatus is a discharge occurring between two pairs of brass spheres which he calls a double spark gap.

This device is adjustable automatically and is devised for the purpose of keeping the two gaps in resonance. The outfit is self contained, of simple construction, and cheap to produce. Mr. Haines states that his apparatus will be ready for the market in about sixty days, as it has passed the experimental stage and is ready for practical application. A large company is being formed for the development of this invention with a capitalization of $10,000,000.

Picture Taken by Vacuum Tubes at 12.30 A. M.

Mr. Haines is at present interesting himself in telephony without wires. He has produced the only successful open arc lamp, which burns on any frequency, and is manufactured by the Imperial Electric Lamp Company. He has also invented an alternating enclosed arc lamp, now manufactured by the Haines Electric Company. The apparatus Mr. Haines makes use of in producing artificial daylight is attached to the ordinary commercial street circuit with a frequency of 7,200 per minute. The light from his tubes is steady and one can read and write with perfect ease in their steady luminescence.

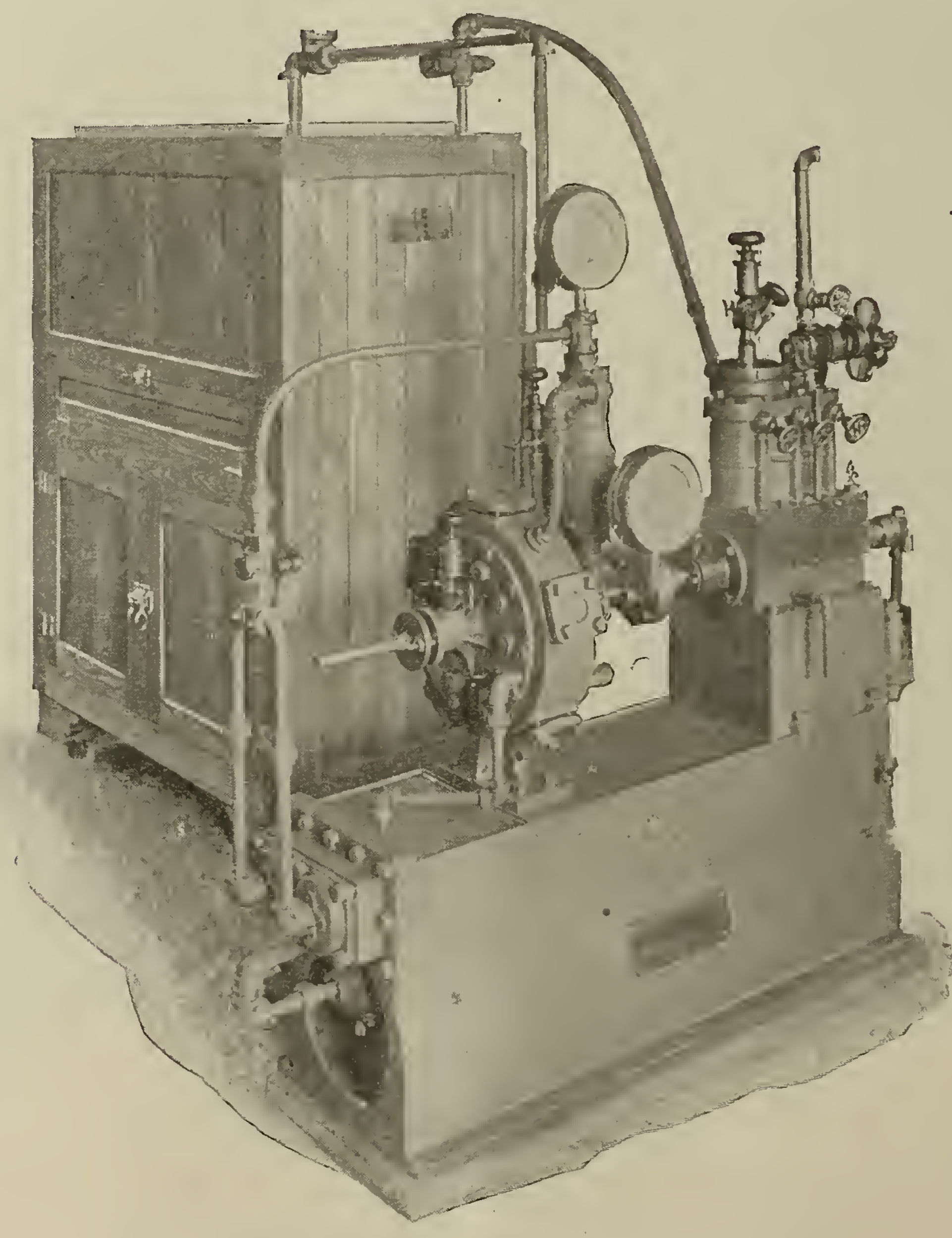
He has performed the experiment of connecting a chain of nine people, connected by vacuum tubes to the main terminals of his device, and has succeeded in brilliantly lighting the tubes. The radical departures made by Mr. Haines will lead to a rapid revolution in lighting methods and probably become one of the great established systems of vacuum tube lighting in Europe and the United States.

MECHANICAL REFRIGERATION BY ELECTRICAL POWER.

The process of producing artificial cold or, more properly speaking, absorbing heat, though known to a few for ages, is a comparatively new discovery to the many and may really be considered such, inasmuch as the mechanical devices now used in connection with this art have been so greatly improved within a decade that artificial refrigeration is now becoming a necessity on account of its increasing low cost of production as well as the low first cost of apparatus as compared with that of ten or fifteen years ago. It was so high that the attention of inventors and manufacturers was concentrated on large plants only, or where the amount of refrigeration or ice required was sufficiently large to warrant the enormous expense of installation and corresponding operating expenses.

considered. In the tropics ice is often sold for from five to twenty cents per lb. and is therefore one of the luxuries in such countries. A small community, by jointly installing a refrigerating and ice-making plant, could obtain their ice at prices little higher than is paid in New York, and so be able to enjoy daily the cooling fluids and food so necessary to the comfort of life in warm weather, and which indeed must be luxuries in the tropics.

The methods of mechanical refrigeration most commonly known are the compression and absorption, though the former is in more general use and is found to be the most economical. Among the agents for producing cold are ether and anhydrous ammonia, the latter being most favored on account of economy. By means of mechanical devices this is expanded, compressed and condensed,



Ice Making and Refrigeration Combined in Refrigerator.

It will readily be understood that where small amounts of ice or refrigeration were required, in places where natural ice could be procured at fairly low cost, no one would consider replacing the latter for mechanical refrigeration at many times the expense. Today, however, this is changed.

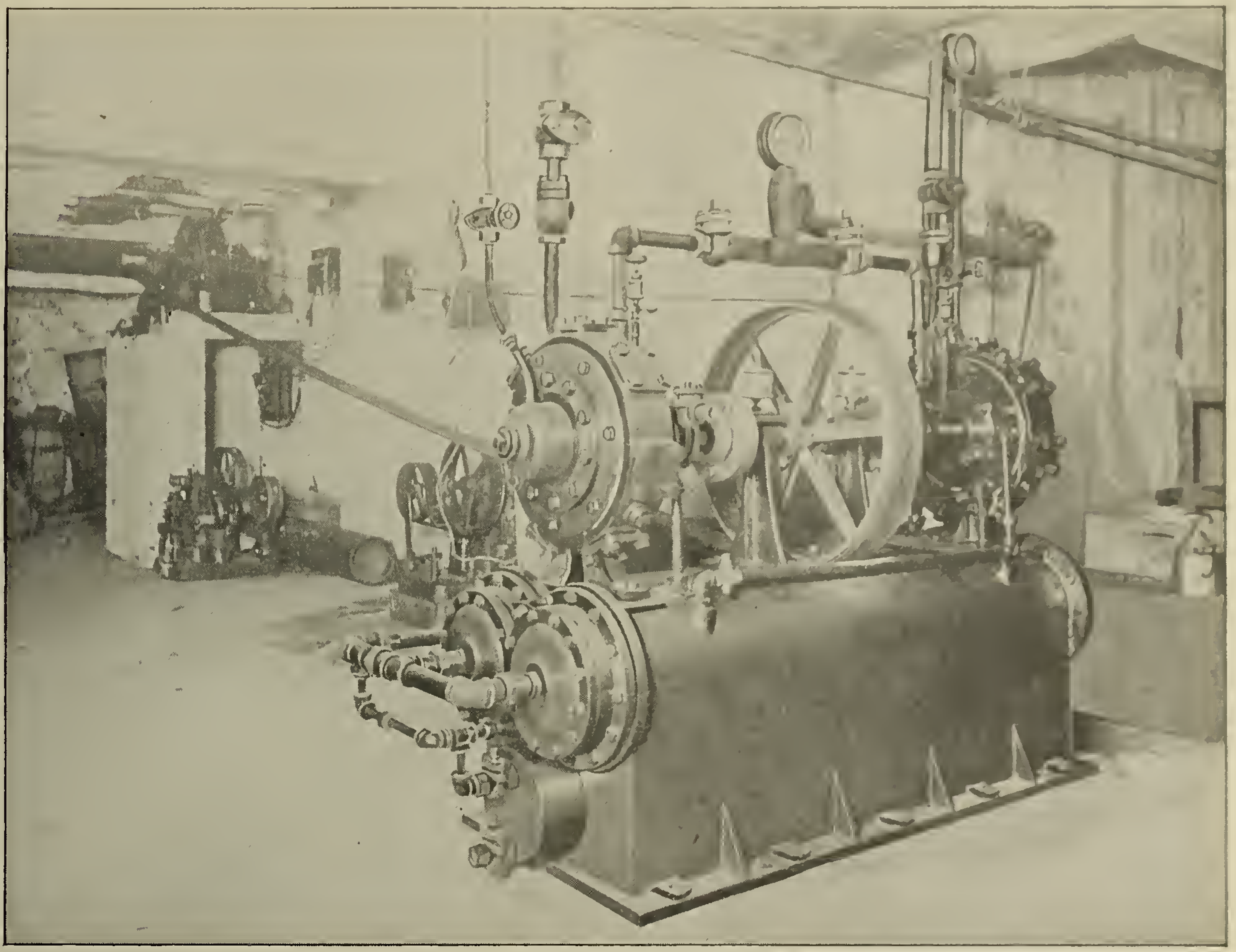
Refrigerating and ice-making machinery has kept pace with other mechanical improvements, and many machines can now be found in the market that will produce as low as 500 lbs. of ice per day, or refrigeration equivalent to that amount of ice melting, at a cost for operating expenses little in excess, if any, of the cost of natural ice in northern latitudes where the price of ice is low. When other advantages are considered, convenience, cleanliness, space used by ice saved, and others we have not room to enumerate here, this cost is very much less than that of natural ice.

When the attention of those living in warm or tropical climes is attracted, there are many other points to be

being used over and over again, only a slight loss occurring by leakage, etc.

The chief expense of operating a small plant such as the Hygienic Refrigeration Co., New York City, are now installing in various markets, hotels, apartment houses, etc., is the power required to run it, and of course this is governed by the kind of power used, the rates of same, etc. The above-named company are now installing several machines that are operated by small electric motors, the latter being mounted on same bedplate with their machine and directly connected to shaft. Others are driven by belt from motor. Electrical power is now supplied at such reasonable rates that the expense of operating by it is moderate, and the power is convenient and clean.

The machines of the Hygienic Refrigeration Co. are practically automatic, not requiring skilled labor to care for them. In many other respects they are greatly in advance of old types, being remarkably simple and compact in construction, all parts contained in one complete machine. The systems of refrigeration used by this need not be operated continuously in order to maintain low temperatures. Several of their plants are now being



Refrigerating Apparatus Complete—E. C. Brownell & Co., New Bedford, Mass.

Storage Refrigerator—E. C. Brownell & Co., New Bedford, Mass.

company are the direct-expansion and the brine circulating and storage. By means of the latter their machines operated, notably the one shown in illustrations, from 10 to 12 hours per day only. The machine shown in cut is a double compressor, a great advantage where certain capacities are required. If weather is cool, one compressor will be sufficient for work, and if in need of repairs, the entire plant will not have to be shut down, as one compressor can be overhauled while the other is running.

For use in hotels, markets, dairies, hospitals and other institutions as well as apartment houses and large private dwelling houses, the refrigerating machine is rapidly superseding natural ice for reasons that must be obvious to all.

Each engine exhausts into a Worthington jet condenser, from which the condensed steam and heated injection water is raised by means of the air-pump about 35 feet to the top of a Worthington cooling tower, in the bottom of which it collects, ready to be again used in the condenser.

The boiler feed pumps are of the Worthington duplex compound type, and ordinarily take their supply from the well of the cooling tower, pumping it through a closed feed-water heater in the exhaust line of the pumps, and thence through the economizer to a common feed-

Show Case—E. C. Brownell & Co., New Bedford, Mass.—Cooled by Refrigerating Process.

TESTS ON THE CHICAGO STORAGE BATTERY RAILROAD.*

It is well known that the Englewood and Chicago Electric Steel Railway has operated 20 cars on its lines using the storage battery, and at the beginning of this winter it was decided to test the plant in order to determine the presence and extent of defects which might otherwise exist without attracting attention. The tests were made under ordinary working conditions and represent the conditions of usual practice. They were carried out by Mr. George A. Damon, assisted by Prof. T. P. Gaylord and a corps of students from the Armour Institute. We are indebted to Mr. G. Herbert Condict and to the "Western Electrician" for the data and diagrams.

The boiler plant includes three Heine water-tube boilers rated at 200 boiler horse-power each, fitted with Roney mechanical stokers. The engines are triple expansion, condensing, of the Willans central-valve type, made by the M. C. Bullock Manufacturing Company, of Chicago. The plant at present contains two of these engines, each of which has two lines of tandem cylinders rated at 200 horse-power, at a speed of 380 revolutions per minute.

The engines are directly connected by the "Arnold" method to four six-pole, shunt-wound Walker generators, rated at 190 KW. each when running at 380 revolutions per minute.

* Illustrations loaned through courtesy of "American Engineer."

water heater above the boilers.

The hot flue gases from the boilers pass from the uptakes into a brick smoke flue extending the entire length of the boiler-room. In a brickwork extension of this flue, located between the power-house proper and the stack, is installed a Green economizer, with passages and dampers so arranged that the economizer pipes may be made to intercept the hot flue gases.

Several tests were made and those to which we direct attention were made on November 26, and Fig 1 shows the results of the boiler test on that day, while Fig. 2 gives the data obtained from tests on the engines and generators at the same time.

The tests were made, on one boiler, one engine and two generators, and the three-voltage method of charging the batteries was not used in these cases. The price of the coal at the plant was $1.90 per ton, and from five tests its caloric value was found to be 10,145 B. T. U. per pound. It had 48 per cent. fixed carbon, 33 per cent. volatile matter and combustible, six per cent. of moisture, three per cent. sulphur and ten per cent. of ash. The cards were taken every thirty minutes and showed an average indicated horse-power of 217, and an average electrical horse-power of 172, with an average all-day efficiency of 79.3 per cent. The theoretical evaporative efficiency of 10.5 pounds of water per pound of coal, and the evaporation from and at 212 degrees per pound of dry coal, was 6.6, giving an efficiency of the boiler and firebox of 62.86 per cent., which was obtained while the

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - $2.50
One Copy, six months, - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, MARCH 12, 1898.

CONTENTS.

TURBO-GENERATORS.

The latest innovation in electric lighting consists of a combination of steam turbine and electric generator; direct connected. The De Laval steam turbine has pushed its way to the front with amazing rapidity and shown its ability to meet many of the demands made upon it. At a test made with a 300-horse-power turbo-generator, operating at the station of the Edison Electric Illuminating Company, of New York, with a steam pressure of 150 pounds to the square inch, with no superheating and a vacuum at outlet of turbine of 25.6 inches, the steam consumption was 25.84 pounds per K. W. hour, at full load.

At the Stockholm exhibition in Machinery Hall a 100 horse-power turbine was shown connected to a direct-current dynamo of 66 K. W.; two 100 horse-power turbines, to which were connected alternators of 66 K. W., and one 50 horse-power turbine connected to a 33 K. W. alternator. The exciter used for the above alternators was driven by a 10 horse-power turbine. It seems from this exhibit that the Swedes place considerable confidence in their turbines for commercial purposes. At the same exhibition, in a separate pavilion styled "Aktiebolaget De Laval's Augturbin," four turbo-generators of 66 K. W. each were installed, and two of 33 K. W. apiece, the plant being fed by a high pressure boiler. The entire exhibition was supplied with light and power from this equipment, the boiler being kept at a steady pressure of 1,700 pounds per square inch. The use of high pressures will certainly cause a change in the construction of steam boilers. Conservative engineers look seriously upon the idea of developing a pressure of almost 2,000 pounds in steam boilers, but they must not forget that their predecessors expressed the same horror at the possibility of running engines at a speed of three or four hundred revolutions per minute. High speeds in steam engines are now accepted without a murmur by the mechanical engineering profession.

It is only a question of time before high pressure boilers and higher speed turbines will be regarded as another cog in the wheels of progress. The simple construction of steam turbines in general without reference to any particular make means, power for power, a cheaper device than the steam engine. The sale of turbines has been growing in Europe in consequence of this advantage as well as those due to compactness and convenience in installation. More than eleven hundred steam turbines have been sold by the Swedish company and the Societe de Laval, in Paris, from 1892 to 1897; the aggregate horse-power disposed of amounting to 32,000. This country is ahead with nearly all classes of machinery but its steam turbines. The time is now ripe for this innovation.

THE LIGHT OF THE TWENTIETH CENTURY.

It seems probable that a new form of illumination will come into use within the next few years. The light obtained from vacuum tubes, containing a highly rarefied gas, has been developed to such a pitch of intensity that the most critical minds would be satisfied with what has been done and admit its immediate usefulness for domestic purposes. The efficient production of light from vacuum tubes depends entirely upon the high frequency of well blended electrical oscillations and experiments have been directed along this line of action, i. e., the use of infinitely rapid vibrations within the tube. As soon as heat is produced, energy is lost, and although electro-magnetic radiations occur in systems employed, which constitute a definite loss, heat within the light-giving chamber is to be shunned as inimical to its success.

A fire-fly emits light which we can only produce by a heat of 2,000 degrees, Fahrenheit, by our modern methods, yet no rise of temperature is perceptible in the light-giving organ of this remarkable creature. Prof. Langley has concluded that Nature produced light in the Cuban fire-fly with about one four-hundredth part of the cost of the energy which is expended in the candle flame. Vacuum-tube lighting has now become a commercial problem—a question of dollars and cents—a prospective system to compete with others. The devices employed by Mr. Haines may be very effective in bringing this peculiar system to the front. The first to market it may be the first to reap the harvest. The public will quickly judge of its merits without bias and their opinions will soon be put to the test.

THE ANACONDA MINING COMPANY is negotiating through the Exploration Company of London, with Mr. William Elmore, of the Elmore Patent Copper Depositing Company, for the use of his new electrolytic refining process, for which he claims a remarkable shortening of the time required by the electrolytic process in making ingots. The old Elsmore process for making electrolytic tubes, sheets and similar work—as the readers of The Engineering and Mining Journal know—was not successful; but it has recently been improved materially by M. Secretan and others, and it is now asserted that excellent sheets and tubes are constantly made. The improvements in the process by which these results are obtained are said to be chiefly in unpatentable details, which overcome the well-known tendency to foliation and prevent the formation of the "pin-holes which rendered the original Elmore tubes unsatisfactory.—Eng. & Mining Journal.

Natchez, Miss.—The Natchez Gas Light Co. will expend about $10,000 in improving and adding new machinery to its electric light plant.

Thomaston, Ga.—J. R. Atwater, Mayor, contemplates the establishment of an electric light plant.

boiler was 26 per cent. under-loaded. The equivalent evaporation per pound of combustible per pound was 8.22, so that the efficiency of the boiler alone was 78.3 per cent., and the boiler loses by radiation and other causes 21.7 per cent., while the furnace is to be charged with 14.44 per cent. of the lost heat, and the remainder 62.86 per cent. appears in the steam.

The test shows that the engines used 18 pounds of steam per indicated horse-power, but it should be remembered that among the unfavorable conditions, the engines were overloaded and had a vacuum of but 24¼ inches. The indicator cards taken with one engine operating one generator showed a friction load of 32.26 indicated horse-power, which is but about 15 per cent. of the average indicated horse-power. The commercial efficiency of the generator is shown to be 93.1 per cent., which efficiency was obtained when the generator was running 32 per cent. below its rated capacity. The total efficiency from the coal pile to the switchboard was 5.58 per cent. The cost of fuel for a net kilowatt hour on the switchboard of the station tested is shown to be .611 cent. As the result of a two days' run with coal at the price named the cost of fuel per car mile was .996 cent., and the pounds of coal per net kilowatt hour were 6.44.

Fig. 3 gives the result of the readings taken on one of the cars every five minutes during the test while it was performing regular service, and Fig. 4 shows the results of a speed trial for 60 seconds. In this figure, A, B, C, D and E were the readings obtained for the watts used, while the controller was placed at the five points representing the connections as follows: A, the four sets of batteries in parallel; B, batteries in series parallel in sets of two; C, batteries in series with resistance; D, batteries in series without resistance; E, same as D with field of motor shunted. The speed of 15 miles an hour attained at the end of the 60 seconds was after a run of 986 feet, showing at a glance that it is hardly worthy of comparison with the speed of electric and other cars which have been recorded, but the equipment of this car was designed to enable it to attain normally a speed of 15 miles an hour. The tests were made on a 13½-ton car, driven by a 50-horse-power Walker four-pole series motor. The entire current used at any one time passed through the armature, so that the ammeter was inserted in the positive brush leads.

The results of the tests point to the suggestion that the engines should be overhauled, the economizer flue repaired, and the question of securing improvements in the fuel as to quality and cost should be taken up.

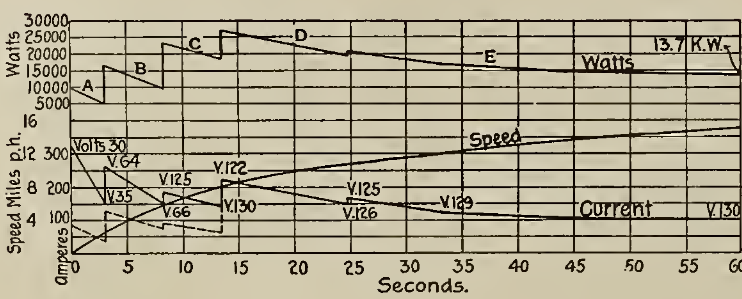
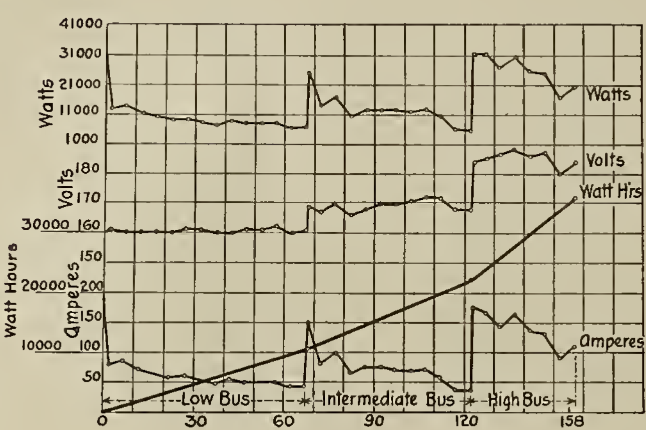


Fig. 4.



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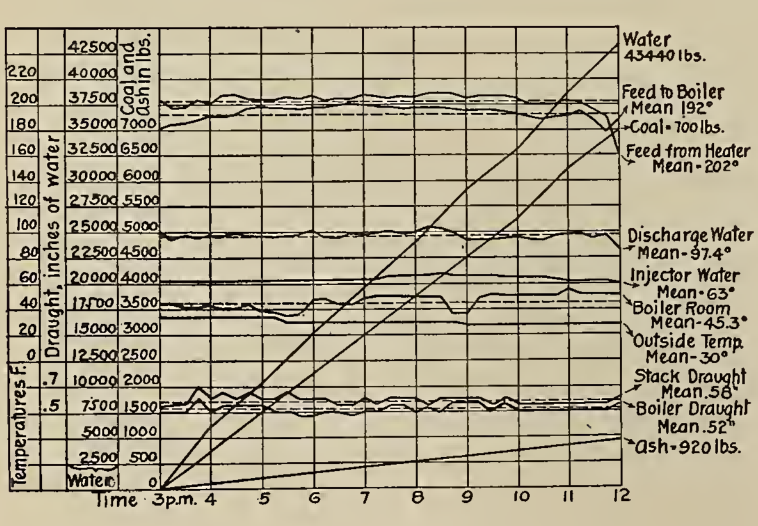


Fig. 1.

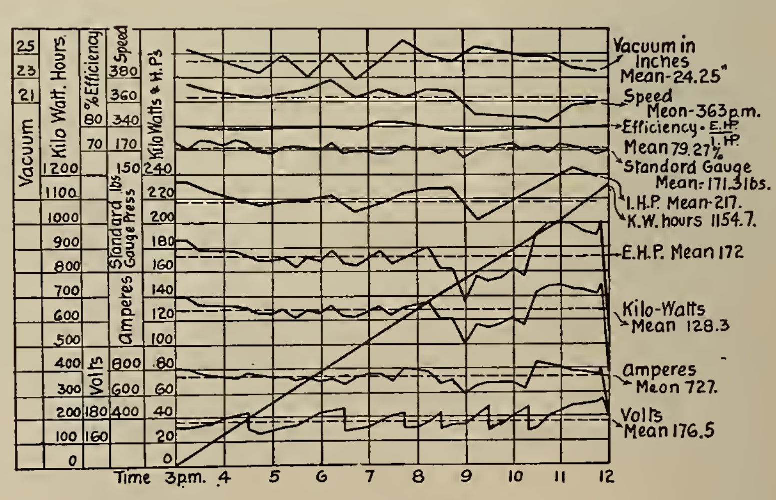


Fig. 2.

LIQUEFIED FLUORINE NON-MAGNETIC.

The much-sought-for alkahest, or universal solvent of the ancient alchemists, is almost realized in fluorine, which was first prepared by Moissan in 1886, says the "Popular Science Monthly." The transparent vessels in which it is contained have to be made of some fluoride, its action on ordinary glass being vigorous and destructive. The difficulty of handling the gas, even in the laboratory, has hence been very great, the fluoride vessels being brittle and clumsy as well as expensive. Professors Dewar and Moissan, being desirous of more fully investigating the properties of the gas, recently conducted a series of experiments at the Royal Institution in London, in which by means of liquid oxygen they succeeded in liquefying fluorine, and in this comparatively inert state could more fully and carefully examine its properties. The apparatus used for liquefying the gas consisted of a small cylinder of thin glass, into the upper part of which was fused a platinum tube surrounding a smaller tube of the same material. The fluorine enters through the larger tube, passes around the glass envelope, and escapes through the smaller tube. The glass cylinder being cooled down to the temperature of boiling liquid oxygen (—183°), the current of fluorine gas was passed through the bulb without becoming liquid; at this low temperature, however, the fluorine did not attack the glass. On still further lowering the temperature of the liquid oxygen, by exhaustion, a yellow liquid was seen collecting in the glass envelope, while gas no longer escaped from the apparatus. At this moment the escape tube was closed to prevent the entrance of air, and the glass bulb soon became full of a clear yellow liquid possessed of great mobility. Fluorine thus liquefies at about — 185°. The chemical activity of the gas was found greatly reduced when in the liquid state, but even then benzine or oil of turpentine underwent spontaneous decomposition when brought into contact with it. It would thus seem that the powerful affinity of fluorine for hydrogen is the last to disappear. In a subsequent experiment in which liquid air was used and a temperature approximating — 210° obtained, the liquid fluorine showed no signs of solidification. Experiments to determine its density led to the conclusion that it had about the same specific gravity as amber, 1.14. Different samples of the liquid examined with the spectroscope showed no specific absorption bands in the visible spectrum. It was found to be not magnetic.—Ex.

In a recent lecture on the subject of compressed air, these facts were demonstrated: Air when liquefied looks like water, and has a temperature of 385° F. below gas. If an alcohol thermometer be plunged into it the alcohol is immediately frozen. Alcohol being ordinarily frozen at 200. When the bulb and contents are withdrawn, it takes some little time to liquefy the alcohol again, as it has frozen very compactly. The experiment of pouring liquid air into a few ounces of whiskey was undertaken, with the result that the fluids became solidified into a mass resembling a stone or mineral. The smell of the whiskey was however given off in the solid state. When a handkerchief was dipped into the liquefied air it dried very slowly and caused the fabric to have a charred appearance when completely dry again. It would seem foolhardy to thrust the hand into a liquid which can produce such an extreme temperature, but it was proved that no harm would attend so doing, provided it was done quickly enough. The explanation being that a small quantity of the liquid evaporates and forms a thin gaseous film over the surface of the hand and will protect it even though there be a difference of 480° between the hand and the liquid.—Yale Scientific Monthly.

The chainless-wheel craze has now reached the stage where a patent has been granted to a man who wants to belt the main sprocket to a dynamo, run wires back to a motor under the saddle and belt dowu again to the rear wheel from the motor. This adds two belts, two electric machines and much weight in the endeavor to "simplify" the bicycle, but it does away with the chain. It's a good deal like some of the attempts to improve the link motion.—Locomotive Engineering.

ALUMINUM AS A RIVAL OF COPPER AND BRASS FOR ELECTRICAL CONDUCTORS.

BY ALFRED E. HUNT, S. B.
President of the Pittsburgh Reduction Company.

Copper has been used for electrical conductors very largely in the past, due to its comparatively high electrical conductivity, power of withstanding corrosion, ease of soldering and brazing, malleability, tensile strength and ductility. The exceptions in the past have been in telegraph wires of soft wrought iron, and the brass, iron and steel used in the parts of electrical machinery.

Aluminum has already been used successfully for the purpose, and this article is written to call attention to its comparative merits as an electrical conductor.

The following facts regarding the metals, copper and aluminum, in bars, rods, and wire suitable for electrical conductors, need first to be considered:

Copper has a specific gravity of 8.93 (Authority—Association of Copper Manufacturers of the United States 1893); an electrical conductivity, when pure and soft annealed, reckoned at 100 in the Matthiessen scale, but as ordinarily used in electrical conductors of about 98—97.61 (Authority— Prof. W. C. Roberts-Austin); a tensile strength of from 16,500 pounds per square inch in soft annealed pure copper (Authority — Carnegie's Hand Book) to 65,000 pounds per square inch in hard-drawn bars; and a selling price of about fourteen cents per pound in the United States, and an equivalent selling price of 130 marks per 100 kilograms in Germany, for wire, bars, and rods, such as are used for electrical conductors.

Aluminum has a specific gravity of 2.68; an electrical conductivity (Commercially pure metal) of 63.00 (Authorities—Chas. F. Scott, of the Westinghouse Electric Company, and Prof. Jos. W. Richards, of Lehigh University); a tensile strength in pure, soft wire of 26,000 pounds per square inch, and in hard-drawn rods or wire of 40,000 pounds per square inch.

Special Selling Price: The firm of Aron Hirsch & Son, of Halberstadt, Germany, are ready to sell aluminum conductors in the form of rods, bars, plates and wire drawn to 2½ millimeters in diameter, at the special low rate of 280 marks per hundred kilograms, for large quantities of metal, and similarly the Pittsburgh Reduction Company will sell rods, bars, plates, and wire drawn down to No. 12 Brown & Sharp gauge (eight hundredths of an inch diameter) in large special orders for electrical conductors, at the rate of twenty-nine cents per pound at their works in the United States.

These prices are special rates, below the regular prices for aluminum which these concerns have decided to make for electrical conductors alone, in order to favor the introduction of aluminum for this purpose and to overcome the handicap which aluminum has, occasioned by its lower electrical conductivity than copper, in the matter of special low relative prices.

From these facts it is evident that:

1. Any given volume of copper is $\frac{8.93}{2.68}$ or 3.332 times heavier than an equal volume of aluminum.

2. The equivalent price of fourteen cents per pound for copper for any length of any equivalent section of aluminum wire or bar, would be 14 cents times the factor 3.332, or 46.65 cents per pound. That is, one thousand feet of wire of, say one-tenth inch diameter, would cost equally as much if bought of copper at 14 cents per pound or aluminum at 46.65 cents per pound. Aluminum, therefore, sold at 29 cents per pound is only about 62 per cent. of the cost of copper at 14 cents per pound section for section.

3. Reckoning the copper conductor to have its maximum of 100 per cent. conductivity, and the aluminum to have a conductivity of 63 per cent. (which the Pittsburgh Reduction Company are ready to guarantee for

their special pure aluminum metal for electrical conductors), then for an equivalent electrical conductivity a given section of copper that can be placed at 100 should be increased in area in round numbers to 160 to give an equal conductivity.

4. Due to their relative specific gravities, the weight of the given equal length of the aluminum conductor with 160 sectional area will be only forty-eight per cent. of the weight of the copper conductor with sectional area of 100, having the same electrical conductivity.

$100 \times 8.93 = 893$, weight of the copper.
$160 \times 2.68 = 428.8$, weight of the aluminum.
$\frac{428.8}{893} = 48$ per cent.

5. As to their relative cost for electrical conductors of equal conductivity, aluminum at 29 cents per pound is the most economical conductor as compared with copper at 14 cents per pound.

Taking as an illustration, an aluminum conductor to replace a copper wire of No. 10, B. & S. gauge (about one-tenth of an inch diameter), the aluminum wire of equal, in fact somewhat superior, electrical conductivity would be of No. 8 B. & S. gauge (slightly over one-eighth of an inch diameter).

The weight of a mile of No. 10 copper wire is 162.32 pounds; and its cost at 14 cents per pound would be equal to $22.72.

The weight of a mile of No. 8 aluminum wire would be 79.46 pounds, and at 29 cents per pound, would cost $23.04.

Forty-eight per cent. of the weight of the No. 10 copper wire, which will give equal electrical conductivity in aluminum wire, would only weigh 77.91 pounds; so that more accurately, $22.59 would be the cost of a mile of aluminum wire at 29 cents per pound to replace a mile of No. 10 copper wire at 14 cents per pound, costing $22.72.

6. The Continental requirements in tensile strength for soft copper wire, rods, and bars used as electrical conductors is twenty-two kilograms per square millimeter; the English requirement being similarly fourteen tons per square inch: and our American requirement is about its equivalent of 32,000 pounds per square inch.

(To Be Continued.)

A PHONO-FARADIC CURE FOR DEAFNESS.

In the use of this unique invention two forces are brought into play: an electrical impulse and a mechanical force, both produced from the same cell. These two forces have therapeutic effects on the ear drum when applied of great value, specifically. The faradic effect acts as a tonic to the nerve structure and the purely mechanical vibrations set up in the ear cavity produce a species of mechanical massage. The bombarding breaks down the adhesions on the small bones, while the tonic properties of the other strengthens weak nerves and tissues.

Application of Phono-Faradic Apparatus.

By this combination of a faradic and sound wave effect in one, the treatment of diseases of the ear becomes a matter of much greater ease and simplicity. The above outfit was invented by Dr. Henry C. Houghton; its selling agents are B. & E. Hanfeld, 108 E. 23d street, New York City, well known to dealers in dental outfits and to physicians on account of their long standing relations with medical men. The above instrument, with its wide range of effects, has recommended itself to specialists and to many medical universities.

TEST OF A NASH GAS ENGINE.—Concluded.

Tests of Electric Lamps.

The candle-power of the electric lamps was measured in six positions 60° apart, the position when the loop of the filament was parallel to the screen being 0°.

x = distance in inches from standard Argand burner to screen.

$100 - x$ = distance in inches from lamp to screen.

$$\frac{\text{Candle-Power of Electric Lamp}}{6.4} = \frac{(100 - x)^2}{x^2}$$

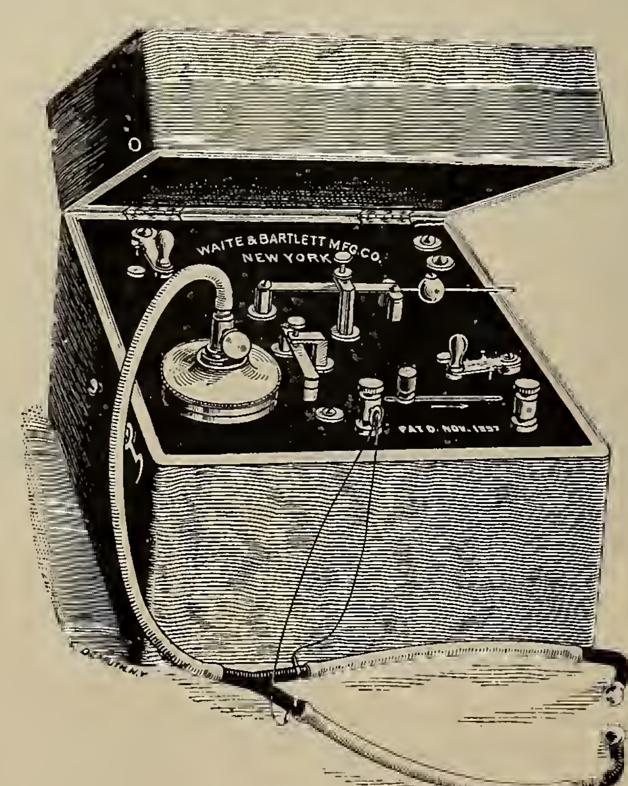
where 6.4 = candle-power of standard Argand burner.

Explanation of Table I.—Comparison of Light.

Table 1 gives the final results, in the tests for the relative amounts of illumination given by electric lights and the gas required to produce those lights. For a heavy load, new electric lamps give 2.21 times as much light as the gas used by the engine would give, medium lamps 1.69 times as much, and old lamps only 1.69 times as much. With a medium load the figures are 2.00 for new lamps, 1.54 for medium, and 1.14 for old lamps.

Six tests were made to determine the calorific power of the gas used, which was shown to yield 701.3 B. T. U. per cubic foot.

The friction of the engine and dynamo was determined by driving them with a motor connected to the engine pulley. The friction, with the cylinder heads off, was found to be 3.83 h.-p., and with the heads on, 4.98 h.-p., showing that 1.15 h.-p. was used in pumping air.



Phono-Faradic Outfit.

The result of a one-hour test for the gas consumption, with no load on the dynamo, showed 95.2 cu. ft. per hour.

A Prony brake test was made with a view to showing the consumption of gas per hour per brake h.-p., which was found to be 17.62 cu. ft., including the gas used to

(Continued of page 152.)

THE DYNAMO.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

BY looking back upon the past few years, the dynamo appears as a new and untrustworthy device. It was a very interesting piece of mechanism and produced a current capable of doing many wonderful things, but it was not received with confidence. Today what a change has occurred. It is a part of every large hotel equipment, a necessity to public and municipal buildings. The elevators of many tall structures depend upon it and the newest developments tend to force its application for heating our dwellings as well as supplying both light and power.

Principles.—It is encouraging to know that the principles upon which our knowledge of the dynamo is based are of a simple, uncomplex nature, and it may free the mind from doubt to realize that even the early history of the dynamo possesses an interest which unconsciously ripens it for the facts which follow.

The seed which led to one of the greatest industries in the world was planted by a careful gardener, whose discriminating mind selected the richest soil in which to place the precious germ.

But its first growth was not very productive. It required many others of recognized genius, whose ability drew comments from their own government to healthfully develop the first idea. Edison in America, John Hopkinson in England, Siemens in Germany and Pacinotti in Italy added their portion to the accumulating heap of facts. From the very first and most elementary discovery of Faraday sprang a host of useful principles to which we owe the growth and practical utility of the modern dynamo. The elements by reference to which the action of the dynamo can be understood will be contained in the following notes.

Arago in 1824 noticed that a magnetic needle would not swing as often when near a metallic body as it would when isolated from it. Copper exercised the most striking effect, and was spoken of as being able to reduce the oscillations in a short while from 300 to 4.

In 1825 he discovered that a plate of copper, rotated under a suspended magnet, caused the magnet to deflect in the direction of motion. Two other experimenters, Bubbage and Herschel, repeated Arago's experiment and drew up a table showing the relative effects of this action on different metals:

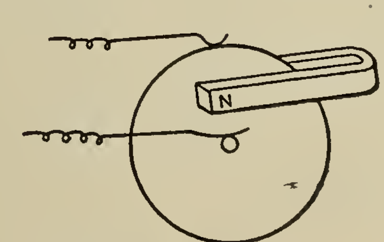
Copper,	100.
Zinc,	95.
Tin,	46.
Lead,	25.
Antimony,	9.
Bismuth,	2.

Faraday with characteristic genius explained these effects in a manner acceptable even to the most sceptical minds. The rotation of the magnet above the copper disk generates currents in it which react upon the magnet. The way in which they react is to destroy the swing of the needle, in the first case, or force the magnet or needle out of its customary position in the second. The law, framed by Lenz, which covers all such cases in which a magnetized body and a metallic mass move in each other's neighborhood is as follows:

Lenz's Law.—In all cases of electromagnetic induction, the induced currents have such a direction that their reaction tends to stop the motion which produces them.

It is but necessary to appreciate this fundamental fact, and the phenomenon of electromagnetic induction in all its phases appears as but a simple and reactionary effect. In fact, to some minds the presence of a current by the movement of the magnet was expected. A force cannot be applied at one point without producing some equally disturbing effect at another. Matter is simply the material by which a given amount of power is transmitted and, therefore, a swinging magnet radiating lines of magnetic force must create in the conductor they strike some such remarkable effect as we perceive. The idea of Faraday's regarding the disk of Arago took root. Faraday himself, in 1831, discovered the principle of induction; he followed the work of Arago and constructed a small dynamo. It consisted merely of a disk of copper revolving between the poles of a magnet, but it gave a continuous current and was named the Faraday disk dynamo.

Arago's Original Experiment.



Faraday's Disc Experiment.

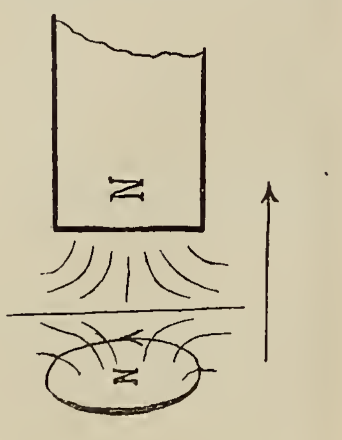
Today machines are used of the same construction in some electro-metallurgical works. Noting in mind the fact that a magnet moved in front of a conductor has its motion resisted, or the converse, a conductor moved past a magnet has its motion resisted, the reason why such retardance is necessarily due to induced currents becomes pretty evident. A magnet moving through the air cannot be held any more than any other object, unless by the presence of another magnet. Neither have touched, yet they either repel or attract each other.

If currents are induced in a mass of metal or a conductor by a magnet, and the production of such currents means resistance to further motion, it is highly evident that the disturbing influence is magnetic, otherwise the magnet would be unaffected. Also the currents which are reduced, and which affect the moving magnet, must hold it back when it moves away and push it away when it moves back. Any movement whatever is restrained, and this restraint is investigated from these two standpoints.

(1) Motion of magnet to a coil.
(2) " " " from "

QUESTIONS FOR REVIEW.

(1) What experiment was performed by Arago?
(2) State Lenz's Law.
(3) How is the Faraday disk dynamo constructed?
(4) What phenomenon is due to the movement of a



conductor past a magnetic pole?
(5) How are results of such motion classified.

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ignite the burners, and 17.37 cu. ft., not including the gas used to ignite the burners.

Efficiency of Dynamo.

The tests compared in the following table are a 4-hour test on the electric output and a ¾-hour test on the brake h.-p.

Load.	Corrected Gas per hour.	Watts.	H. P.	Per Cent. Slip.
Electric.........	397.1	13125	17.59	7.01
Brake...........	394.5		22.71	

From curve of watts and gas for loads of 10.1, 8.7, and 13.1 kilowatts, the number of kilowatts corresponding to a gas consumption of 394.5 cubic feet is 12.97.

* This ratio is the candle-power of light emitted by the electric light to the candle-power of the gas when burned in a flat flame burner. The ratios are greater than unity, which shows that there is more light generated by the electric system for a given amount of gas than by burning the gas in a flat flame burner.

If a = total power delivered by engine to friction clutch,
If y = efficiency of dynamo including friction,
b = fraction of total power lost in friction clutch,
p = external electric h.-p.,

$$\text{Then } y = \frac{p}{a(1 - b)}$$

12.97 kilowatts = 17.39 h.-p. $= p$

$$y = \frac{17.39}{22.71\,(1 - .0701)} = \frac{17.39}{22.71 \times .9299} = .831$$

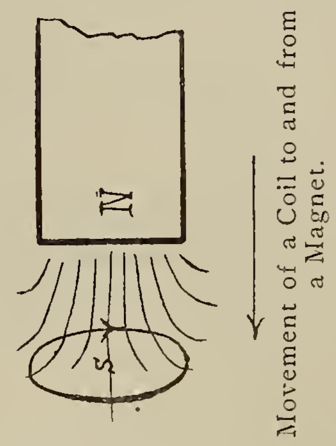
Efficiency of Engine.

Taking the gas per hour per brake h.-p. = 17.62 cubic feet. and the calorific power of the gas per cubic foot as 701.3 B. T. U.,

$$\text{the efficiency of engine} = \frac{60 \times 33000 \times 100}{17.62 \times 701.3 \times 778} = 2.06\%.$$

Conclusion.

The results of the tests are as follows:—
First.—Best length of air pipe = 3 feet.
Second.—Best position of gas valve, 7½.
Third.—Gas per K. W. per hour (full load) = 30.83 cu. ft.
Fourth.—The amount of light given by electric lamps which have been in use some time is 1.69 times as much light which the gas used to drive the engine would give if burned directly in burners.
Fifth.—Calorific Power of Gas = 701.3 B. T. U.
Sixth.—H. P. lost in friction of engine and dynamo = 3.83 = 13.8 per cent. of total h.-p.
Seventh.—H.-P. lost in pumping air = 1.15 = 4.2 per cent. of total h.-p.



Eighth.—Prony brake h.-p. = 22.71.
Ninth.—Gas per brake h.-p. per hour = 17.62 cubic feet..
Tenth.—Gas per hour to drive engine and dynamo (no load) = 95.2 cubic feet.
Eleventh.—Efficiency of engine = 20.6 per cent.
Twelfth.—Efficiency of dynamo = 83.1 per cent.

The above test of a direct-connected Nash gas engine and Dynamo, referred to in The Stevens Indicator, October, 1897, shows the economy of generating electric lights by this method.

Not alone are electric lights produced at an extremely low figure—less than 31 cubic feet of gas per kilowatt—but much more light is realized when the gas is used in the engine to generate electric lights than if it is used direct at the burner.

This amounts to 2.21 times when new electric lamps are used, and 1.69 times when medium lamps are used. (This includes gas consumed for igniting burners.)

The average price for furnishing 16-candle-power electric lights is usually one cent per hour per light, when supplied from the street service.

This test shows that 16 c.-p. electric lights can be produced by the Nash gas engine at less than one-fourth of a cent per lamp hour when using gas costing $1.25 per thousand feet.

Where gasoline is used, costing 8 cents per gallon, the cost would be one-tenth of a cent per lamp hour. The Nash gas engine is manufactured by the National Meter Company, 118 Chambers street, N. Y.

The Electrical Age.

Vol. XXI—No. 12 NEW YORK, MARCH 19, 1898 Whole No. 566

10-in. x 18-in. Pump and 85 H.-P. Motor.

ELECTRICITY IN THE LEHIGH VALLEY COAL MINES.

In the mines of the Lehigh Valley Coal Company, four miles north of Wilkesbarre, Pa., an interesting electrical installation has been in operation during the past year. The main workings of the mines are under the Susquehanna River Flats eastward from the shaft toward that river from the Wyoming Hills—the Western outcrop of the anthracite coal belt.

As the workings were greatly extended the problem of handling the constantly increasing volume of water became daily more difficult and the haulage of coal by mules more expensive. A steam plant on the flats was impracticable on account of their submersion and, after careful investigation, the Company decided to use electricity for the operation of the mine pump, and an electric cable hoist for the haulage of the coal over an extension of the main gangway.

The power house is placed near the head of the main hoisting shaft and contains the main hoisting engines, the generator and its driving engines. Steam is supplied from a battery of boilers set in another house about 200 feet away. The dynamo is a General Electric slow speed, 150 K. W. direct-current six-pole machine, driven by a Ball automatic tandem compound non-condensing engine. The speed of the engine is 200 R. P. M., that of the generator 400 R. P. M. The generator is compound-wound for 500 volts at no load and 550 volts at full load. An oak switchboard is placed against the wall of the engine room and current passes from the generator to the switchboard through heavily insulated copper cables suspended on porcelain insulators in a conduit under the floor.

The conduit is provided with a removable cover allowing ready access to the cables. The board is provided with two double pole feeder switches for the pump and hoist circuits in addition to the main double pole station switch. The pump circuit is protected by fuses, the hoist circuit by an automatic circuit breaker. From the two feeder switches the pump and hoist circuits are carried to the pole line. The positive and negative sides of each circuit are connected to suitable lightning arresters to protect the instruments and generators from the destructive effects of lightning.

The pole line runs from the station to a point almost above the centre of operations and the wires are run through a bore hole especially drilled for that purpose. The poles are 30 feet long and each carries one four pin cross arm with iron braces, wooden pins and glass insulators.

The positive feeders for the pump and hoist circuits consist of two separate 0000 B. & S. wires, and two 0000 B. & S. provide a common return. At about 5,000 feet from the power-house two bore holes, each 350 feet deep, are driven from the surface of the flats. One is provided with a six-inch iron pipe as a casing for the wires, the other with a 12-inch casing for the pump discharge. The six-inch pipe rises about 18 feet above the surface of the ground, the opening is thus protected against any rise of water during freshets. A small cable house is supported on this pipe, into which the line wires pass and make connection with the cable in the bore hole. The two positive feeders are connected to two separate cables; the two common return wires to one large negative cable; each cable is heavily insulated with rubber and jute braid, and then leaded and armored with iron wire protected from corrosive and electrolytic action by tarred jute. The cables are supported from the top of the stand pipe.

The method of suspension of the cables is unique. Six cast-iron plates, 1¼-inch thick and 18 inches square, are drilled with three 2-inch holes close together near the centre of the plate. The six plates are placed one above the other on top of the stand-pipe and the cables pass through the holes in all of the plates. The six plates are divided into three sets, each two in a set forming a clamp tightened by several small bolts. As one cable passes through the bottom clamping set the iron-armored wires are spread out and tightly clamped between the two plates.

Another passes through the hole in the first set and is clamped between the plates of the second set, the third armored cable being held between the third set. Each cable is, therefore, supported by its own armor and a separate clamp. Three additional lightning arresters protect the cable and line wires in the cable tower.

At the bottom of the hole the cables are connected by single pole-switches to the circuits operating the hoist and pump 600 feet distant. These underground wires are double rubber-covered and are supported on glass insulators fastened to props along the ribs. A wooden switchboard carrying fuse boxes, main switch and starting rheostat for the pump is erected in the pump chamber.

Point of Suspension of Feeders.

The motor for this pump is mounted on a cast iron bed plate and is geared by a double reduction gearing to the crank shaft operating the plungers. The motor is a General Electric shunt-wound machine, with a capacity of 85 H. P. continuously at a speed of 700 revolutions per minute. The pump is a duplex, double-acting pot-valve pump, manufactured by the Jeansville Iron Works with outside packed and connecting plungers, 10 inches in diameter x 18 in stroke. The pump capacity at 25 revolutions is 600 gallons per minute, under a head of 360 feet. As with all pumps operated with shunt-wound motors the speed of the gearing is approximately constant—a great advantage where the pump receives little attention and where the pump capacity is limited. Should the pump happen to run on air there would be no racing, as in the case of air and steam pumps, and the amount of energy consumed is only that required to overcome the mechanical friction of the rotating parts. The suction pipe drains from a large pump near the pump chamber, and the water passes up through the 12-inch bore hole to the surface, where a check-valve prevents the water returning during any freshets when the pump is not in operation. A small 4-inch x 6-inch triplex plunger pump geared to a 5 h.-p. multipolar slow-speed motor, pumps water up the small slope to the large electric pump.

The hoist is placed at the head of a small slope extending east from the parting at the foot of the main slope. The gangway in which the pump is placed is from 20 to 25 feet high and rather narrow. The hoist is placed on a platform built over the gangway and the operator stands on an auxiliary platform directly behind the hoist, where he is not troubled by the vibration of the hoist when running. The motor is of the General Electric Railway type, completely closed to protect the windings from dust and moisture. It is series-wound for 500 volts and is capable of developing 110 h.-p. for the intermittent work it is called upon to perform. The motor and drum are mounted on the same bed plate, and are connected by double reduction gears.

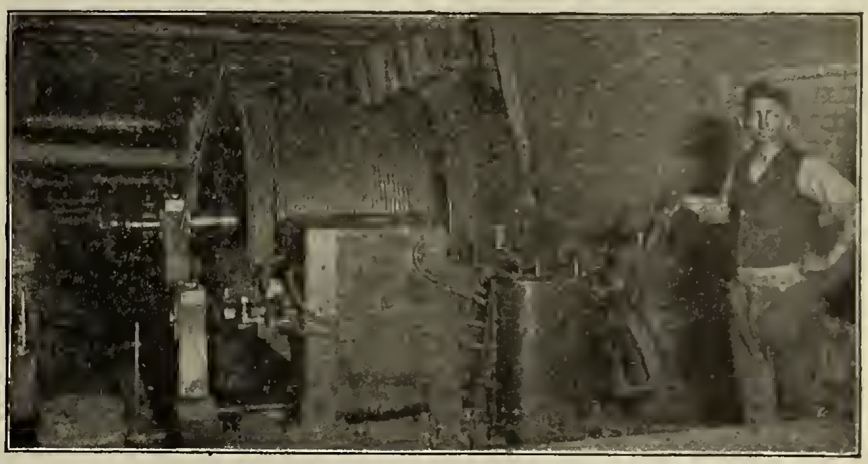
Power House.

The drum is of the friction-cone clutch type, manufactured by the Lidgerwood Manufacturing Company, and is provided with two band brakes lined with wood. The clutch and brakes are operated by three levers and quadrants, while the motor is operated by a rheostatic controller to the left of the levers. The controller is provided with a magnetic blow-out. The hoist drum is 48 inches in diameter and 36 inches face, and holds about 1,400 feet of one-inch wire rope.

Under full load the rope strain on the hoist, at an average speed of 500 feet per minute, is rated at 5,000 pounds. The hoist is operated under the single rope system, the empty trips are lowered by gravity and overhaul the rope, while the loaded trips are hauled up out of levels situated at intervals along the slope. The lowest level is about 1,200 feet from the hoist. The slope pitches on an average about 5°, with a maximum of 8° at the approach to the knuckle, above which the empty and loaded trips pass on a parting directly under the hoist.

The usual load up the slope is four loaded cars per trip at an average speed of 500 feet per minute. Each car weighs about three and a half tons, loaded, and in case of necessity the hoist is capable of hauling six cars per trip.

The installation of this plant was effected by the General Electric Company, and since it was started has operated continuously with satisfactory results.



110 H.-P. Hoist at Head of Slope.

ALUMINUM AS A RIVAL OF COPPER AND BRASS FOR ELECTRICAL CONDUCTORS.

BY ALFRED E. HUNT, S. B.
President of the Pittsburgh Reduction Company.

(Continued from page 150.)

Aluminum wire, rods, and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and therefore with the electrical conductivity equivalent of forty-eight per cent. of the weight of the copper and sectional area of 160 against the area of the copper section 100, the tensile strength of the aluminum conductors will be as 100 for the copper is to 160 for the aluminum. This would mean if a square inch of copper conductor was used of, say, 32,000 pounds per square inch tensile strength, the equal conductivity area of 1.6 inches of aluminum would have a tensile strength of 51,200 pounds.

It has been already determined that with aerial lines, the snow and ice load is practically as heavy on lengths of small wire as upon larger sections, so that no objection upon this score can probably be found to the use of the larger sections of aluminum wire.

Both on account of having only 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminum conductor could be used in much longer spans between supports, and the number of expensive poles and insulators can be materially diminished. Properly drawn aluminum wire is as tough and will stand bending as severely without breaking as soft copper wire. The toughness of aluminum wire is, however, greatly modified by the care and skill used in manufacture. If it is drawn too severely through the dies or is not well annealed at the proper intervals in the drawing operation, it is finished much more brittle than when properly manipulated.

Hard-drawn copper wire, especially that in the smaller sections drawn through diamond dies, is furnished with a tensile strength of 65,000 pounds per square inch. What the maximum tensile strength of the best pure hard-drawn aluminum will reach under similar favorable conditions for developing the maximum tensile results, has not yet been determined, but from experiments already made it can quite surely be predicted that at least 50,000 pounds per square inch can be obtained, and perhaps even higher strength still.

Aluminum hardened with a few per cent. of alloying ingredients can be furnished in wire with a tensile strength far in excess of what can be obtained in pure aluminum. Experiments are now being made by The Pittsburg Reduction Co. to determine just what alloy will furnish the maximum tensile strength, together with maximum electrical conductivity. From results already obtained, it can surely be predicted that an alloy of aluminum can be furnished which drawn into wire will have a tensile strength of at least 65,000 pounds per square inch and electrical conductivity of more than 50 in the Matthiessen scale. This material to rival hard-drawn copper wire and the silicon-bronze materials which are now in use, where maximum tensile strength together with good electrical conductivity are required.

The power of withstanding corrosion is greatly in favor of aluminum as an electrical conductor over copper. Copper does not change in dry air, but in moist air it becomes covered with a green layer of basic carbonate of copper, which itself has a corroding action and does not coat and protect the underlying copper from further corrosion. Ammonia in contact with copper absorbs oxygen and the copper dissolved in consequence of the formation of a soluble cupric-oxide and ammonia. This action is especially a source of trouble where copper wire is used in connecting rail joints in the tracks of electrical railroads where the ground is often subjected to ammoniacal solution.

Aluminum similarly is not acted upon in dry air and the corrosion in moist air is of the oxide of aluminum, alumina, a harmless salt which forms an impenetrable coating on the metal and protects it from further corrosion to a considerable extent. Ammonia solutions act on aluminum only upon the surface, attacking it and leaving behind a more resisting surface coating of a brown color containing silicon, which resists corrosion from dilute mineral acids and dilute solutions of organic acids as well as moist and dry air. Subject to sulphur gases such as locomotive flue gases, aluminum withstands corrosion better than copper.

If kept free from galvanic action with any other metals electro-negative to itself, aluminum is far less easily corroded than copper.

The difficulty of soldering or brazing aluminum is the chief drawback to its use as an electrical conductor. Aluminum can be soldered strongly, but it is a more difficult and slow operation at best as compared with copper, and there is much more rapid weakening of the soldered joint due to galvanic action between aluminum and the metals of the solder than with the less electro-positive metal, copper.

In many places the aluminum can be first coated with copper and the soldering or brazing operation made on the copper surfaces thus formed.

Several forms of joints have been successfully used to avoid the necessity of soldering; the best forms being to use thin aluminum sheets to wrap the joints and to twist or otherwise bind with the aluminum bars or wires to be joined. These wrapped and twisted joints with aluminum sheets can be left smooth on the outside when desired, can be made much stronger than the body of the conductors, and are really a more serviceable job than soldered or brazed work in many cases with copper. One very practical way of making joints of aluminum wire is to roll the thin aluminum sheet of about six inches width into two cylinders from opposite edges of the sheet. These double cylinders are very cheaply made on mandrels in a lathe. The ends of the wires to be joined are inserted in these cylinders from opposite ends and both the wire and sheet twisted with pliers until a firm joint is secured, much stronger than the body of the wire. The joint can readily be made impervious to the air and moisture.

The C. McIntire Company, of Newark, N. J., have a patented joint which is made very much along the lines of this joint. Information regarding their patented form of joint can be obtained by correspondence with them as above. Also the American Electric Fuse Co., Chicago, Ill., make a very satisfactory joint.

Another disadvantage which handicaps aluminum in special uses for electrical conductors will be, where the material has to be insulated, that the cost of insulation will be approximately one-third greater for the larger section required in aluminum over the cost for the smaller section of copper required for the given conductors; and where aluminum is to economically compete for insulated conductors, the price of the aluminum will have to be further reduced to meet this contingency.

Aluminum is soon to be placed in an extensive line of conductors where this added extra cost of insulation will be determined by actual fabrication; The Pittsburgh Reduction Co. in this particular case agreeing to pay the added costs, in order that actual experience may be gained as to their relative amounts.

There are certain places where aluminum will be at a disadvantage over the smaller section of equal conductivity of copper, in ducts or conduits where space is a considerable item. In such cases, the use of aluminum would necessarily be prevented.

An ample field for the employment of aluminum for some time to come, however, seems open at the present time for bare transmission lines, especially for high-potential long-distance work and for long-distance telephone lines and for rapid transmission telegraph lines.

Aluminum next to gold is the most malleable of all the metals and is much more malleable than copper.

Aluminum in ductility stands next to copper and is easily drawn into all sections that are furnished in copper for electrical conductors.

Aluminum can be furnished fully as uniform in its composition as copper.

The metallurgy of copper is comparatively complicated, owing to the difficulty of converting its ores into the oxide free from impurities. In most of the copper ores used, sulphur, lead, and iron are contained as well as small quantities of other elements, as arsenic and antimony. All of these elements in metallic copper very materially lower its electrical conductivity. The native pure copper of the Lake Superior region enjoys the preference, due to its uniformity and freedom from impurities, for many purposes, but for electrical conductors the electrolytic copper is most used.

Aluminum can now be furnished rivalling for electric conductors at least 99.50 per cent. pure—it is granted not as yet in purity of composition—the best electrolytic copper used for the purpose of electric. conductors. When as pure metal is obtainable it will undoubtedly more nearly rival copper in electrical conductors, section for section.

Aluminum has been already in successful operation as an electrical conductor for some time. The first use in a large way was with the conductors for the electric current at the Niagara Falls Works of the Pittsburg Reduction Co., where it has been used since the year 1895; the currents were of several thousand horse-power each and of very large volume and comparatively low voltage. Both in conducting power, freedom from heating effects, power of withstanding corrosion, ease of making, wear, and efficiency of joints, the aluminum conductors have given better results than copper used for the same purpose.

In the Chicago Stock Yards, a mile of aluminum wire of No. 11 gauge has now been in use for some time, upon a telephone line that has been badly corroded out in copper wire, due to its being frequently subjected to sulphur gases from passing locomotives. The aluminum line is giving good satisfaction and is withstanding corrosion much better than did the original copper wire subjected to the same influence.

If the theory be true that the passage of high voltage alternating currents of great frequency is largely upon or near the surface of the conductors only or mainly, then the larger section of the proposed aluminum conductors will make them especially adaptable for such currents.

On telephone lines, it has already been determined that as good sound transmission is obtained with aluminum of equal section as with copper, in ordinary lengths of less than ten miles of wire. No comparative results, however, have as yet been determined on long distance telephone transmission; but the evidence would seem to point that a much less section than 160 of aluminum to 100 of copper will give equally good results.

Aluminum is now being used to replace brass very considerably in the arts, as it is sold in the open market at rates which make it ten per cent. cheaper, section for section, than brass.

For electrical purposes, the metal can be advantageously used to replace brass in a good many ways. Commercially pure aluminum as furnished today contains less iron than does commercial brass, and is therefore more non-magnetic than brass.

The electrical conductivity of aluminum is far superior, section for section, to brass. Almost every electrical apparatus of present construction in which an iron core—usually a laminated iron core—is used, in motors, generators, or transforming machinery, has spaces for ventilation, and the spacing is made by the means of drawn bars, flat rods or angles or tee-shape pieces. Brass has been almost invariably used for this purpose in the past—probably on account of its non-magnetic properties as compared with iron or steel. Drawn aluminum sections can be furnished at a price which is ten per cent. cheaper than brass, section for section; and on account of the lightness of aluminnm, it can be advantageously used.

Where a low electrical conductivity is desirable, as in parts that are moved in a magnetic field, to prevent the occurrence of eddy-currents, aluminum can be alloyed with zinc and other metals that will lower its electrical conductivity to the desired points.

A STEEL FRAME BOX-CAR.

In an interesting paper, read at the December (1897) meeting of the Northwest Railway Club, Mr. H. H. Vaughan presented a design for a 40-foot, 60,000-pound box-car, which has some novel features, among the most important of which is the use of the side framing of the upper part of the car for carrying the load, the object of this being to reduce the weight of the car to the lowest terms. The load in Mr. Vaughan's design is provided for entirely by the car sides, and the centre sills are supported and are used for local strength and for the pulling and buffing stresses. The car is 8 feet 6 inches wide over the side sills and has a total floor space of 330 square feet, which will accommodate a load of 60,000 pounds. Mr. Vaughan describes the design in the following words:

"The general design is shown by Fig. 1, and it will be seen that the truss is of the ordinary 'N' type, with posts in compression. The transoms are 30 feet centres, and the floor is carried by four beams at the panel points, which are spaced about 6 feet apart. Each of these floor beams would carry a load of 9,300 pounds if the load were uniformly distributed, but I consider that the possibility of heavy local loading must be taken into account, and for this I have allowed a double load of 18,600 pounds on one floor beam, but under these circumstances have taken the load on the adjacent floor beams at 4,700 pounds, making as before a total of 28,000 pounds for three beams. I believe that such an assumption will be

The paper also treats of the resistance to bulging of the ends and sides of the car, showing the necessity for providing for these stresses especially in steel members acting as struts, because the fiber stresses increase very rapidly under combined compression and bending, and also because steel has less margin between elastic limit and rupture than wood. To guard against these stresses the three-inch channels shown at posts and braces are placed with their webs at right angles to the sides or the ends of the car, which gives a strength of about four times that of wooden posts. Another feature of the design is the arrangement of the posts so that the loads come upon the outside of the posts at the top ends and are transmitted to the car at the bottom on the inside of the posts, whereby the eccentric loading is almost entirely neutralized. To guard against stresses caused by poling or pushing the car from one corner, the designer uses diagonal braces from the corners of the car

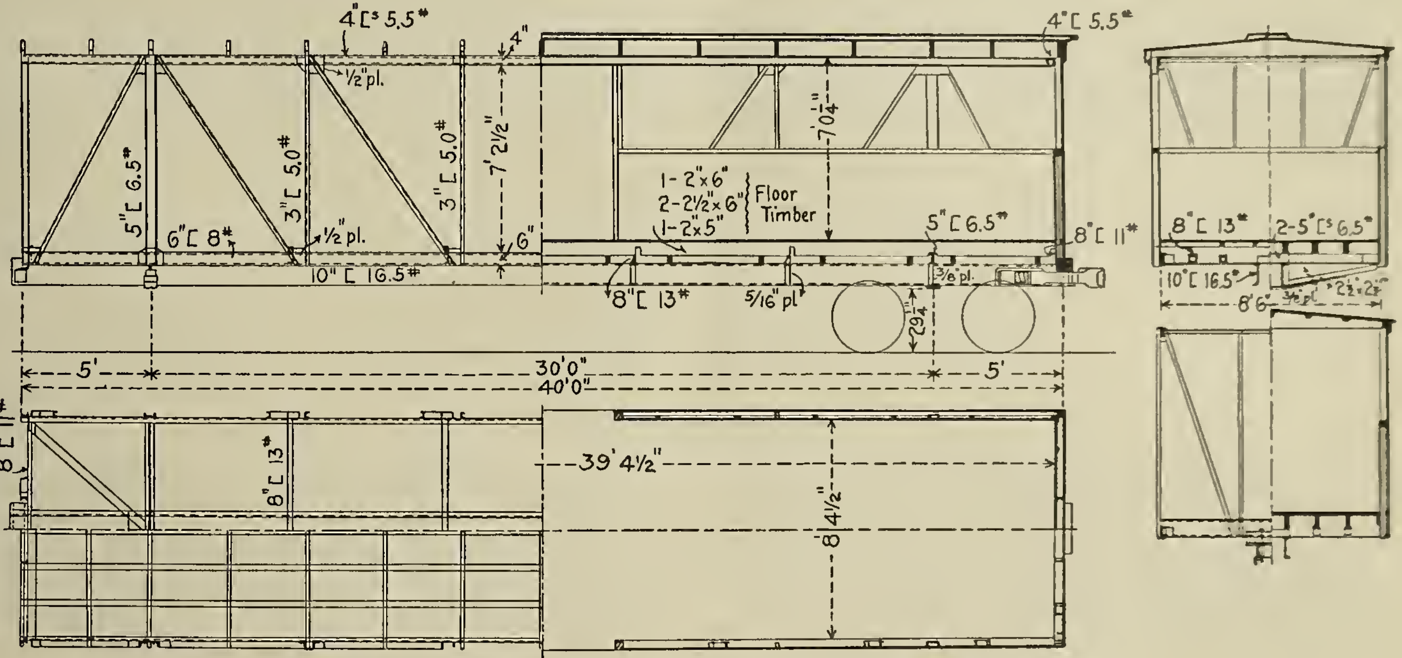


*Fig. 1—Design for 60,000 Pounds Capacity Box Car.

found to meet all cases that will be encountered in practice, as no machinery or metal will be loaded that would give rise to greater local weights.

The diagram Fig. 2 shows the stresses on the framing, the left-hand side being for a uniformly distributed load and the right-hand side for a load concentrated as above described, but symmetrical with respect to the centre. The weight of the frame sheathing, roof, etc., is included. The allowable stresses in the various members are taken as follows:

On framing, 12,500 pounds per square inch for tension, 8,000 pounds per square inch for compression.

"On rivets, 7,500 pounds for shearing, 15,000 pounds per square inch for bearing.

"By reference to Fig. 1 it will be seen that the posts and braces are made of 3-inch channel, 5 pounds per foot, and the maximum stress will be 10,000 pounds for tension and 6,800 for compression. The transom post is a 5-inch channel, 6.5 pounds per foot, and the stress on it is 7,600 pounds per square inch. The side plate is a 4-inch channel 5.5 pounds per foot; the maximum strain for this occurs between the door posts, and for a uniform load is 8,300 pounds per square inch, but as this is a continuous section, an excess is perfectly allowable, and it is prevented from buckling sideways by the roof, fascia boards and door track.

"The buffing and pulling strains in this car are taken by two 10-inch channels, 16.5 pounds per foot, which run the entire length of the car. The combined area of these is 9.8 square inches, or as great as that in the shank of the coupler, and in my opinion should be strong enough to resist any shock that will not entirely wreck the car. The collapsing strength as a column is about equal that of the four centre sills in a 60,000-pound car, and would appear ample by that comparison."

to the centres of the body bolsters. He considered it desirable to attach the draft rigging directly to the sills by riveting, which would probably save repairs.

The weight of a car body built on this plan was put at 17,500 pounds, which included all attachments and fittings above the trucks. The details of the weight are as follows:

	Pounds
Steel frame with centreplates and attached castings........	6,440
Floor beams, belt rails and railing strips....................	1,550
Roof and running board lumber...........................	2,150
Sheeting side and end door lumber........................	2,470
Floor..	1,270
Coupler and draft rigging, deadwood, etc.................	1,220
Brakes...	1,980
Side and end door iron work..............................	220
Hand holds, corner plates, etc...........................	250
Bolts, nuts, etc.......................................	160
Total..	17,510

The total weight of a wooden car body of this size and capacity was 20,000 pounds, or 2,500 pounds more than that of the steel car, the difference being in the first two items in the list. Allowing for variations which might be required in his design after placing it in service, the author considered one ton per car to be the amount saved by his design over a wooden car. Then by figuring on the car mileage he places the cost of hauling one ton of extra weight in a car for a year at $27; this amount, and probably also a saving in the cost of repairs, should be credited to the use of such a car.

In conclusion, Mr. Vaughan says: "The trussed frame car in some form or other offers the lightest car for a given capacity, and while it is less sturdy than those with metal underframe alone, it appears to me the most advantageous form to use."

*Cuts loaned through courtesy of Amer. Engr.

A GENUINE TOURNAMENT.

S already announced the New York Electrical Society, during the month of May, will give, under its auspices, an electrical exhibition in Madison Square Garden, New York. In connection therewith, an auxiliary and educational committee has been formed to take general charge of exhibition matters other than commercial, and it has been decided that one or more evenings duriug the exhibition shall be set apart for a telegraph tournament, and we take great pleasure in advising the "crack" senders and receivers of America to tune up their keys and sounders and get on their best gait, for there will certainly be a "hot time" in Madison Square Garden some time during the month mentioned.

It goes without saying that this will be the greatest telegraph tournament ever held in the world. The committee has secured the services of Mr. Fred Catlin, who is the most competent gentleman to successfully conduct an affair of this magnitude. Mr. Catlin is justly termed "the father of telegraph tournaments," for, with one exception, he has managed every telegraphic contest which has been held in New York since 1866, when Mr. Pat Burns, of Boston, won the gold key, including the Bunnell key contest, in the Western Union Building in 1884, which was won by Mr W. L. Waugh ; the Victor key contest in the United Press rooms in 1885, won by Mr. J. W. Roloson, and the great national fast-sending tournament at Hardman Hall in 1890.

These affairs were not conceived or carried out by Mr. Catlin with a view to pecuniary gain, but through his interest in the matter of bringing the art of telegraphic manipulation up to its highest point. We have heard him say he would prefer hearing the music of a Roloson's, Gibson's, Kihm's, or Frank Catlin's transmission to listening to the grandest of operas, and in this respect he is not unlike many whom we have met.

Mr. James D. Reid, the "the father of the telegraph" and well known to every operator the world over, has consented to act as chairman of the board of judges. Mr. Reid's appearance on such an occasion as this will be hailed with positive delight by the fraternity at large, and no doubt his presence will encourage operators from all sections of the country to visit New York to capture some of the numerous prizes.

Mr. J. B. Taltavall, a member of the auxiliary and educational committee, will also assist in looking after the interests of the telegraph boys.

In conversation with Mr. Fred Catlin a few days ago, he remarked that he also was determined that the telegraph tournament should be a success in every particular and that it shall surpass any previous affair of its kind. The management will spare no efforts to make this feature of the exhibition a most attractive and successful one. The prizes will be liberal and the contests numerous, and there will be ample opportunity for the young talent which has come into the field since the last tournament of five years ago to show of what stuff it is composed. "It is my opinion," said Mr. Catlin, "that the records will be smashed by more than one.

"The exact dates of the contests have not yet been determined. If it is found that one afternoon and evening are not sufficient time for running off the various classes, more time will be allotted.

"Handsome medals or badges will be awarded to the winners, to which will be added liberal cash prizes.

"The prevailing opinion, in which I concur, is that the same matter should be used in every telegraphic contest for the purpose of comparison. It is just as necessary and important in this work as it is that the mile-race track should measure exactly 5,280 feet.

"At the tournament of 1893 the top records were :

	Minutes.	Words.	
Kihm,	5	248	perfect.
Catlin,	5	248	"
Gibson,	5	246	2 errors.
Mecredy,	5	249	14 "
White,	5	248	10 "

"The matter used in the contest of '93 was entirely different from that used in '90, so exact comparisons of work done cannot be made. The transmission of Mr. Pollock in the tournament of 1890, while it was the most remarkable ever listened to in a public contest in the matter of speed, would not have been acceptable under the conditions of the contest of 1893, owing to the frequency of imperfect characters. It is possible for a first-class operator to read easily perfect transmissions up to a speed of about sixty words per minute—a speed not likely to ever be reached by hand transmission. The value of transmission is lost when it is not rendered clear and accurate, and judges will so render their decision."

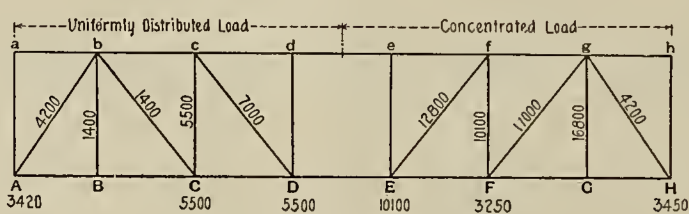


Fig. 2—Stress Diagram.

Mr. Catlin will as soon as possible issue a circular for the information of operators desiring to participate in the contests. This circular will contain records of past tournaments, conditions to govern the coming affair, classifications, date of closing of entries, the matter to be used in transmission, and other things which may be suggested as being of interest to the fraternity.

Of course one of the features of the tournament will be a typewriter receiving contest, which it is expected will be participated in by the friends of every known typewriter on the market.

The most liberal prizes will be awarded to the victors, and we can assure those who wish to participate in this tournament, whether residents of New York, Chicago or San Francisco, that they will be well taken care of and repaid for their trouble if they will visit New York and take part in this greatest of all telegraph contests.

RAILWAY EARNINGS IN SWEDEN.—Under date of February 12, 1898, Consul Winslow writes from Stockholm: I have the honor to send a synopsis of the annual report of the state railway system in this kingdom. The year 1897 brought a golden harvest, and a very material increase in business is shown by the following figures: The number of passengers carried was 8,379,096, of which 37,358 were first class, 1,122,872 were second class, and 7,228,866 were third class. In addition, there were carried 117,020 soldiers and prisoners. The number of animals carried amounted to 563,494 head, of which 21,422 were horses, 22,040 dogs, and 320,152 cattle and swine. The receipts were: Passengers, $3,125,000; transportation of mail, $200; transportation of live stock, $195,000 ; total freight receipts, $,500,000; sum total with other items for 1897, $9,600,000; sum total for year 1896, $8,250,000.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - $2.50
One Copy, six months, - - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, MARCH 19, 1898.

CONTENTS.

TWELVE THOUSAND VOLTS IN THE LONGEST UNDERGROUND LINE IN THE WORLD.

The transmission of power over long distances has been successfully performed in many notable cases. The secret of economical power transmission is to be found in the use of a high pressure. The development of alternating current systems has been greatly stimulated through inventions relating to polyphase motors; in fact, the adoption of two and three-phase systems for commercial use only became successful since motors have been perfected to run on these circuits.

There are certain questions arising in the consideration of power transmission systems which have been so well answered by modern electrical engineers as to cause wonderful progress in the transmission of power at pressures that could have not been even insulated a few years ago. The point to be considered in the use of thousands of volts in a transmission line is one met with in every text-book dealing with the subject of transmission of power. It is as follows: "With double the E.M.F., or half the current, we require only half the cross-section of wire. We can therefore deliver current twice the distance with the same percentage of loss in the wire. A ten-thousand foot line, carrying five hundred volts, loses 25.9 per cent.; a 20,000 foot line, carrying 1,000 volts, loses exactly the same amount of energy."

It is obvious that power transmission has become eminently successful through a full comprehension and application of this principle. High-tension transmission lines are not only placed upon poles with suitable insulators attached, but laid underground in conduits. In Germany it is the practice to paint poles carrying high tension wires with a skull and cross-bones. But even this does not prevent the little village boys from throwing stones at the insulators and taking extreme delight in fracturing them.

This is but a mild case of the difficulties met with by proprietors or managers of high-tension transmission plants. Of late, paper-insulated cables have come into use for high-tension service, and to one we call particular attention. It is a cable more than nine miles long, which has easily withstood a pressure of 18,000 volts for more than eight hours. This is the longest underground three-phase cable in the world. It carries a steady pressure of 12,000 volts and transmits the power running all of the city of St. Paul's trolley cars, which represents 2,000 horse-power at the very least. An exceedingly high pressure test has been made of the St. Paul cable, during which 25,000 volts were sent through it. An extract from a letter received by the National Conduit and Cable Company from the Twin City Rapid Transit Company states that "this cable, over nine miles long, carried 18,000 volts alternating current for over eight hours. After this test the high potential switches were broken on 12,000 volts, when the cable was transmitting 700 horse-power." The present pressures used will gradually be raised in the near future. It is very likely, in view of the economy due to these high voltages, 20,000 and 30,000 volts will be used on transmission lines. There is one conclusion to be drawn from the above statement and that relates to the remarkably high insulating power of the materials used in covering transmission lines, particularly the high grade of paper-insulated cables. The demands made upon the manufacturers of cables and conduits have increased year by year until at present we view an illustration of the survival of the fittest. The pressure used for power transmission has grown to such enormous figures that only those manufacturers able to deal with this problem in a highly scientific as well as commercial manner have remained in the field.

The others through incompetency have passed away, and as the tests become severer and the requirements greater, manufacturers of conduit and cable will find their only salvation in a policy as outlined above.

So far, however, remarkable results have been obtained through the earnestness with which cable manufacturers have continued their experiments. The profession owes a great deal to those whose confidence in high tension electrical transmission have instituted such changes.

The power plant at Niagara will soon be but one of many, and who knows but that a perfected system of high-tension transmission will not soon override the railroads by transmitting thousands of horse-power from the coal mines direct to large cities, burning the fuel where it is found, and saving thereby the millions of dollars that its carriage calls for.

ELECTRIC RAILWAYS AND LIGHTS IN FRANCE. —Consul Jackson of Cognac, under date of February 25, 1898, reports that the city of Niort proposes to have an electric railway and lights for its streets. Communications should be addressed to Monsieur la Maire de la Ville de Niort, Deux-Sèvres, France. There is also, says the consul, a movement on foot to connect La Rochelle with the new port, La Pallice, by an electric line 2½ miles long. Communications should be addressed to Monsieur P. W. Morch, Chamber de Commerce, La Rochelle, France.

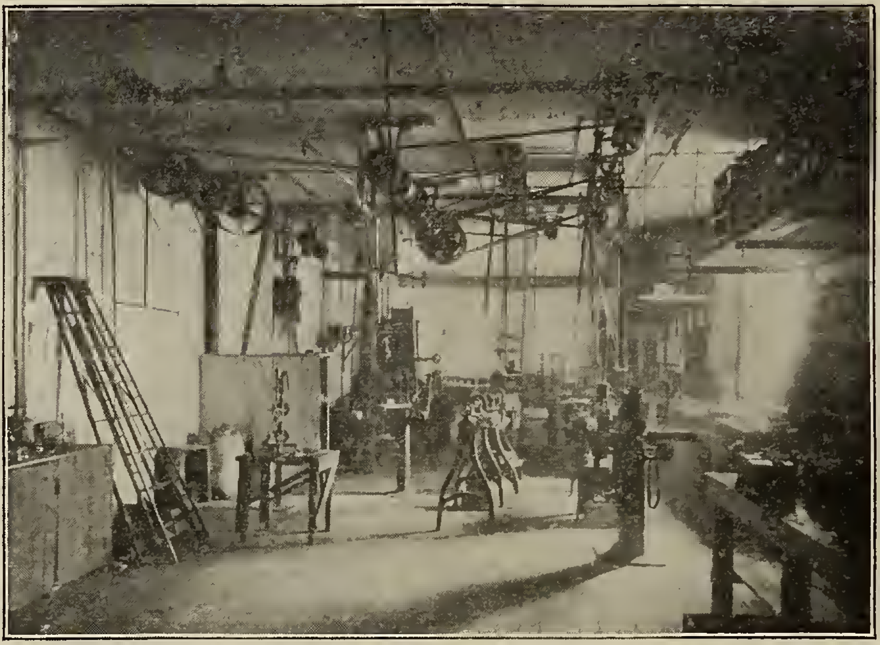
Tests were recently made by a celebrated French mechanical engineer to ascertain the work expended in the propulsion of a bicycle. It was found that at ten miles per hour the work per semi-revolution was 18.58 foot-pounds, and at twenty miles an hour it was 63.62 foot-pounds. From this it would seem that the work of propelling a wheel at twenty miles an hour is more than three times as great as the effort expended to keep it running at ten miles an hour.—Locomotive Engineering.

Muscatine, Iowa.—The Mississippi Valley Telephone Co. will shortly establish a new telephone line.

THE TELEPHONE WORKSHOPS OF DE VEAU & COMPANY.

The quarters occupied by De Veau & Company, of 27 Rose street, New York, possess every facility for the rapid construction of telephonic apparatus. The latest types of machinery are in use and the most modern methods employed in the construction of De Veau outfits. All materials and goods are handled at the Rose street end of the factory. Adjacent to the office, which is separated from the work-room, is a spacious shop in which all the machinery employed is to be found. The lathes, screw machines, drills and tables are of the kind most suited to the rapid construction of the telephones, magnetos, transmitters, etc. Everything is systematically arranged, so that no delay is experienced in assembling the apparatus.

De Veau & Company have earned a worthy name through the high grade of their telephone equipments. The best of materials are used and the greatest care taken in the fitting and perfection of each individual part. Their telephone switches are decided improvements over others already on the market. They make a better contact and possess a greater range of action, and in other respects override competition. The transmitter consists of a carbon disk, permanently attached to the diaphragm. At the back of the transmitter is another diaphragm stamped with concentric corrugations. Coal grain carbon is held between the two disks by a piece of wool cloth, thus holding the granulated particles between diaphragm and diaphragm. A spring gives the utmost flexibility, holds the carbon particles in place, but also allowing vibrations to be clearly transmitted. A covering of oiled silk between the diaphragm and mouthpiece keeps the transmitter free from moisture. This exceedingly delicate and practicale instrument operates with a single cell in circuit.



*New Telephone Factory of De Veau & Co.

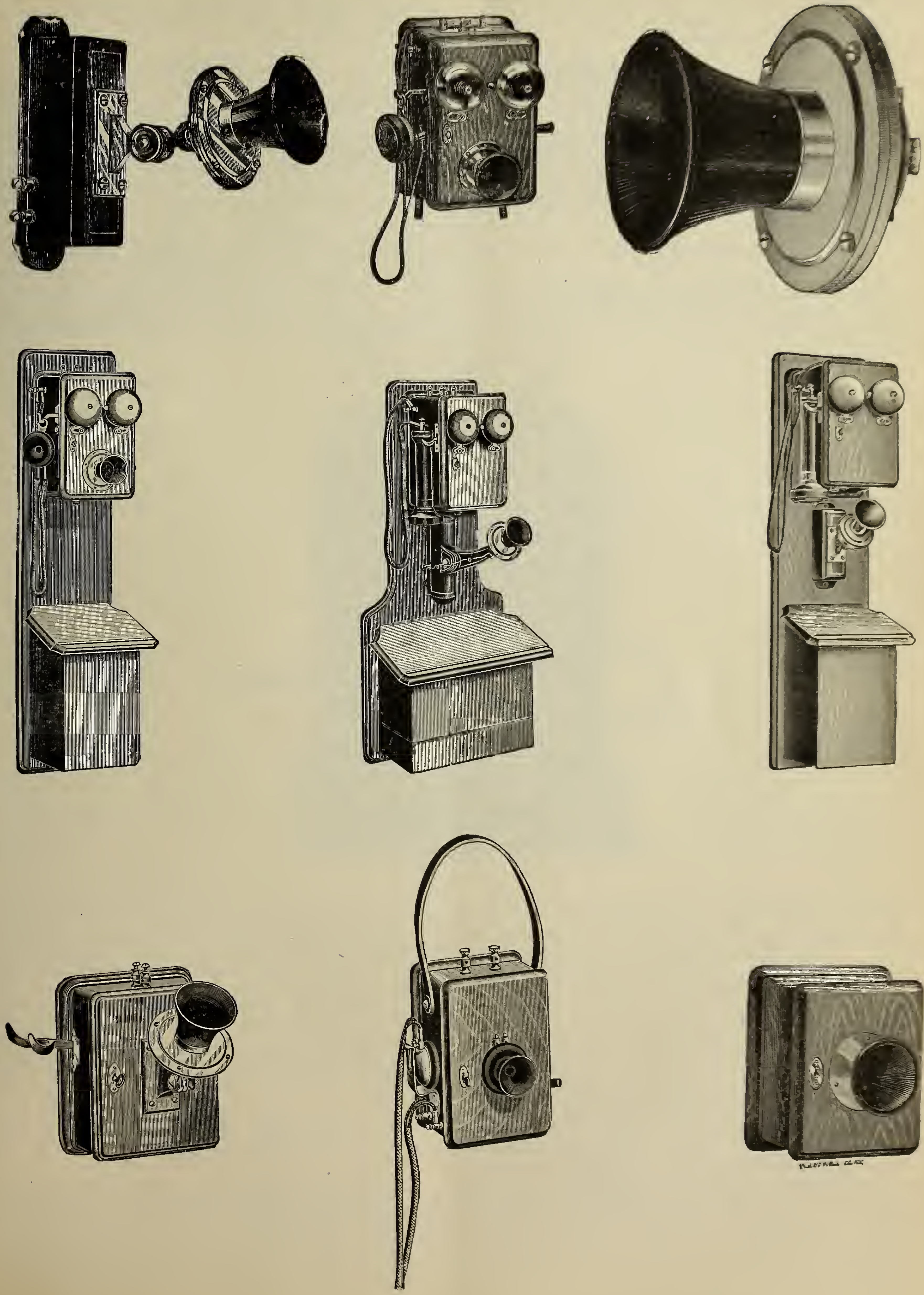
Besides the above transmitter many other interesting pieces of telephonic apparatus are manufactured by De Veau & Company, including a watch-case receiver of excellent design. De Veau outfits may be found on board of U. S. war vessels Brooklyn, Iowa and others not quite finished. They make a specialty of divers' telephones and will supply any form of telephone used in marine ork.

De Veau & Company possess an excellent reputation as manufacturers, their goods being known among the world's producers of telephones. They will be glad to extend every courtesy to friends visiting them at their new quarters.

*New Telephone Factory of De Veau & Co.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—The twenty-first convention of this association will be held in Chicago, Ill., June 7, 8, 9 next. The headquarters of the association will be in the Auditorium Hotel, and hotel rates will be from $3.50 to $5 on the American plan or $2 to $4 on the European. The meetings will be held in the banquet hall of the hotel, which have been kindly offered for the use of association.

*Cuts loaned through courtesy of Elec. Review.



DE VEAU & CO.'S TRANSMITTERS AND TELEPHONE OUTFITS.

INCANDESCENT LIGHT AND EDISON SYSTEM.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The history of electric lighting is not very old. Its different branches have developed to such an extent that some of the heaviest investments in this country are made in electric light plants. The electric light systems of the United States may be divided up into two general departments:

Incandescent Lighting.
Arc "

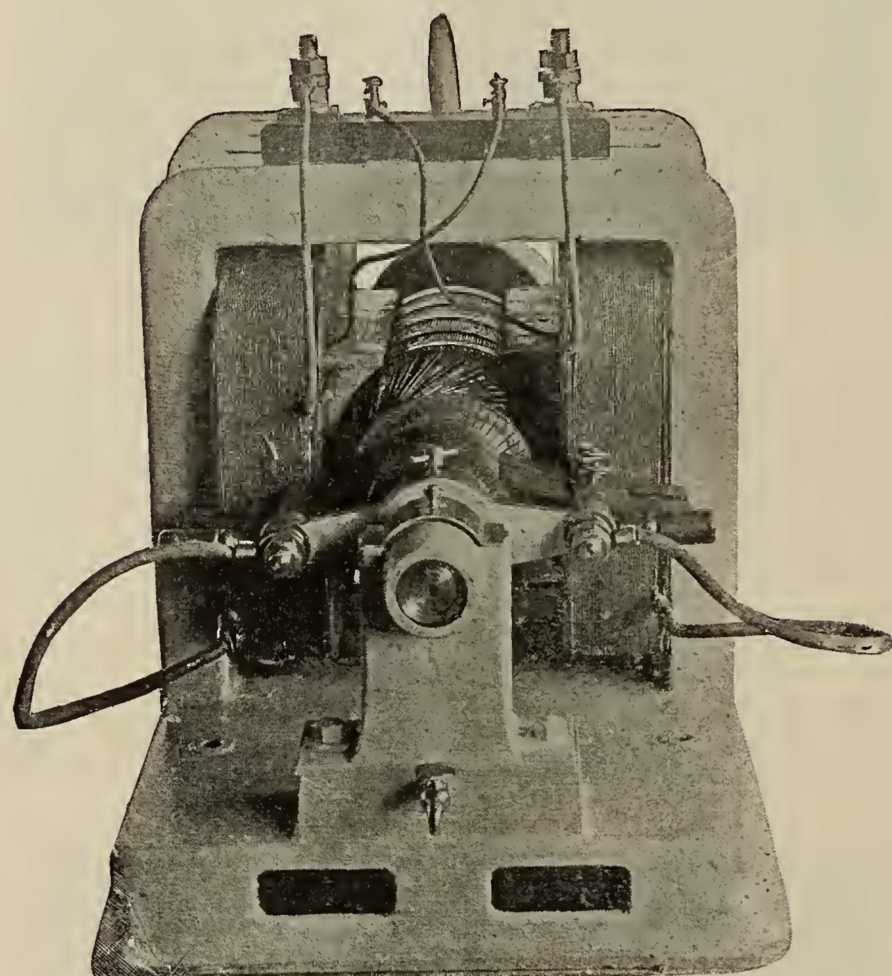
Under the heading of the first we are prepared to consider the development and present condition of incandescent light systems.

Basis of Lighting System.—Any wiring system which will allow a uniform pressure to prevail throughout is valuable in two respects:

(a) Lamps are saved.
(b) Light is constant.

Under the conditions mentioned the long life of a lamp is assured. There is no greater cause of breakage in lamps than the rising or fluctuating pressure in the lamps. Again, from a purely commercial standpoint the constancy of the light is so important that, unless some means is taken to keep it constant, customers cannot be retained, and the damage caused by this double difficulty becomes irreparable.

Function of the Dynamo.—To keep the pressure constant in the line the dynamo itself must preserve a uniformity of pressure, or at least within very slight variations. The line depends upon the dynamo, but by means of an ingenious arrangement the dynamo can be also made to depend upon the line. By the two affecting each other we have a system sensitive to outside changes. Compound winding enables us to retain the pressure about constant, or at least to raise or lower it when so desired. This at once brings us to a consideration of the cause of such changes.



Iron Clad Dynamos.

Kinds of Lighting.—The lighting of incandescent lamps is effected either by continuous or alternating current. An incandescent lamp only calls for a certain pressure and current; when these are supplied the lamps at once become normally bright and the problem of incandescent lighting, as far as the light is concerned, is complete. There are, however, certain stringent reasons for observing such limits as are imposed by circumstances, and which prevent the attainment of more than a limited light without extraordinary expense. That to which reference is made is the line circuits which carry the current, and which by their arrangement practically gives the system of lighting its name. The success of incandescent lighting depends entirely upon the size, length and support of the line as well as the nature of the dynamo and its additional attachments. The most common system of incandescent lighting known is the Edison. There are in this system certain features which have made it the superior of all others. The reason for this is due to the fact that all the wiring represents a network of squares, arranged in such a manner that one point is at the same pressure practically as any other. The secret, therefore, of successful incandescent lighting is the preservation of a uniform voltage at all points.

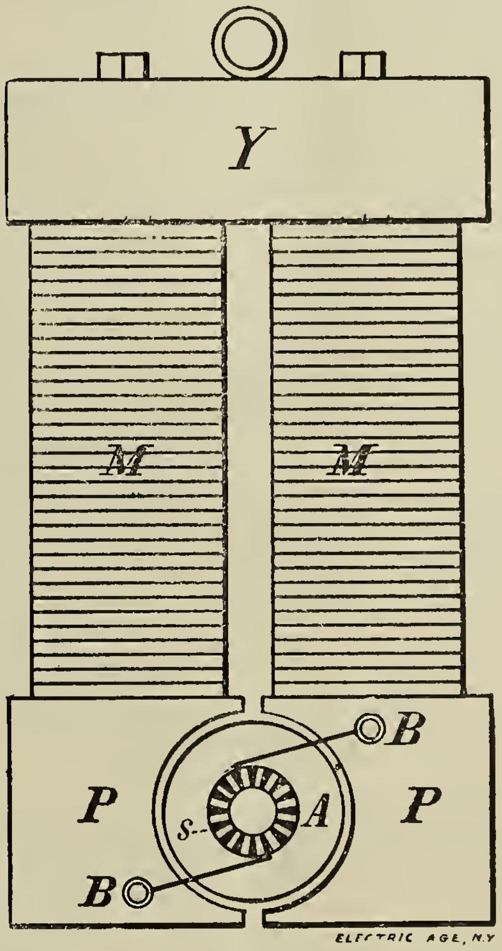
Regulation.—The dynamo would not require any extra device if the load upon it were constant, but the continual changes affect the dynamo as follows: When the dynamo is supplying 110 volts and a load of lamps are thrown on, the pressure may fall to 105 volts, due to the

drop in line,
armature reaction,
drop in armature.

Conversely, if the dynamo is laboring under full load and the lamps to a large extent are removed, the pressure will rise from the point it is at and perhaps cause serious injury to the remaining lamps. A regulating device is therefore necessary when circumstances cause such rapid changes as these. The device used is in itself simple enough.

Compound Coil.—A rise or fall in volts is due to the conditions enumerated; a loss of volts in the armature, a loss in the line and armature reaction. These three factors pull down the voltage considerably, and their combined effect is very noticeable with each increase in the number of lights.

To compensate for this loss the dynamo is made sensitive to the changes of load in a very simple manner. A coil is wound around the magnets of the dynamo of large enough wire to carry the current of the line; when the current in the line increases the ampere turns due to this winding increase also, and the dynamo has its pressure increased because the ampere turns have strengthened the field.



Y—Yokes. M—Magnets. P—Poles. B—Brushes. A—Armature.

If these changes are automatic the dynamo will adjust its potential to the number of lamps, and always be high enough to keep them at normal candle power. The ease with which this arrangement works is surprising; it is in popular use in every isolated as well as central station plant.

The success of incandescent lighting depends upon a wiring system that causes as little loss as possible with the greatest possible variations in current.

The Edison network is the nearest approach to perfection of anything we have. It consists in the main of three parallel webs of wire; between each two adjacent webs there is 110 volts pressure, and between the two most apart, the first and third, 220 volts. The economy of saving one wire and yet having two lighting circuits that are independent, yet in close combination, is obvious. The two outer circuits, between which there is always 220 volts, are greatly used for motors. When the same number of lamps exist on each side of the middle web of wire the system is said to be balanced. The web-like formation is due to the fact that the wire is distributed through streets, which give it the shape of a netting with square meshes, each mesh including one block.

QUESTIONS FOR REVIEW.

(1) Name the two great electric light systems.
(2) What kinds of incandescent lighting are in vogue?
(3) What must be preserved in an Edison system of electric lighting?
(4) State the benefits of a good wiring system.
(5) What purpose does the dynamo serve?
(6) Why must the dynamo regulate?
(7) What is a compound-wound dynamo?

AMATEUR MODEL MAKING COMPETITION

AT THE ELECTRICAL AND KINDRED INDUSTRIES EXHIBITION.

A committee consisting of Prof. Loeb, Dr. A. Doremus, Dr. W. E. Geyer and Mr. T. C. Martin has drawn up rules and regulations for an amateur model making competition in connection with the electrical exhibition. Printed forms can be had from the Management, 15 Cortlandt street. The classes are given below, each class having prizes not to exceed $50.00 and bronze medals, the exhibits to be judged by a committee of five well-known men. It is believed that the contest will awaken general interest and elicit some beautiful and interesting apparatus. There are a great many young people and students in and around New York who find pleasure in handiwork of this character. The classes are as follows, and the exhibits must be entered a week before the exhibition begins.

Class A.—Working model or actual machine of a dynamo-electric or electro-dynamo type; made by one or more boys under twenty-one, so far as designing lathe-work, assembling and finishing is concerned.

Class B.—Instrument of precision, made by amateur or student; including galvanometers, resistance bridges, etc., etc.

Class C.—Practical application of electricity to communication, the assembling to have been the work of a single exhibitor.

Class D.—Ingenious application of electrical appliances to domestics, etc., uses by an amateur under eighteen; none of the apparatus to be necessarily of home manufacture.

Class E.—Design or working drawing of an electrical appliance or installation, made within the past twelvemonth by a student of a recognized chartered institution, and bearing the instructor's certificate.

Class F.—Design or instrument made by a teacher, below the grade of college professor, for illustrating some electrical law.

Nanaimo, B. C.—The Nanaimo Light, Heat and Power Company are seeking to extend their powers.

GREAT VERMONT POWER PLANT.

The Winooski river, which flows across northern Vermont and played so prominent a part in the history of the state during the French and Indian wars, is now destined to hold a no less important place in its industrial development, says the Electrical Review.

Between Essex Junction and Burlington, about two miles from the latter place, the river has cut an immense gorge through the rocks nearly 100 feet in depth. Just at the head of this gorge the stream divides, leaving a high rocky island in the centre. At this point the Vermont Electric Company has installed one of the most substantially built and finely equipped electrical plants in New England.

The dam, which is 204 feet long, 31 feet high, and 60 feet thick at the bottom (with an apron 12 feet wide extending across the top), is built of wood and stone, 700,000 feet of hemlock timber being used for the crib, which is filled with stone. A large reservoir is thus formed, furnishing abundance of water even in the driest seasons of the year, and giving a maximum head of 40 feet.

There are at present three turbine water wheels developing an aggregate of 1,600 horse-power, and openings in the dam for five more wheels of 600 horse-power each, which will be added as required.

The power-house is 115 by 60 feet, and is built of stone and iron, set on a solid masonry foundation extending across the stream, and is a model of arrangement; so smoothly does every part work that very little vibration is perceptible even when the entire plant is in operation.

Extending the entire length of the upper story of the power-house is a 7-inch steel shaft 210 feet long, to which the turbines are belted by 52-inch belts, and from which are belted two 225-kilowatt Westinghouse three-phase generators (2,500-volt primary, 250-volt secondary); two 2,000-light Thomson-Houston alternators (2,000-volt primary, 104-volt secondary), and five 60-light Brush arc dynamos. Each dynamo is provided with a voltmeter and ammeter and an automatic circuit governor.

The switchboards are of skeleton pattern, made of iron and marble, provided with down-pull knife switches, and so arranged as to connect the dynamos in series or to any circuit desired. The several circuits, after leaving the dynamos pass out of the power station through a tall cupola to the poles.

To provide for any emergency that might occur by the breaking down of the water-power plant, a steam plant has been installed consisting of three 125-horse-power and one 150-horse-power horizontal tubular boilers, connected to a 500-horse-power engine. Light and power are furnished for the city of Burlington and the village of Winooski.

Two hundred and fifty arc, 6,000 incandescent lights and 37 motors developing 350-horse-power are used at present, with a probability of more motors and of larger capacity being added soon. No small amount of credit is due the Vermont Electric Company, and especially its general manager, Dr. Walter S. Vincent, for the successful installation of this plant, as it really was the pioneer to demonstrate in Vermont that electricity could be successfully generated by water-power and transmitted for commercial purposes.

Capital is finding these forms of investment to be both safe and remunerative, and it is safe to predict that in 1898 Vermont will see marked advancements in electrical development.—Manufacturers' Gazette.

NEW ELECTRICAL INCORPORATIONS AND BUSINESS CHANGES.

Woodsfield, Ohio.—Monroe Telephone Co. has been incorporated with a capital stock of $1,000.

Trenton, Ill.—Trenton Light and Power Co. has been incorporated by J. C. Eisenmayer, Louis Reimann and Frank Leonhard; to operate light, heat and power plant. Capital stock $8,000.

Crestline, Ohio.—People's Light and Power Co. has been incorporated with a capital stock of $30,000.

Chicago, Ill.—Western Telephone Manufacturing Co. has been incorporated by M. B. Kennedy, W. A. Bisland and S. C. Platt; to manufacture telephones. Capital stock, $2,000.

Saginaw, Mich.—The Saginaw Suburban Railway will build an electric line about 50 miles long.

Shell Lake, Wis.—City Clerk may be addressed concerning electric power and light plant. The business men are considering a proposition from the D. & D. Electric Manufacturing Co., of Minneapolis.

Eldora, Colo.—A telephone line will probably be established.

Bucyrus, Ohio.—The Bucyrus Telephone Co. has been incorporated with a capital stock of $30,000.

Huntsville, Ala.—The Huntsville Electric Co. has enlarged its plant.

Corunna, Mich.—Mr. Holly will put in an electric lighting plant.

Newark, N. J.—The Western Electric Appliance Co. has been incorporated by Edward Weston and others. Capital stock, $750,000.

Versailles, Ky.—The Versailles Telephone Co. has been incorporated with B. B. Smith, president; Charles S. Powell, vice-president and W. R. Proctor, secretary-treasurer; to establish a telephone system. Capital stock, $5,000.

Milwaukee, Wis.—The Uihlein Bros. have been granted permission to construct and maintain an electric conduit under the surface of Grand ave.

Detroit, Mich.—The New State Telephone Co. has petitioned for permit to operate a telephone system in this city.

Nebo, Ky.—Dr. Ferguson is arranging for the extension of telephone line from Nebo to Silent Run.

Wise, Va.—John E. Hale is interested in the proposed erection of electric light plant.

REMOVAL NOTICE.—Believing that our former location, 511 W. 13th street, was inconvenient for our customers, we have removed our place of business to the electrical district, 107 Liberty street, where we will be pleased to see our patrons. Eureka Tempered Copper Works, 107 Liberty street, New York City.

The Electrical Age.

VOL. XXI—No. 13 NEW YORK, MARCH 26, 1898 WHOLE NO. 567

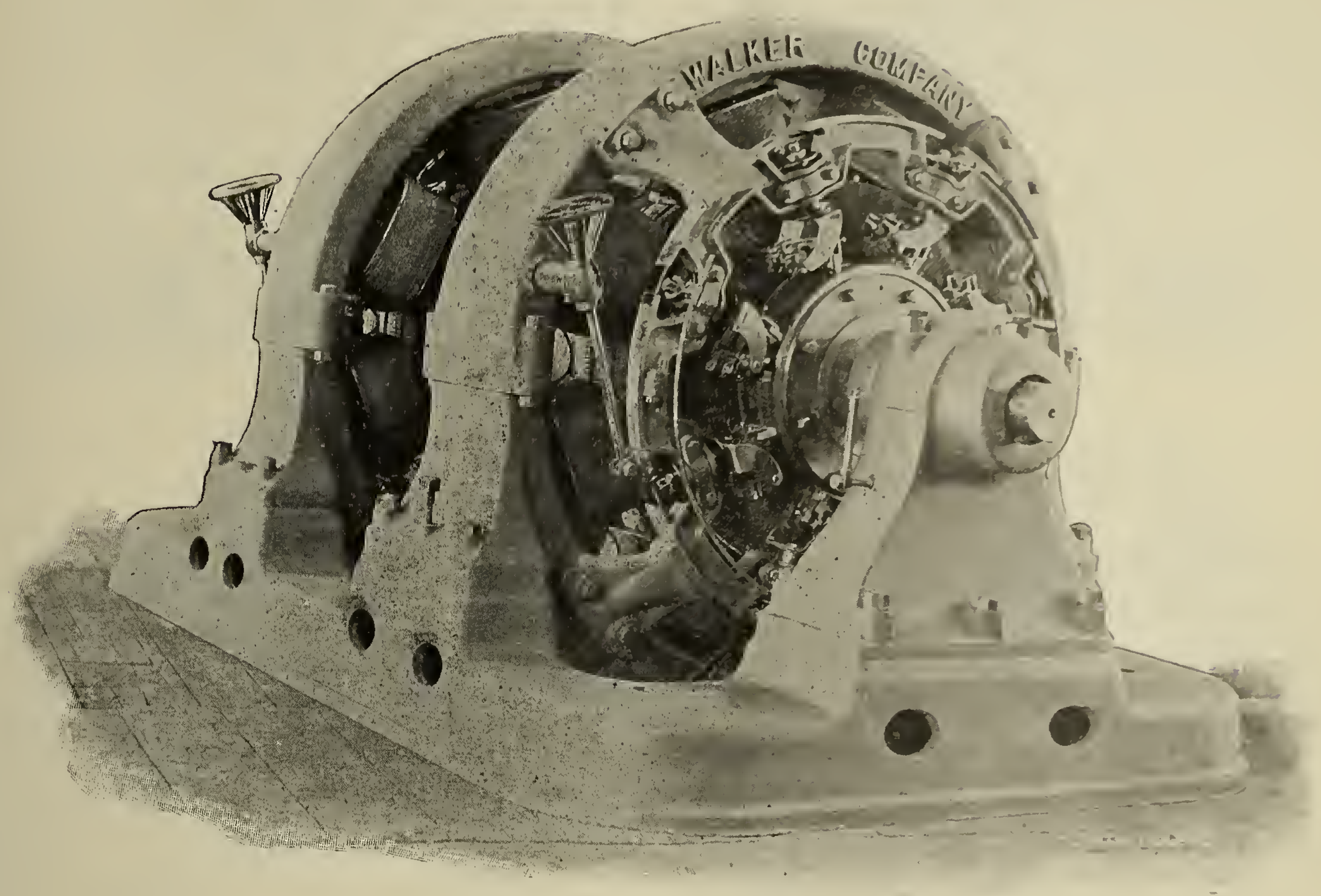


Fig. 1. 400-K. W. Booster.

BOOSTERS.

Motor dynamos, or "Boosters," as they are commonly called, are in reality step-up transformers for direct currents; that is, they give an added pressure to compensate for extra long circuits or portions of circuits in street-car service, electric lighting, or power distribution of any kind; in fact they raise the voltage of a direct current wherever that may be desirable.

The usual form of machine is one with a double field and two armatures mounted on one shaft—the motor armature driving that of the generator. This apparatus is self-regulating, as the main current passes through the generator field and armature in series with the motor, so that, as the load on the main circuit increases, the strength of the field in the booster proper is increased, and the necessary additional pressure is furnished to the booster circuit.

These machines may be wound for any desired increase in voltage, and in the Walker booster the regulation (that is, the ratio of increased pressure to increase of load) is very exact.

The photograph illustrates a 400 K. W. booster built for the Baltimore & Ohio Railroad, and used to furnish additional pressure to the 500-volt current, which is sufficient for the street-car service in Baltimore. The machine delivers the current at 700 volts, and at this pressure it is used to operate the 68-ton electric locomotives which draw the Baltimore & Ohio trains and those of the Royal Blue line through the Baltimore tunnel.

It will be noticed that this machine embodies all the well-known features of design common to Walker apparatus—the celebrated brush-holding device, self-oiling bearings, graceful form, massive construction and general excellence of workmanship.

The arrangement of circuits will be at once apparent from the diagram, Fig. 2. The main circuit from the generators passes through the motor end of the booster with a shunt field and in series through the field and armature of the generator end where the necessary 200 volts extra are added, delivering the current to the locomotive feeders at 700 volts. The ordinary street-car circuit at 500 volts is shown at the left of the diagram.

Fig. 3 is a dimensioned drawing of this type of booster, which is built in six sizes.

Fig. 4 shows a small booster of 35 K. W. capacity, built for railway and lighting service in Lecce, Italy. This is used in connection with a battery of storage cells which are charged from the street-car mains during the periods of light load. The current in the mains is at 600 volts, and it is delivered to the storage battery through the booster at 300 volts. At night, when the load on the car line is very light indeed, the generators are shut down and the line is run from the batteries, the booster re-converting the 300-volt current of the batteries to the 600 necessary for the cars and the few lighting circuits which are fed from the railway mains.

This system illustrates admirably the economy in operation which may be achieved by the use of this type of machine.

ELECTRIC POWER IN MILLS.

At a recent meeting of the South Staffordshire (England) Institute of Iron and Steel Works' Managers, an interesting paper on "The Application of Electricity to the Transmission of Power," was read by Mr. H. W. Ravenshaw, C. E. The president prefaced the paper by remarking that it was a matter of considerable moment to all to be well posted in what was going forward in the world if they were to hold their present positions. They all must agree that in the iron trade they could not expect any material rise in price in the near future, and, therefore, what they had to look to was greater economy and more perfect methods of working.

The author, in his paper, said managers of works and manufacturers generally were beginning to realize the fact that the old methods of transmission of power to their machinery were in many cases extremely wasteful, and that the electric motor was far cheaper in the end than the line shafting and isolated steam engines which have been generally employed. For years in an engineering works, mill, or colliery immense quantities of coal were uselessly consumed in wearing out belts and bearings, and in raising steam which was to be condensed in long lines of steam pipes, and perhaps re-evaporated in the cylinders, without any useful purpose. In order to reduce losses electricity was being employed in many cases with great success, a central station being established in the works, and electric motors being employed to drive the machinery, a separate motor being generally used for each machine. Transmission of power by electricity was decidedly economical, the loss in a good dynamo being not more than 7 per cent., and another 5 per cent need only be lost in the cables within a radius of, say, half a mile, and the loss in the motor and gear for reducing the speed to, say, 100 revolutions per minute need not be more than 12 per cent.

These figures gave a total efficiency of about 76 per cent., and with boilers evaporating eight pounds of water per pound of coal, and engines using 24 pounds of steam per b.h.p. hour, a consumption of less than four pounds of coal per b.h.p. delivered to machines could be obtained.

The continuous current motor had many good points. The question of pressure to be employed was an important one, as the first cost and efficiency of working depended to a great extent on a good selection. In collieries 500 volts were generally employed, and with this pressure several hundred horse-power could be transmitted over a radius of at least one mile without difficulty. In a works covering a comparatively small area, however, both lighting and power could be obtained from a 200-volt circuit with economy, incandescent lamps being now made to work up to 220 volts. A good many works and mills had been fitted for 100 volts, but there was no advantage in so low a pressure, while with 200 volts a very great saving was made in the cost of cables.—Amer. Mfr.

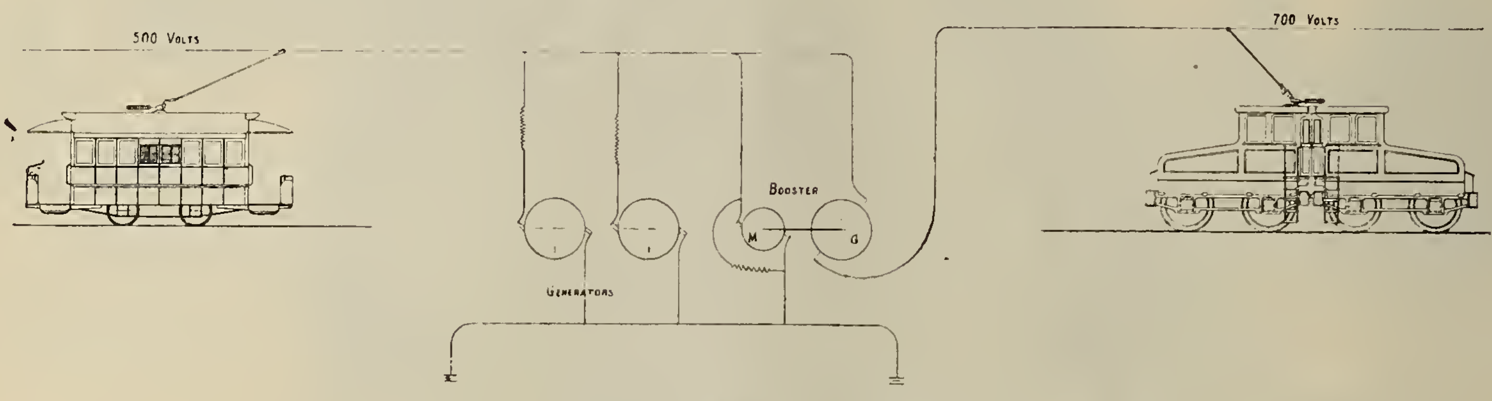


Fig. 2. Booster Connections.

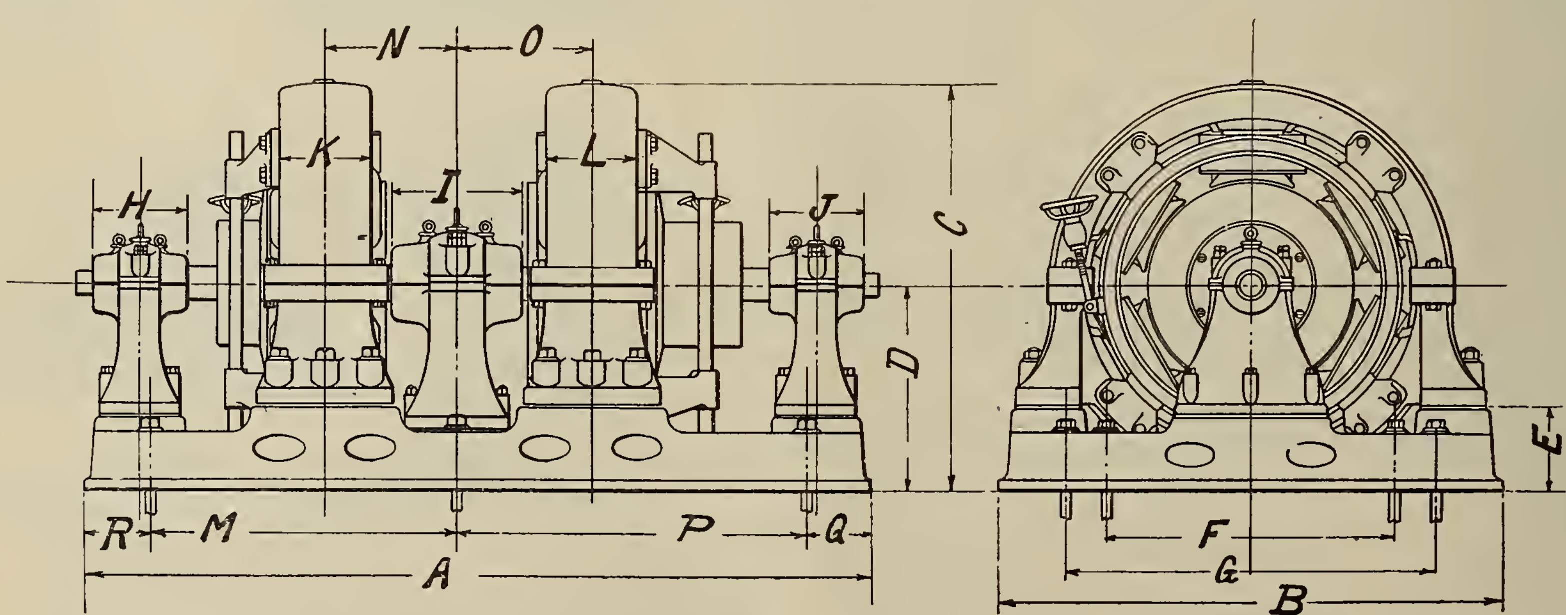


Fig. 3.

ALUMINUM.

During the year 1897 prices have been further reduced from 37 cents per pound at the beginning to 33 cents at the close of the year. The same tendency ruled on the continent of Europe; from 2.60 marks per kilo at the commencement of the year—equivalent to about 28 cents per pound—it declined to 2.40 marks per kilo—equivalent to about 26 cents per pound—for large quantities. The reduction in values was the result of a largely increased production. The official figures for the year 1896 showed a production in this country of 1,300,000 pounds. The production for the year 1897 will show that the same has tripled and amounts to 4,000,000 pounds. The same tendency in the way of production is going on in Europe, and the year 1898 promises a very largely increased output. Our own production of 1897 was markedly in excess of the home demand, and therefore foreign outlet had to be sought, and frequent exportations of importance were made. The reduction in prices has commenced to bring the article in competition with other metals. Taking the price of sheets as a basis, aluminum is relatively cheaper than brass, and will prove a worthy competitor. It will take time to demonstrate this to the trade at large, but as long as the fact exists, it is only a matter of time when success will follow.

Next to brass, copper will feel its influence as a rival for electrical conductors. Aluminum as a conductor for electric current is already in practical use at the Niagara Falls Works of the Pittsburg Reduction Company, and in the Chicago Stock Yards a mile of aluminum wire is in use as a telephone wire. Both, as far as known, give full satisfaction. If reports to hand are correct, the near future will bring forth new developments, bringing this metal into more extensive use for electrical purposes.

ELECTRICAL EXHIBITION NOTES.

MR. FRED CATLIN, the manager of the telegraphic tournament, has completed the preliminary arrangements for that contest and has arranged the classes. Circulars on the subject will be ready this week for general distribution, and there is already a great demand for information on the subject from all parts of the country. Mr. Catlin informs the exhibition management that the entries will probably be more numerous than at any other tournament that has occurred, and thinks that some of the records will be phenomenal. It is proposed, in addition to the regular contest, to have interesting exhibits of telegraphic skill in novel directions. Mr. Jesse H. Bunnell, the electrical manufacturer and veteran operator, is taking a deep interest in the contest, and has volunteered to equip the whole stage with the necessary apparatus for the competition in the shape of keys, sounders, batteries and auxiliary appliances. Mr. Bunnell is desirous to have a separate prize offered for an "old-timer's class," and has already entered himself for that contest. He has the reputation, dating from the war, of being an unusually fast and skilful operator.

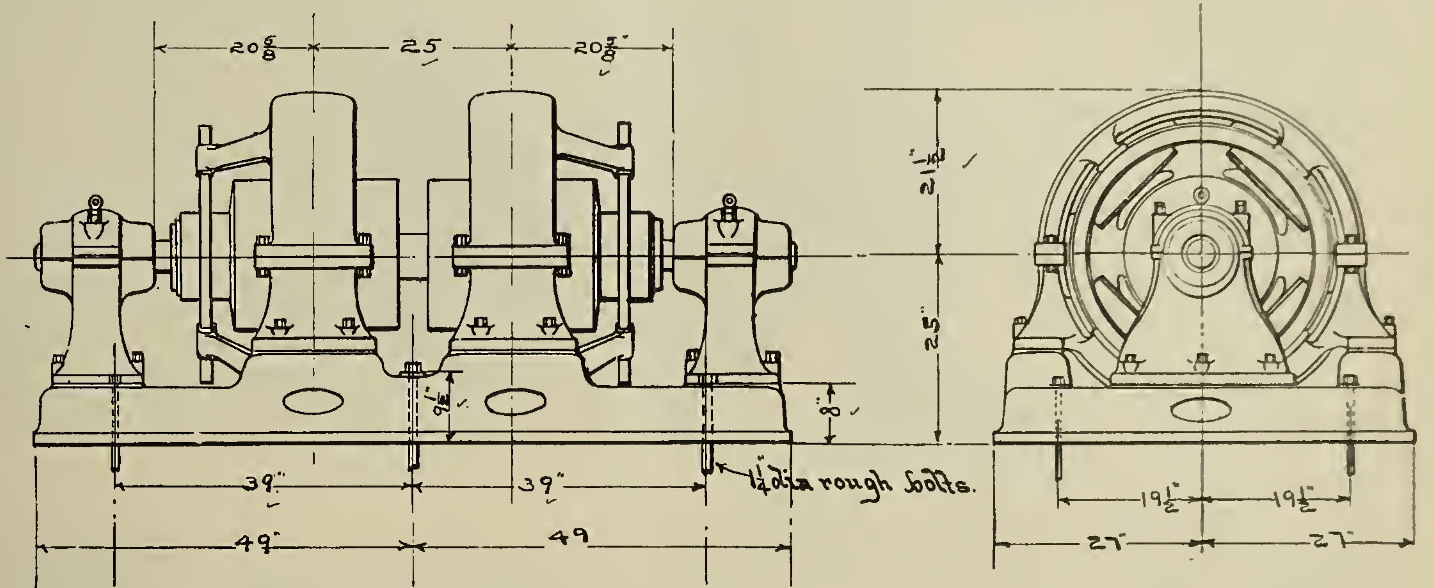


Fig. 4. 35-K. W. Booster.

Mr. H. V. PARSELL, the well-known banker of this city, who has long been interested in electric deposition work, has kindly placed in the hands of his son, Mr. H. V. Parsell, Jr., the electrical engineer, for exhibition at Madison Square Garden during May, a marvellous collection of galvanoplastic work, done during a long series of years. It may be doubted whether any other amateur could possibly show anything approaching this remarkable collection in beauty and interest. It will not only include several striking pieces, as large as 25 inches by 25, and reproducing celebrated works of art and famous men, but will comprise large numbers of coins, medals and fac-similes of antique gems. The most extraordinary part of this beautiful collection, however, will be that which embraces the reproductions from natural objects. It is safe to predict that there will be a crowd around these exhibits all the time. The manner in which they are made, for example, is of deep interest.

There are, for instance, snakes and frogs which have been made to the life and from the life. The snake is etherized under a bell jar, then taken out and greased with sweet oil and replaced in the bell jar, while a sufficiency of thin plaster is mixed with warm water. The snake is then placed on a glass plate and posed. Around him is built an enclosure of four square bars, and the plaster is slowly poured over the snake, the bars confining the cast in a rectangular shape. When the plaster is hard it is freed from the sticks and glass plate and the now defunct reptile is carefully removed, tail first, from his intaglio impression. The plaster cast thus obtained is rendered water-proof by immersion in molten paraffine. A metallic conducting surface must now be given to the interior of the cast. This is done by moistening the surface of the mould with a solution of silver nitrate and by exposure to sulphuretted hydrogen, precipitating the silver on the cast. A conducting wire is now fastened around the edge, and the mould is carefully suspended in the depositing bath. A good, firm coating takes about three days to form, and then the mould is softened in boiling water and carefully broken off.

PEOPLE HAVE OFTEN HEARD of the incinerating effects of high-frequency currents, but rarely get any practical demonstration. The attention of the electrical and popular press has lately been drawn to the grim fate of various birds that had, in an unfortunate moment, perched on some of the high-tension wires of the power transmission circuits in California. Mr. Geo. P. Low, the well-known electrical engineer of San Francisco, has preserved the remains of two eagles, some storks and other birds, which had short-circuited part of the current while sitting on the wires, with the result of leaving only their beaks and talons, not a vestige of their bodies or feathers being discovered. Mr. Low is forwarding these curious relics to the Electrical Exhibition, where they will be mounted in such a position as to show how the thing happened and just what happened. It will be the first exhibition of the kind that has ever been made.

IT IS PROPOSED at the Exhibition to have amongst other railway apparatus, a working model of track intended to demonstrate the operation of the third-rail system as applied to steam railroads. Colonel N. H. Heft, the electrical engineer of the N. Y. N. H. and H. Railway Company, whose work is so widely known in connection with the successful third-rail line between Hartford and New Britain, Conn., has very kindly placed at the disposal of the management blue prints showing the construction of the track and some of the actual material used. The model track, from 50 to 100 feet long, single and double and about five inches gauge, is now being constructed on Col. Heft's plans, and will be shown in actual operation during the continuance of the show, the details of the track being imitated as closely as the conditions will allow. Over this track a train of cars will run to and fro, continually showing how the current is picked up and delivered to the motor and how the switches and signals are included in the operation.

San Francisco, Cal. — Electric Mortar Hardener Co. has been incorporated by James McKendrick, Abraham Blumenthal, William Loewi, J. C. Meyerstein, and L. F. Humphrey. Capital stock, $1,000,000.

TRADE OPPORTUNITIES IN SIAM.*

Siam offers a field for development which is not appreciated by American exporters and manufacturers. During the coming year special effort should be made to increase the trade of the United States with this rich and prosperous kingdom of southeastern Asia. A critical period is approaching, and the results thereof will determine the control of Siamese foreign trade.

Too little is known about this country in the United States, or, I might say, there is too little respect for it as a factor in Asiatic trade. True, it is small compared to our vast area and population, but it is deserving of far more attention than it receives. It is of more consequence in the political world at this writing than it has ever been before, and its commerce is growing. Exporters of Europe have fully awakened to the importance and possibilities of Siam's markets.

After a residence of four years in Siam, I think that here is one of the best opportunities for the United States to build up a trade that is afforded anywhere in the world, considering, of course, the population and area. But all efforts to induce American exporters to enter these markets have been unsuccessful. Letters have come in unlimited numbers, to all of which careful attention has been given; catalogues have arrived and been distributed where they would do the most good; questions asked have been answered in detail; and many reports, general and specific, have been sent to Washington and duly published for the benefit of the exporters and manufacturers of the United States; but still there is a most discouraging lack of interest. This interest should be evidenced by sending to Bangkok experienced and capable representatives to carefully investigate the field, secure trial orders, and establish reliable agencies. In this connection, three facts are worthy of note: First, not more than six qualified representatives of American houses have visited Siam during the past three and a half years; second, almost without exception those that have come have been surprised at the extent and opportunities of the market, and have gone away with satisfactory orders, or, at least, with sufficient to pay expenses; third, in the same period no less than one hundred capable representatives of European firms have visited Bangkok, and, in 90 per cent. of the cases, have done very well.

If an American house which deals in the class of goods exported to foreign lands is strong enough to employ one or more travelling agents in the United States, it can afford to send a capable man to the far East to take charge of the entire field, from Yokohama to Singapore, which would include Bangkok. If he did not pay expenses, and so caused loss to his company, it would either be because he was not qualified by experience and training, or because the class of exports he was endeavoring to market would not be suited to the field. If the products he offered were in demand, his trip should result favorably.

Catalogues are valuable in their way—invaluable, in fact—but too much reliance is placed on them. They do not discuss the matter with the buyer; they do not answer all his inquiries; they do not obviate his objections to trying a new firm, a new class of goods, or to giving up his relations with some European house which has supplied him for years. Most merchants at home have already read this observation, but I will add this comment: If firms which are rich enough to publish the elaborate catalogues, which they issue annually, would devote even a small portion of that expense to sending energetic, educated, and tactful representatives to the far East, they would obtain far more substantial returns.

One great point about Siam, which has been repeated time and time again in my reports on the opportunities for American trade, I now wish to call to the attention of American merchants for the last time, although it is quite probable that my successor will make the same recommendation. It is, that there is unquestionably an excellent and practicable opening in Bangkok for the establishment of a large, strongly capitalized American importing and exporting firm. The field is here, the business is here, present conditions are favorable, and the outlook for such an investment is good. All the important European houses (of which there are many) which have been well managed have succeeded financially, paid satisfactory dividends to stockholders, and are today enlarging rather than curtailing their operations. A United States company would run little or no risk in opening a house at Bangkok, because a retail department could be established which would pay all current expenses of employees, clerk hire, rent, lights, insurance, etc. I seldom discuss American trade opportunities with a foreigner or native whose opinion is reliable, without reference being made to the absence of a representative American importing and exporting house. The concensus of opinion is that, with good executive control, it would pay handsomely. It would be best if a company already permanently established in Japan and China would operate an extensive branch here; but if a new firm were organized in New York or San Francisco with sufficient capital—say $100,000 to $200,000 gold, with only a third or half paid up to begin business—and with a local manager who has had experience in dealing with Asiatics, I am confident that it would not only pay expenses from the start, but a dividend of 10 to 15 per cent. at the end of the second year.

*John Barrett, Minister Resident and Consul General, Bangkok.

Proctor's Theatre,
New York.

Swann Manufacturing Company,
New York City, N. Y.

Gentlemen:—I find that your coloring enamel and frosting which you furnish for the lamps we use in our Living Picture Exhibition and other stage lighting, gives excellent satisfaction. It has proved superior to genuine colored glass lamps, giving much better light. I have in the past ten years tried many kinds of coloring enamel, but the Bohemian is the best and the finish is as smooth as natural glass.

Yours truly,
G. W. Whittaker, Electrician,
Proctor's Theatre.

We hear through the columns of The Engineering and Mining Journal that Dr. Carl Auer von Welsbach has recently completed some important investigations with regard to the application of the rare earths to the incandescent electric lamp, and he claims to be manufacturing filaments in which these earths are used. In this way he obtains an increased light with the expenditure of much less current. The patents are not yet published, and neither the inventor nor the company controlling the patents is inclined to give any details at present. A few months ago the English Welsbach Company was reorganized on a larger scale and additional capital obtained. At the time, the public and the press were inclined to deprecate this reconstruction which they called watering, but now the reason for it becomes apparent.

An International Magnetic Congress will probably be held either in 1899 or 1900, at which those interested in the study and recording of the phenomena of the earth's magnetism will have an opportunity to exchange views and decide upon definite plans of observation for the future.—Mfrs. Gazette.

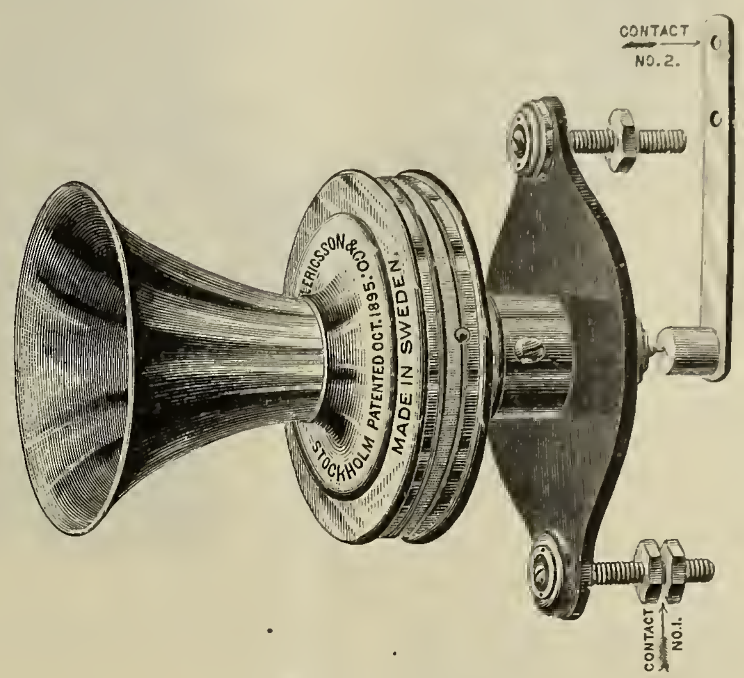
Meyersdale, Pa.—Meyersdale Electric Light, Heat and Power Co. has been incorporated, with a capital stock of $10,000.

A NEW TELEPHONE COMPANY.

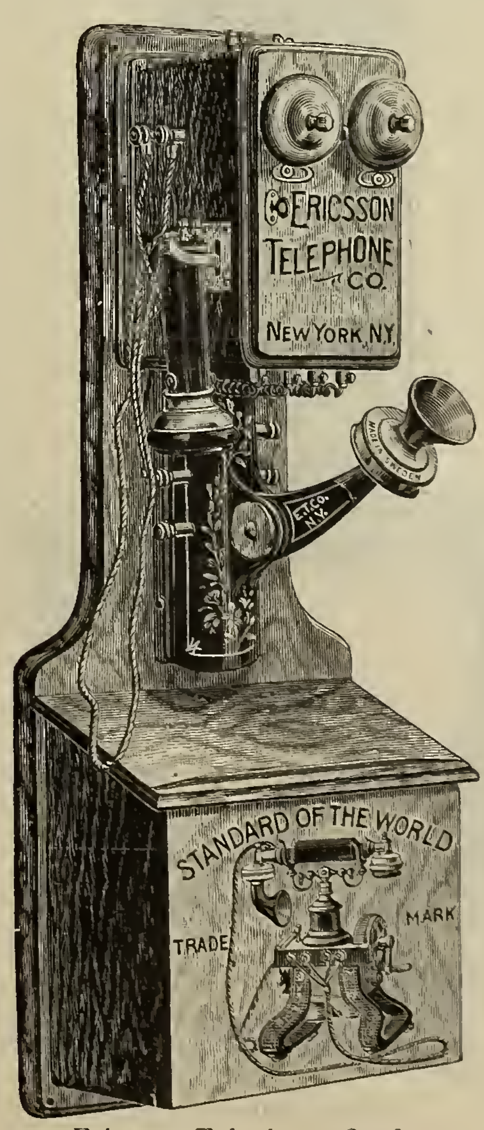
The Ericsson Telephone Company was organized a few days since in New York to succeed the firm of Smith & Patterson, sole representatives for the genuine L. M. Ericsson & Co.'s Swedish telephones. These goods have been sold in all parts of the United States, and have been found to be all that is required of a first-class telephone, and to give absolute satisfaction in all particulars. They are built on mechanical principles, and every detail is looked after with as much care as though it was a watch. The maintenance of the Ericsson telephones is nothing, after they are once installed, and they are worth every dollar of their price.

In addition to importing, they will manufacture a domestic instrument of the regular type, double and single cell battery boxes, with and without arm, using the Ericsson imported receiver and transmitter, and putting same on the market at the popular price of the best American instruments shown to-day. They have also begun to import the Swedish switchboard. Owing to the heavy demand that Ericsson & Co. have had for the past few years in their foreign trade, they have been unable to allow the sale of any switchboards in the American market, except in a very limited way. They are prepared now to put out a complete multiple system or trunking system, as may be required. All goods will be carried in stock in New York, and orders will be promptly executed and not held over, as the old firm (Smith & Hemmingway, No. 10 Warren street) formerly did.

They show, in this reading matter, a few cuts of their latest instruments, such as the new 1898 long-distance microphone, with back and contact to go on any style of telephone manufactured; also microphone mounted on arm, as well as long-distance exchange set, and, in addition thereto, the latest switchboard that is manufactured



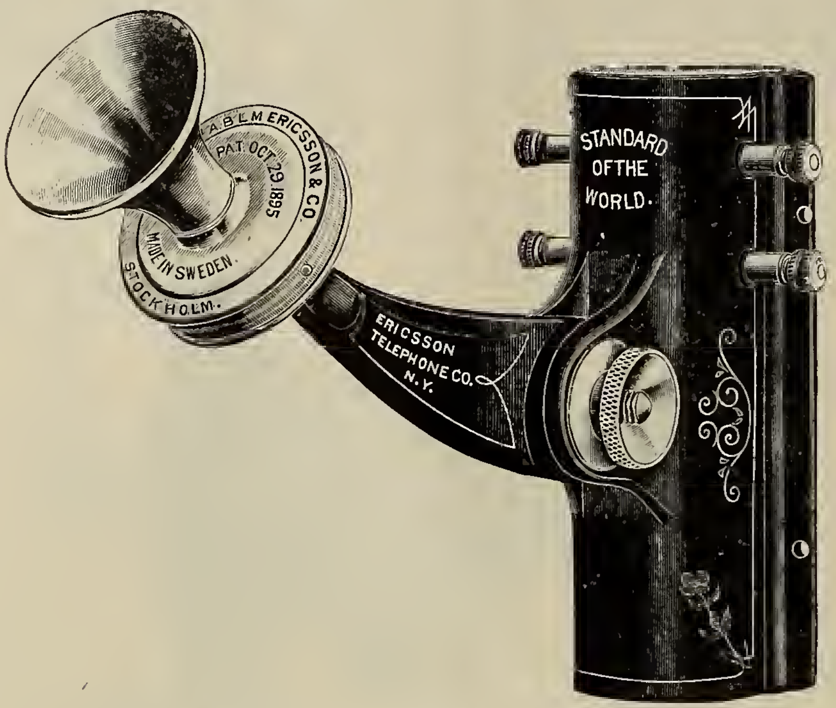
Ericsson Transmitter.



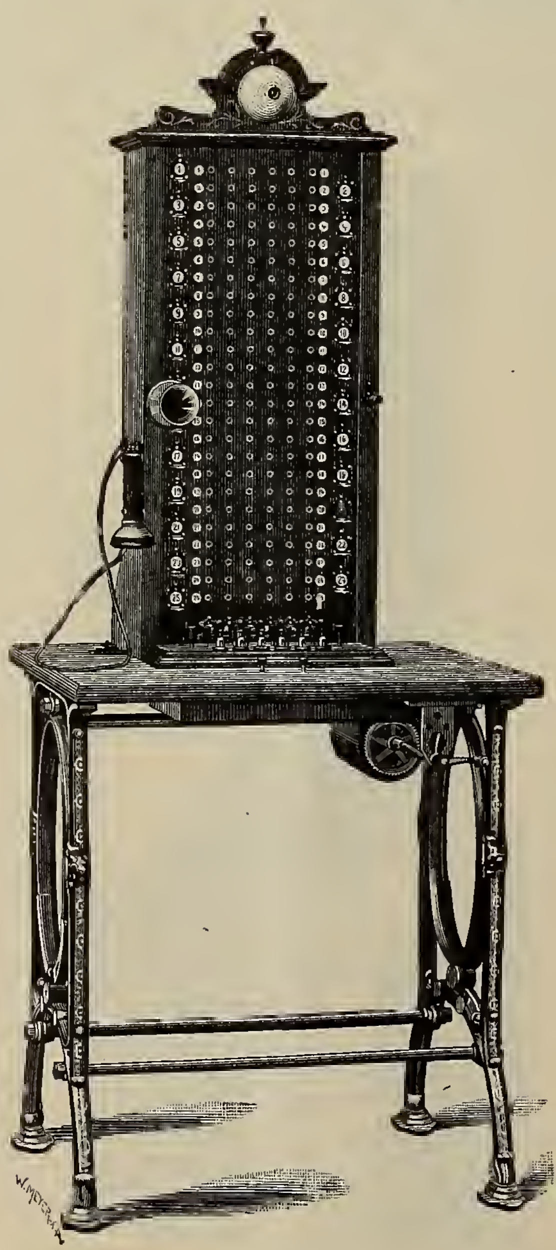
Ericsson Telephone Outfit.

by Ericsson & Co., one without cords and jacks.

They are preparing now, and will have out in about three weeks, their new catalogue (5th edition), which will be sent out to the trade on application. In bringing out this new catalogue, the company will introduce some novel inventions in the telephone line, such as breast-plate transmitters and receivers, an all-metal telephone, their famous $375 combination wall and desk telephone, lightning arresters that require no plugs and quite a few novelties.



Microphone Mounted on Arm.



Swedish Switchboard.

THE WALKER COMPANY, of Cleveland, Ohio, recently finished the largest direct-current generator ever built. It was contracted for by the Brooklyn Heights Railway Co. of Brooklyn, N. Y., and its total weight was about 150 tons, the weight of the armature alone being nearly 50 tons. Orders are now being filled for 20 motors for the Metropolitan West Side Elevated Railroad of Chicago, for forty double equipments for the Union Railway of New York, and 100 double equipments, including controllers and motors, for shipment to Dresden, Germany.

Wilmington, Del.—The Wilmington & Chester Traction Company has been incorporated by a company with a capital stock of $2,000,000; to build and operate electric trolley lines in Pennsylvania, Delaware, or elsewhere.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, MARCH 26, 1898.

CONTENTS.

ELECTRICITY IN WARFARE.

The present crisis between this country and Spain will bring into use the latest forms of protecting devices and electric armaments such as have lain in abeyance for the past five years. Some of these appliances, used for attack or defence, will prove very formidable. In naval warfare the search-light, sweeping the sea for miles around, will prove an able means of defence.

Our modern war vessels are equipped with powerfnl search-lights, which will reach a distance of from two to twelve miles. Modern practice has shown that the best system to employ in order to keep the vessels free from attacks from torpedo boats is one involving the use of many search-lights, because, in the interval during which one part of the sea is dark and another part illuminated, a torpedo boat could glide forward from a distance of two miles and successfully blow up the vessel. It is, therefore, necessary to sweep the ocean with the luminous rays and keep every inch of it as far as possible under inspection.

In the control and management of the fish torpedo we deal with a device depending absolutely upon electricity for its propulsion, guidance and subsequent explosion. The torpedo is projected from a steel tube at the enemy's war vessel, and when in the water guided by its own devices. It forms a powerful means of attack, and with the proper number a given line of advance may prove impregnable.

Naval vessels frequently make use of the electrical log for measuring the speed of the vessel, and although such a device will not give the velocity at any instant, it will enable the executive to judge of the rate of progress in any given case. Battles in the future between civilized nations may become to a large extent a war of push-buttons—the pressure on a key being sufficient to set in action tremendous forces or deliver a volley of projectiles of deadly effect. The U. S. dynamite cruiser "Vesuvius" discharges projectiles from pneumatic guns which are subsequently exploded by a charge of electricity. Each projectile carries six hundred pounds of highly explosive material and will wreak a terrible vengeance wherever it strikes. A few dry cells are carried within the projectile and raise to incandescence a platinum wire which is surrounded by fulminate of mercury, thus causing an explosion of the main mass of material. This last method is employed whenever explosives, such as dynamite, gun cotton, etc., are to be dissipated—a detonating charge being found most effective.

In submarine work for boats built on the plan of the famous "Nautilus" of Jules Verne, such as the Holland submarine boat, experience has shown that electricity is the only force that can be successfully employed. A war vessel will find great difficulty in protecting itself from so invincible a destroyer as a well constructed and properly controlled torpedo boat. Its power of doing evil is almost beyond calculation, and when in operation it may remain at a safe distance and project its deadly missile against the comparatively unprotected bottom of the most massive war vessel ever built.

The Fiske range finder represents in many respects the crowning success of this age, as it enables an operator far removed from the scene of battle to train a swiftly moving explosive device with unerring accuracy upon any given point within its reach. A fish torpedo may be directed along given lines to an enemy's ship and steered with a touch of the finger from shore with almost absolute certainty.

The control of submarine mines from any given point along the shore is so effective in case of war as to absolutely prevent entrance by an enemy into any harbor or body of water. It is but necessary to make an extensive employment of these means and a coast will be safe from the ravages of marine assailants, its maritime ports ably protected and its freedom from immediate danger apparent and pronounced. On land the telephone and telegraph have their parts to play, and a new institution, the war balloon, gives to an observer therein a bird's-eye view of the country of the utmost value. Communication between this aerial device and the earth can be easily carried on and the movements of an enemy laid bare in detail.

It is but little for us to say that the future of war and even its possible discontinuance willl depend greatly upon the development of electrical devices in naval and land warfare. It may be as Bulwer-Lytton has said "that when each nation is capable of exterminating its neighbor war will cease, with its horrors, misery and bloodshed."

Mobile, Ala.—The People's Light and Heat Company has been organized by J. W. Whiting, Leopold Lowenstein, S. T. Prince, James K. Glennon, R. H. Clarke, and others, for the purpose of lighting and heating by the Kitson hydrocarbon system. Capital stock, $100,000.

Detroit, Mich.—John C. Shaffer, of Chicago, is the organizer of a new company who will build a line from Detroit to Toledo, to be operated by electricity. He has associated with him a syndicate of capitalists of Chicago, Pittsburg and Detroit.

Fitzgerald, Ga.—The Mayor may be addressed concerning erection of electric light plant, for which $30,000 worth of bonds will probably be issued.

Bay St. Louis, Miss.—The Mayor may be addressed concerning erection of electric light plant, for which about $40,000 worth of bonds will probably be issued.

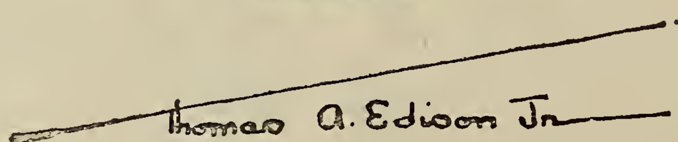
Pocomoke, Md.—Dr. W. H. Walters may be addressed concerning construction of telephone system.

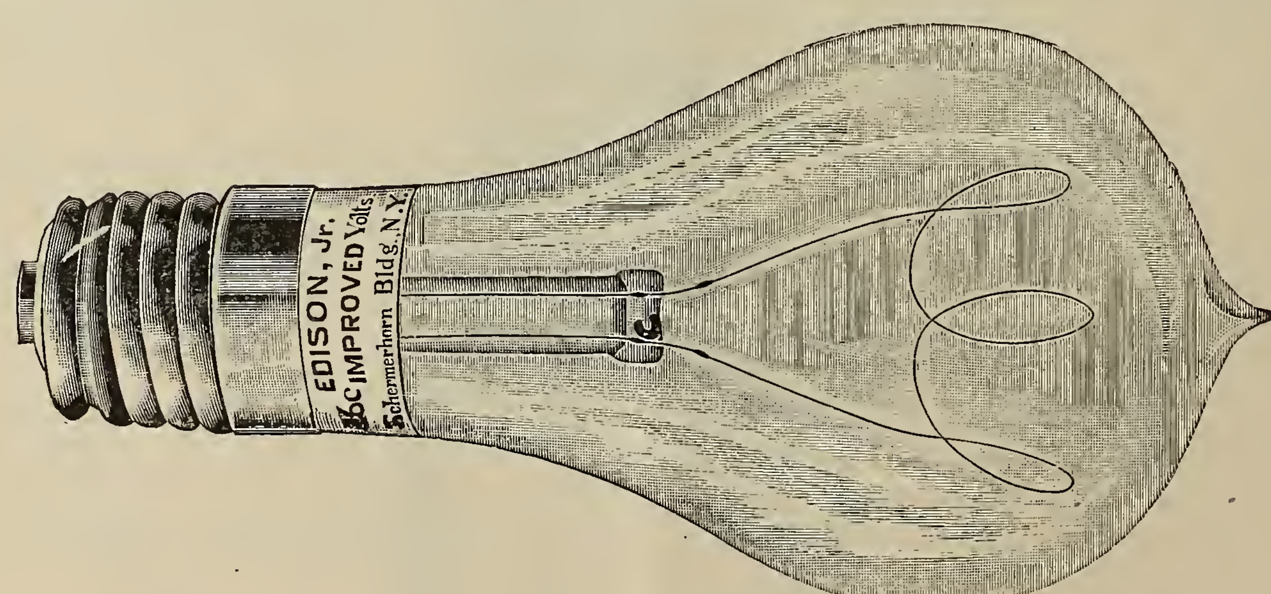
THE THOMAS A. EDISON, JR., INCANDESCENT LAMP.

The Edison, Jr., lamp is being used by all the great lamp consumers of New York City and its vicinity, as well as throughout the United States. Its excellent qualities, which include long life and high efficiency, have made it known to all electrical contractors and supply dealers. In a recent test, published in these columns, a fifty-five volt Edison, Jr., lamp was kept burning on a 117-volt circuit for twenty-five minutes without apparent injury.

The Watt consumption per candle-power of the Edison, Jr., lamp, combined with its long life, have placed it first in the eyes of station men and engineers in charge of private plants. Thomas A. Edison, Jr., has lately returned from an extended trip. His business was carefully attended to during his absence by Messrs. Stilwell and Holzer, two very well known lamp experts. They have so largely developed the lamp trade that orders can hardly be filled with sufficient rapidity. They will be compelled to enlarge their works to meet the demand. The Edison, Jr., lamp was only produced and marketed after a long series of important tests.

Mr. Edison, Jr.'s, unequalled laboratory experience in lamp construction has enabled him to give to the world a light producer whose reliability, efficiency and general superiority to other lamps can be proven by test and usage. Thomas A. Edison, Jr., is one of the greatest specialties in incandescent lamps, and fully understands the requirements of the trade. The address of Thomas A. Edison, Jr.'s New York office is 96 Broadway.





Edison Jr. Lamp.

DEMAGNETIZING WATCHES.

A simple method of curing a magnetized watch consists in hanging it from a string, which latter is twisted as tightly as possible, and then holding the string and watch near a dynamo or strong magnet. The watch is then released, and, of course, begins to spin and while doing so is gradually carried away from the dynamo and out of the magnetic field. The demagnetization is due to the rapid alternations of the poles of the magnetized parts in a magnetic field, that is decreasing in intensity. This is well known to be a thoroughly reliable method.

Charleston, S. C.—The Charleston Light and Water Co. has been incorporated by Samuel Lapham, Charles R. Valk, W. H. Welch, A. G. Rhett, H. F. Bremer, George I. Cunningham and others. Capital stock, $500,000, with privilege of increasing to $3,000,000.

Winchester, Tenn.—S. M. Alexander is interested in the establishment of a telephone system.

ARC LIGHTING AND ARC LIGHT CIRCUITS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

When a motor is to be installed certain precautions must be observed in order that no injury from fire can result and no danger from shock exist.

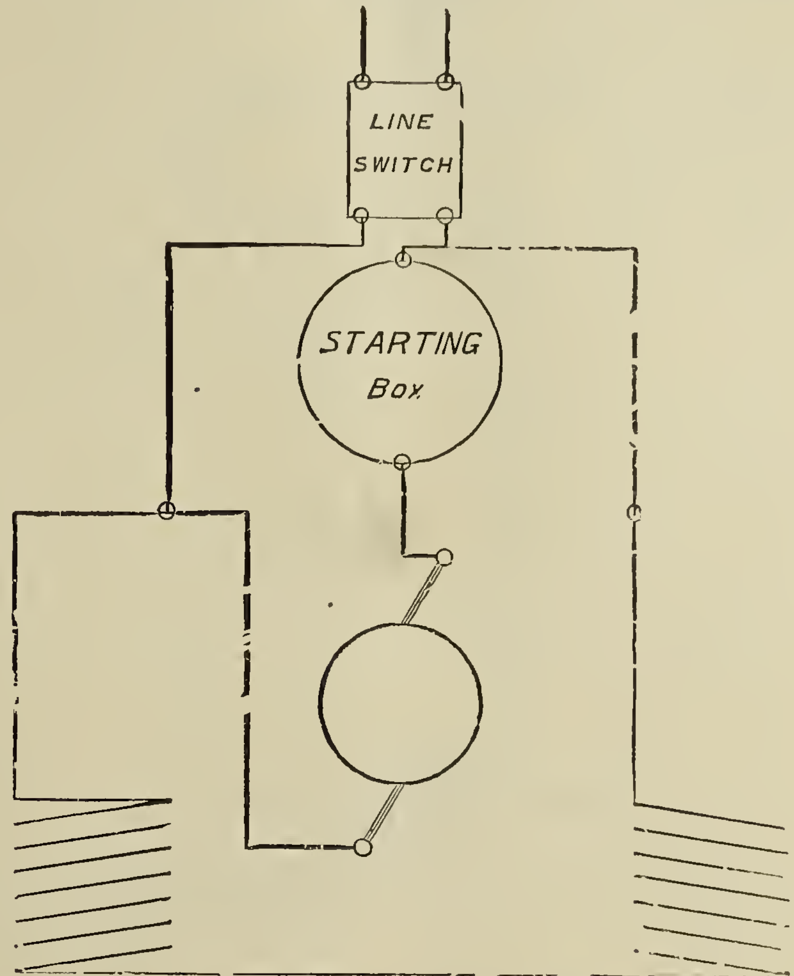
The fire underwriters of every large city impose limitations upon contractors and prevent them from doing careless work. It is usual to mount the motor upon a fireproof foundation and have a large pan underneath to catch the oil drippings. A zinc pan is frequently used for this purpose, the motor being mounted in the centre of it. The starting box must be of slate and have under it a large sheet of asbestos paper. The fuse blocks, devices used for the protection of a line, must be covered to prevent the dangers of fire from the vaporized metal.

In total, the installation of either motor or dynamo must be so made that the risks from shock and fire are entirely removed. A low voltage motor or dynamo does not introduce much danger from mere shock; and, up to about 400 volts the person in charge is secure, but the chances of fire always exist.

A loose-hanging connection, a short circuit on the line, a bad ground, etc., may bring about this danger unless regular tests are made to keep the line clear and dynamo insulated. A lightning arrester is a very necessary adjunct to a plant having an outside line. Frequently a station is destroyed by lightning, according to report. This may not be true, although lightning is in many cases the original cause. Lightning by striking a line, or dynamo through the line, usually sparks across every available gap.

An arc is thus started and continued by the generator itself. It is thus very likely that in many instances the burning is done by the dynamo current, although the original cause—lightning—has long since disappeared. Protectors in many cases fail to protect because there is a certain defect in lightning arresters, and a peculiar oscillatory nature to the lightning discharge that must be better understood before arresters can be used with certainty in every case.

Both dynamo and motor are protected from an overflow of current by means of a safety fuse or cut-out. This is simply a piece of lead wire inserted in the circuit and of such a size that a flow exceeding the regular amount will melt it and open the line. The danger being over it is then replaced by another piece. Good insulation to either dynamo and motor, good safety devices, in the shape of either cut-outs or lightning arresters and a drip pan to catch the oil, comprise the essential elements of good installation.



Connection of a Shunt Motor.

Arc Lighting Machines.—Arc lighting machinery differs from incandescent in one or two respects.

As a rule arc light machinery is of higher pressure; it is also series-wound and therefore regulated differently, and in additon the line is a simple series circuit. The high tension or direct-current dynamos, as they are often called, require an attendant, only valuable if experienced, and ready to grasp a situation at times filled with deadly danger.

The care of high tension arc machinery is not the pleasantest occupation in the world. In an arc dynamo, the armature of field winding form one continuous circuit in addition to a long outside line.

Pressure of Arc Lamps.—The string of arc lamps connected to the outside line each require 50 volts. The pressure developed by a machine is automatically regulated according to the number of lamps in circuit. A 50-light machine would generate $50 \times 50 = 2,500$ volts, if fully loaded, yet it will give anything less than that if so required.

Regulation.—To control the voltage of any dynamo it is necessary to vary either the

speed,
armature turns, or
field strength.

In practice the speed cannot be changed, as the engine runs at a fixed number of revolutions per minute. The field strength may be varied, or the armature controlled so that its full pressure is not collected at the brushes. The two methods employed, therefore, may be defined under the following headings:

Regulation of field,
Regulation of armature.

By shunting the current of the field on and off automatically, will supply more or less lines of force to the armature.

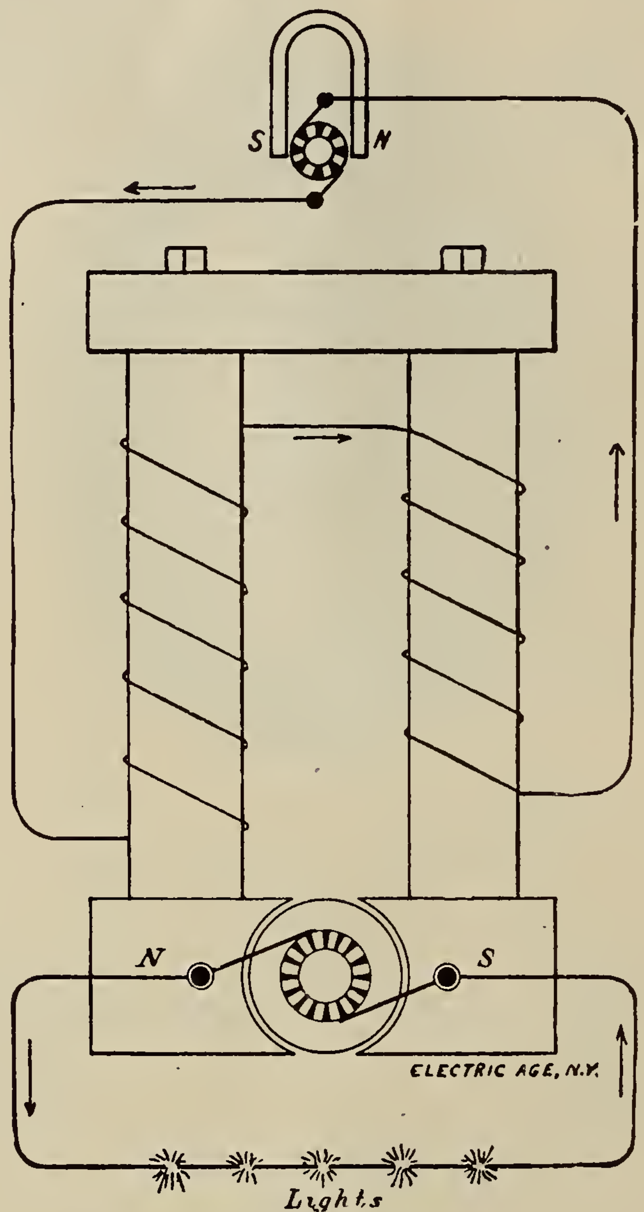
An electromagnet may do this if governed by the outside line; when the pressure is too great, it is reduced by decreasing the field automatically, and the current diminishes likewise to its normal value; the converse is also true.

We are now prepared to enter into a general classification of all continuous-current dynamos, namely:

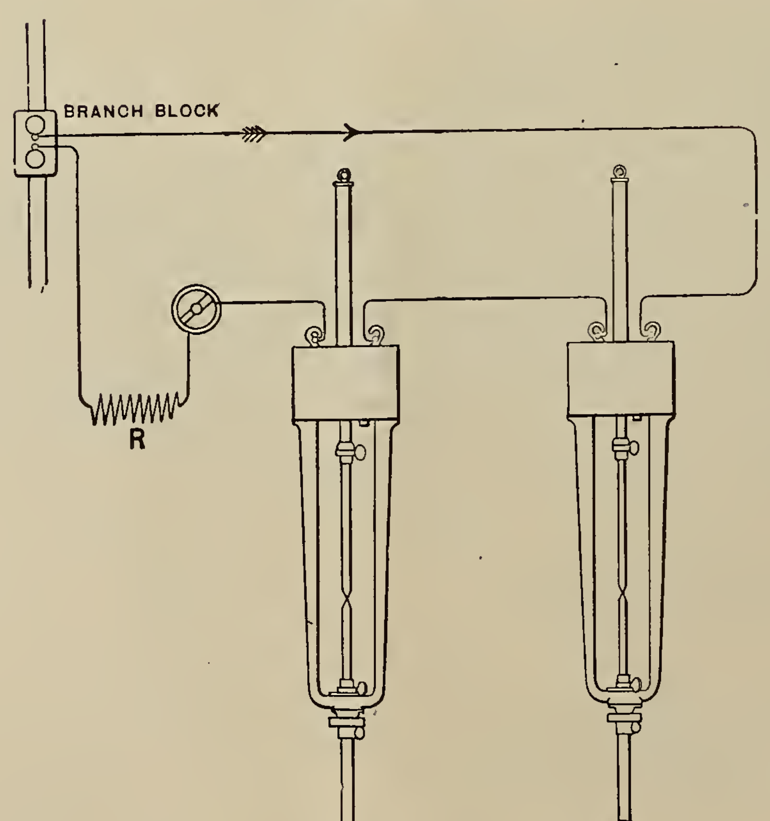
Constant current and
Constant potential machines.

The object of all arc light high tension systems is to preserve a constant current of about 10 amperes and regulate the pressure to the number of lamps used to the extent of just 50 volts apiece. In incandescent dynamos the pressure is kept constant and the current varied to suit the number of lamps.

The regulations of each is, in one case, arc lighting, with reference solely to the current; in the other, incandescent lighting, to the pressure. Therefore, shunt-wound or incandescent dynamos and series-wound or arc-



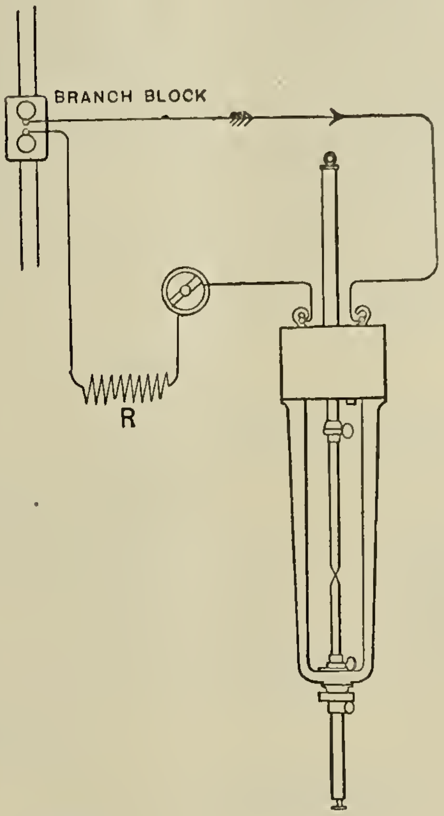
Series Circuit.



Two Lamps in Series on 110 Volts.

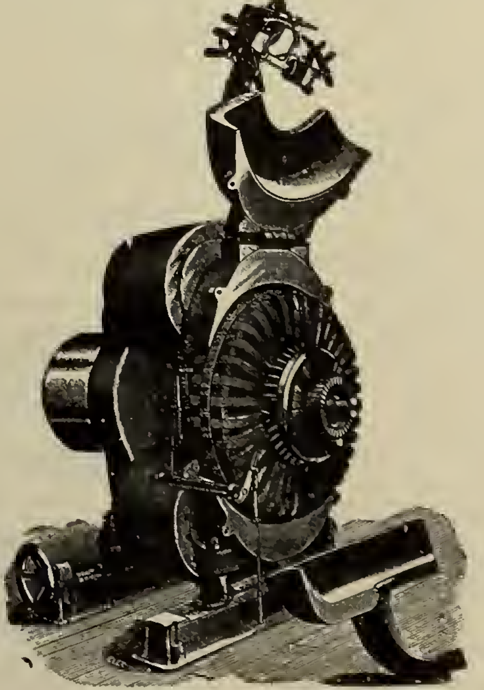
light dynamos are strikingly different in this respect. Dynamos that supply incandescent lights are used for arc lighting also. They obtain their current in shunt from the main current, and are treated like large incandescent lamps in consequence. For long-distance lighting, or the illumination of straggling towns, high tension systems are cheapest.

The regulation of arc systems by means of a special



Arc Lamp in Circuit on 110 Volts.

device affecting the armature are most popular. By shifting the brushes on a commutator, the pressure may be varied from nothing to its highest value. If this change in volts is in exact correspondence with the load or number of lamps, then the purpose of automatic regulation is fulfilled. This is also done by means of an electro-magnet in series with the line. When the load is lessened by lamps being removed the pressure, acting through a decreased resistance, increases the current momentarily; this strengthens the magnet, and it pulls the brushes over to a point of lower pressure. These



Hochhausen Arc Light Dynamo.

positions of the brushes and volts required for lamps must correspond. The brushes must not move too far or too little, but must be adjusted to touch at the required point of the commutator.

This is practically equivalent to changing the turns on the armature. Therefore, it is seen that the methods of arc light regulation depend upon either a change in field or in effective turns.

QUESTIONS FOR REVIEW.

(1) What precautions are taken in installing a motor?

(2) Why is a lightning discharge dangerous in a station?

(3) How are power lines protected?

(4) How many volts are required per arc lamp?

(5) By what means is the voltage of any dynamo regulated?

(6) What general methods are employed in arc-light regulation?

(7) What is a constant current?
What is a potential?

NEW YORK NOTES.

The Metropolitan Electric Construction Company is now doing all of the installation work of the Sprague Electric Company, an agreement to that effect having been recently closed. The announcement was made in a striking two-color circular by the Sprague Company, in which circular it was pointed out that the construction Company would not only contract for installation and maintenance of Sprague machinery but of any other machinery as well. The offices of the Construction Company, as well as those of the Sprague Company, are in the Commercial Cable Building. The officers are W. D. McQuesten, president and general manager, and Mr. Wallace E. Carver, treasurer.

The organization of the Sprague Electric Company, which our readers well know, was formed by the consolidation of the Interior Conduit & Insulation Company, and the Sprague Electric Elevator Company, is being rapidly perfected. The offices of the company now occupy practically the whole of three floors in the Commercial Cable Building. The company recently secured a suite of rooms in the Marquette Building, Chicago, which will be in charge of Mr. Millard B. Kitt and Mr. E. B. Kittle, long identified with the company. Well-known electrical men and houses are being rapidly secured to represent the Sprague Company in various sections of the country, and the organization bids fair to be a remarkably strong one in every way.

An Advertising and Press Bureau is one of the new Departments of the Sprague Company, and it has been installed in a suite of rooms on the 10th floor of the Commercial Cable Building.

The Stieringer reissue patent No. 11,478 (original No. 259,235) on Electric Light Fixtures and Combined Gas and Electric Light Fixtures was sustained on March 2d, inst., by the United States Circuit Court of Appeals of the Second Circuit, in the suit of George Maitland against the B. Goetz Manufacturing Co.

L. E. FRORUP, of Schiff, Jordan & Co. N. Y., is scouring the West and will return with a book full of orders. They control the original "ELECTRA" arc Carbon Works of Germany.

CARD ELECTRIC CO., of Mansfield, O., are giving away to all who send a business card a fine paper weight. They make all sizes and styles of dynamos and motors.

THE MANSFIELD TEMPERED COPPER CO., of Mansfield, Ohio, are giving away fine paper cutters. They are made of tempered-copper segments for dynamos, motors, etc. W. T. H.

NEW ELECTRICAL INCORPORATIONS AND BUSINESS CHANGES.

Greensboro. Ala.—Louis V. Massey can give information concerning erection of electric light plant.

Baltimore, Md.—James F. Bohen will put in an electric light plant for the purpose of lighting his hotel and grounds near Stevenson Station.

Bartlett, Ohio.—The People's Telephone Company has been incorporated with a capital stock of $2,000.

Wilmerding, Pa.—The White Electric Railway; work has commenced on the extension.

Pine Bluff, Ark.—An electric street railway is to be established.

Detroit, Mich.—American Typal Telegraph Company has been incorporated with a capital stock of $50,000.

Caldwell, Ohio.—An electric light plant will be established, and about $7,000 worth of bonds will probably be issued.

Warrenton, Tex.—A new telephone line is being constructed between this city and Roznor, and will be in operation shortly.

Hunter, Miss.—The Hunter & Maharris Telephone Company has been incorporated with a capital stock of $500.

Des Moines, Iowa.—City Clerk may give information concerning electric light plant.

CANADIAN LETTER.

ELECTRIC RAILWAYS.

Ottawa, Ont.—The British American Light and Power Company want power to construct and operate by electricity or other power tramways in Dawson City, Fort Selkirk and other points in the Yukon district.

Winnepeg, Man.—At the next session of the legislature a local company will ask for a charter to build an electric railway from this city to St. Andrew's Rapids, and through the municipalities of Springfield, St. Boniface, Kildonan, St. Paul's and St. Andrew's. The company also propose to construct saw mills, boats, telegraph and telephone lines.

St. Thomas, Ont.—A meeting of the St. Thomas Street Railway Company will be held on March 2d to authorize the issue of debentures for the sum of $50,000.

Perth, Ont.—James Fowler, of Arnprior, is reviving the proposal to build an electric railway from Perth to Sanark.

Chatham, Ont.—A proposition is now being considered to build an electric railway to Rondeau Park. C. W. Richardson is one of the promoters of the scheme.

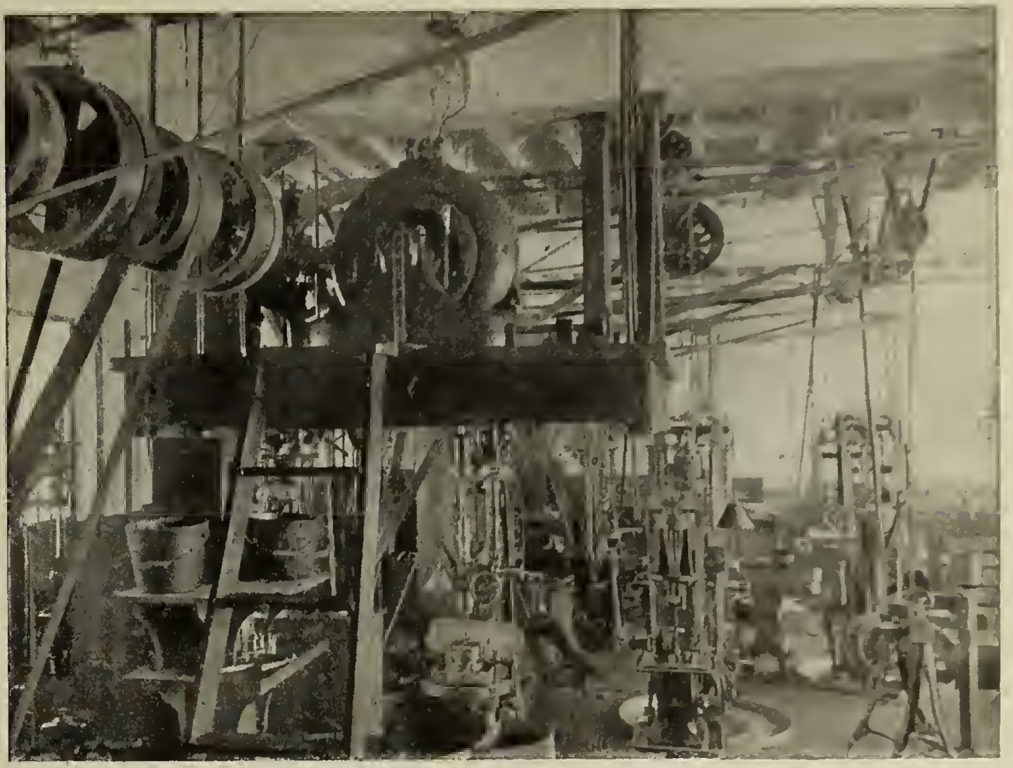
Sarnia, Ont.—It is said that the St. Clair Tunnel Company are considering the conversion of the steam power of the tunnel into electric power. The matter is understood to be under the consideration of Mr. Joseph Hobson, of Montreal, chief engineer of the company.

TECHNICAL SCHOOLS IN GERMANY.

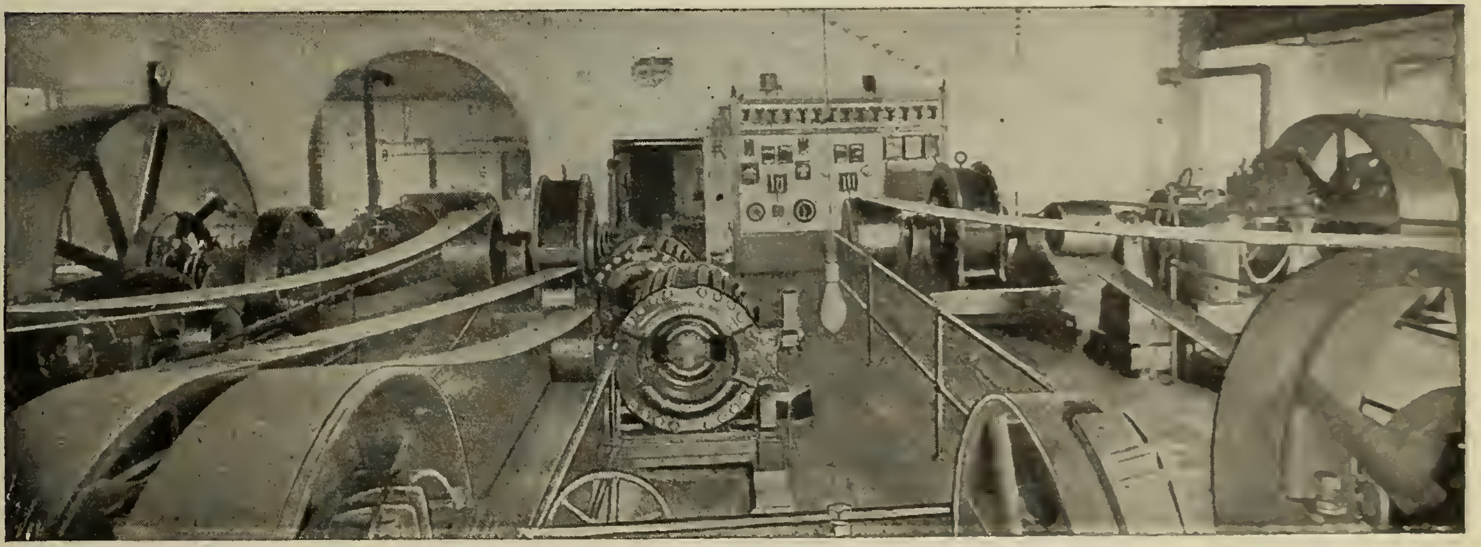
The kingdom of Saxony is perhaps in political abeyance. But it is the leader of the industrial world. Nowhere else is technical skill so highly developed; nowhere else does manufacturing approach so nearly to the rank of a learned profession. Small as the kingdom is it has no less than 111 technical institutes, including 10 of agriculture and 40 of commerce. Prussia has 260 such schools, with over 12,000 pupils; thirty-five of the schools are for painters and decorators, 16 for tailors, 9 for shoemakers, and so on. Every trade has at least one. The royal government appropriates $600,000 a year for their support, besides liberal subsidiaries from towns and cities, Berlin alone paying $70,000 a year. Baden, with only 1,600,000 population, spends $280,000 a year on technical schools. Hesse, with 1,000,000 population, has 83 schools of design, 43 of manufacturing industries and many others for artisans of various trades. Bavaria, Wurtemberg and other states have similar systems. The whole German people are being educated scientifically in the arts of industrial production. No wonder "Made in Germany" is becoming a familiar trade-mark in all the markets of the world.—Kuhlow's.

The Electrical Age.

VOL. XXI—NO. 14 NEW YORK, APRIL 2, 1898 WHOLE NO. 568



Drill Room, Miama Cycle & Mfg. Co.



Interior of Station.

MONOCYCLIC STATION AT MIDDLETOWN, O.

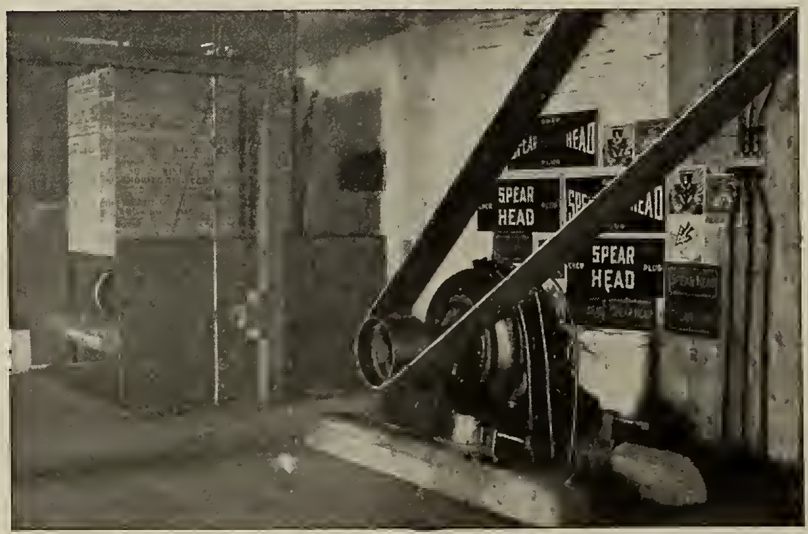
The number of central stations using that modification of the single-phase system known as the monocyclic, by which current may be supplied to both lamps and motors at the same time from their alternating generators, has within the past two years greatly increased. This system was introduced at a time when the question of extending their area of operations began to force itself upon the attention of central-station managers using either the single-phase alternating or the direct-current system of supply. With the first-named the question of distance presented no difficulty, but motors could not be operated successfully by it ; with the direct-current system, while the motors presented no difficulty, the area of operation was limited. With the newer system it was found that both arc and incandescent lamps, as well as induction motors, could be supplied from the same alternator, the first-named operating directly from the ordinary two-wire single-phase circuits, the motors merely requiring a third wire to give a displaced voltage. Operation of the monocyclic system has evidently proved satisfactory, as the present installations number not less than ——.

An interesting example of the introduction of the monocyclic system into a direct-current station, allowing the area of its operation to take a wide extension, exists at Middletown, Ohio, where Mr. E. H. McKnight, the President and General Manager of the Middletown Electric Light and Power Company, has recently found it necesary to increase the monocyclic capacity of his plant to meet the increased call upon his station. In addition to the arc and incandescent lighting usual in towns of the size of Middletown, certain factories under progressive managers have adopted electricity in place of steam, and the motor load on the station already far exceeds the lighting load.

The station fronts on the Miami and Erie Canal, having the tracks of the M. and C. Railroad immediately behind it. It is 65 feet wide and 115 feet long. Steam is supplied from two Brownell and Company Dayton boilers, to one 450 H. P. compound condensing Buckeye engine, and one 300 H. P. four-valve Russell condensing engine. The generating plant consists of two General Electric 12-pole, 150-Kilowatt, 1,040-volt, 600-revolution monocyclic generators excited by two 1½ K. W. exciters ; three 50-light Thomson-Houston series arc dynamos, and one G. E. 100 H. P., 500-volt, direct-current generator, all driven from countershafting furnished with the necessary friction clutches.

The 500-volt machine is used exclusively to furnish direct current to several small motor plants throughout the city ; the arc machines operate 112 city arc lamps.

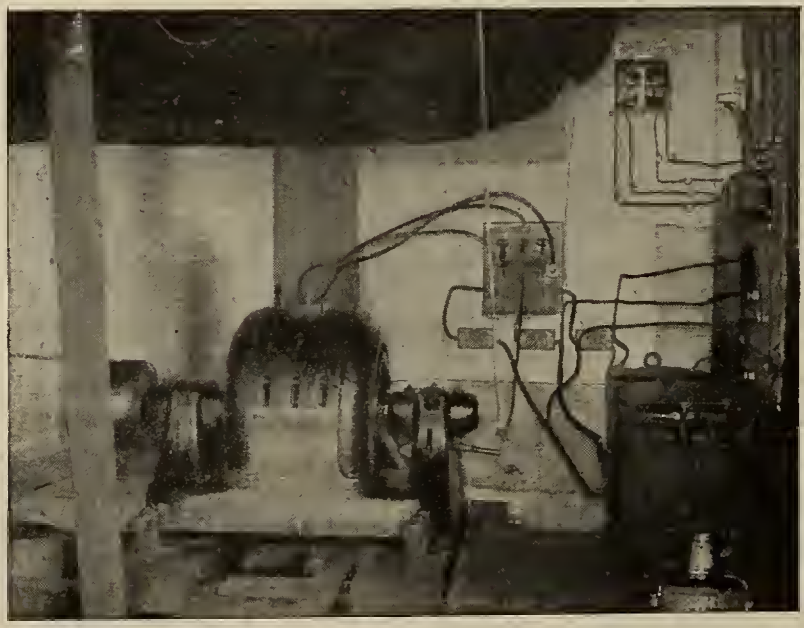
The motor load on the monocyclic machines runs up to within a short limit of their capacity. The factory of the Miami Cycle and Manufacturing Company, a little over a mile from the station, takes 200 H. P. when its motors are running at their rated capacity, and considerably in excess of this under usual working conditions. This company manufactures the well-known Raycle, and 1,200 of these wheels are built weekly, giving employment to 600 hands. The current is received in the factory in six 40 H. P., one 20 H. P. and two 10 H. P. transformers, reducing the pressure to 115 volts. The motor circuits run from the 40 H. P. transformers, the lighting circuits from the three of smaller capacity, and all the current is measured in a recording watt meter, connected on the primary circuit. The motor equipment consists in all of ten General Electric induction motors—three of 20 H. P. in the machine shop, driving 88 machines ; one of 10 H. P. in the drill and pattern room, driving 29 machines ; another of 10 H. P., driving the machinery in the frame department ; three of 30 H. P. in the polishing room—two for the polishers and one for the 48-inch exhaust fan ; one of 5 H. P., driving two plating dynamos in the plating room, and another of similar capacity operating a number of small machines in the assembling room, as well as a three-ton elevator. The incandescent lights in the factory number 750, of which during the rush season almost all are lighted.



Assembly Room.

Forge Motor No. 1.

In addition to the cycle factory, Mr. McKnight furnishes power to the tobacco factory of the P. J. Sorg Company, in which two departments are already equipped, each with a G. E. 30 H. P. induction motor. The first (Fig. —) is the smoking tobacco department, on the first floor, and is belted to shafting operating, on the three floors above, 3 Caldwell pickers, 1 cutter, 2 granulators and 2 dust machines. The second motor is on the



Motor No. 2 in the Factory of the P. J. Sorg Co.

xth floor (Fig. —), and is shown with the transformer ıd the meter to which the primaries from the station e connected. From this point secondaries are carried motor No. 1 in the smoking tobacco department, disnt about 500 feet, and the lights in the different deırtments being tapped off before the motor is reached. otor No. 2 drives two 7½-inch Sturtevant fans, used to y all the tobacco. It also operates a five-ton elevator. he capacity of the drying department is 100,000 pounds tobacco daily.

The benefits of electric drive by induction motors are, rhaps, nowhere so forcibly demonstrated as in these o installations. In the cycle factory, the constant eed of the machinery, the absence of vibration and the wer of the motors to respond to calls reaching as high 50 per cent. over their rated capacity, have enabled e manufacturers to give to every part of their wheels a rfect finish, as well as to greatly increase the output. the tobacco factory, the steady rate at which the tocco passes through the dryers gives it a uniform cure. eviously, the speed being variable, the tobacco would y in spots only, and a second handling was almost alys necessary. According to the foreman, the motor saves him lots of time."

The incandescent lights in the town already wired ımber 3,800 ; of these, 750 are in the cycle factory, 100 e in the tobacco factory, 650 are in the Opera House, d 2,300 in other parts of the town. These lamps burn th absolutely no interference from change in the motor ad ; in fact, the entire motor load may be thrown on or f without in the least affecting the burning of the lamps, e presence of the motor load being usually only deterined by reference to the ammeter. The monocyc machines operate with almost perfect regulation, reiring little or no attention to maintain the constant tential at all times.

A syndicate of New York and Saratoga capitalists has rchased, at a cost of $60,000, the land in the vicinity of ell Gate Rapids, on the upper Hudson, about seven iles above Glens Falls. The intention is to utilize the eat water power at the place for an electrical plant. A m and power house are to be erected, and with the ectricity generated therein a railroad, to be known as e Saratoga Northern, running between Saratoga Springs d South Glens Falls, will be operated. This road will ve branches to intermediate places and also to Glens alls, Sandy Hill and Fort Edward.—Scientific Am.

Work on the Jungfrau railway is progressing satisfacrily. The Lauterbrunnen River furnishes 2,400 horse wer used for the electric rock drills. The bed of the ver has been changed for a distance of about six miles. he line is practically complete to the Eiger glacier, and is section will be opened for traffic in June. Work has so been begun on the main tunnel, and more than 150 rds have been completed ; the solid rock has been found 30 yards under the snow, instead of 70 yards, as first pected.—Cosmos.

THE DEVELOPMENT OF ELECTRICAL SCIENCE. *

In a brief discourse on the development of electrical ience little time can be given to the early history of the bject. This part is more or less familiar to all the memrs of the Academy, and hence it may be passed over by ly such brief reference as may serve to recall to mind e more important of the early discoveries. The early reeks have recorded some elementary phenomena now nown to be electric, and it is probable that such knowledge was not uncommon, though little noticed. It is only in comparatively recent times that scientific research has taken the place of superstition and attempts have been made to classify and find reasons for the existence of all natural phenomena.

Beginning with the 17th century, probably the first investigator worthy of notice in this subject was Gilbert, of Colchester, who published his work entitled "De Magnete" in 1600. Gilbert made systematic experiments and showed that the property of attracting light bodies could be given to a large number of substances by friction. He also showed that the success of the experiment depended largely upon the dryness of the body. These experiments gave rise to the classification of substances as electrics and non-electrics. The true significance of Gilbert's observations as to the effect of moisture was not appreciated for a long time. Gilbert's list of electrics was added to by a number of other observers, prominent among whom were Boyle and Newton. The fact that light and sound accompany electric excitation was called attention to by Otto von Guericke, who also showed that a light body, after being brought into contact with an electrified body, was repelled by it.

Coming now to the 18th century, we find Hawksbee in 1707 and Wall in 1708 speculating on the similarity of the electric spark and lightning. Then comes one of the most prominent experimenters of this century—Stephen Gray—who began to publish in 1720, and who in 1729 found that certain substances would not convey the charge of an electrified body to a distance. These experiments were the first to introduce the distinction between conductors and non-conductors, and, of course, very soon served to explain the reason why certain substances could not be electrified by friction when held in the hand. Gray also made the important discovery that the charge of an electrified body is proportional to its surface, and this was afterwards confirmed by the experiments of Le Monnier. Many of Gray's experiments were repeated and extended by Du Fay, who found that all bodies could be electrified by friction if they were held by an insulatory substance. Then came the improvements of the electric machine by Boze and Winckler ; the firing of inflammatory substances, such as alcohol, by means of the electric spark by Ludolph, Gordon, Miles, Franklin and others. About this time (1745) the properties of the Leyden jar were discovered by Kleist, Cuneus and Muschenbroeck, and a few years later it was given practically its present form by Sir William Watson. Then follows one of the periods of exceptional activity in electrical research. A party of the Royal Society, with Watson as chief operator, made a series of experiments having for their object the determination of the distance to which electrical excitation could be conveyed and the time it takes in transit. They found among other things that several persons at a distance apart might feel the electric shock if they formed part of a circuit between the electrified body and a conductor such as the earth ; also that the earth could be used to complete the circuit in Leyden jar discharges. They concluded that when two observers, connected by a conductor, and at, say, two miles apart, obtained a shock by one touching the inside coating of a Leyden jar and the other the earth, the electric circuit was four miles long, that is, the earth acted as a return conductor. They also concluded that the transmission was practically instantaneous. Watson had ideas as to electric fluids similar to those which were afterwards systematically worked out by Franklin. A great many curious and interesting experiments were made about this time, as; for example, the influence of electrification on the flow of water through capillary tubes as discovered by Boyle, the experiments of Mowbray on the effect of electrification on vegetation, and those of the Abbe Menon on the loss of weight of animals when they were kept electrified for a considerable time.—Science.

[To be Continued.]

* Address of the President, Professor Thomas Gray, delivered bere the annual meeting of the Indiana Academy of Sciences on ecember 29th, 1897.

INSULATION AND CONDUCTION. *

BY REGINALD A. FESSENDEN.

A thing insulates because it is possessed of two distinct properties, first, the ability to stand the mechanical and electrical stresses due to the voltages used ; and, secondly, because it is such a poor conductor that but a negligible small current can flow through it and leak away. In other words, it will neither allow the current to break through it, nor to steal through it. The first property is called by Maxwell the "dielectric strength" of the insulator, the other property is called the ohmic resistance. The two together form its insulating power.

In the two great branches of electrical work, the requirements for an insulator are widely different. For apparatus used for the transmission of intelligence, as a rule low voltages are used, and so dielectric strength is of relatively small importance ; but the currents used are small, the circuits long, and material of high ohmic resistance is needed. For apparatus designed for the generation and transmission of electric energy, on the other hand, where the voltages are high and the currents large, dielectric strength is the main thing desired, and the leakage of a small amount of current is not objectionable. Consequently the two branches of the profession have come to use the word "insulation" in quite different senses, the former and older as meaning something having high ohmic resistance, and the latter branch using it with reference chiefly to material having great dielectric strength.

10,000 volts was looked upon as monstrous, but some experiments of the large companies, of which I have been informed, seem to show that 100,000 volts may be quite practicable, even in quite unfavorable climates. With overhead wire the leakage will merely mean a loss of energy, and the use of porcelain for all insulation, as any oxidizible material (used for instance to protect the primaries of transformers), would be speedily destroyed by the ozone. Where, however, oil is used in the transformers, the leakage may cause quite serious trouble, owing to the large surfaces and their proximity. In addition, as Prof. Elihu Thomson pointed out some years ago, with high potentials, impurities in the oil are apt to group themselves along the lines of highest slope of potential like the iron filings around a magnet, and if, as is generally the case, the impurities have a higher specific inductive capacity than the oil such a group is thus apt to form a bridge between two points of great difference in potential, hence causing an arc. In those convection currents it is not, I believe, the very small particles which cause the trouble, because small bodies, when charged from a comparatively large and smooth one, are not repelled but attracted ; consequently a small grain of dust after touching a highly charged flat conductor would remain close to it if there were no negatively charged particles near it to drag it away or no currents in the oil to wash it off.

The relation between the size of the particle, the voltage, and the radius of the charged conductor when the particle after touching the conductor is neither attracted nor repelled can be obtained by the method of images,

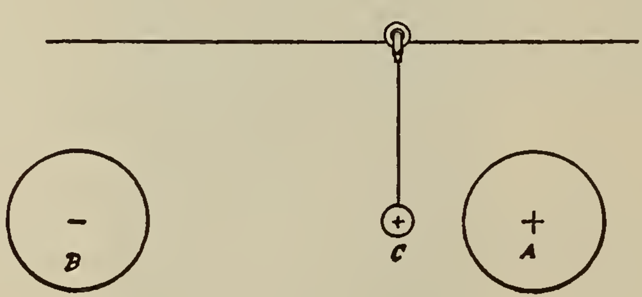


Fig. 1.

The Ball, C, having touched A and got A+ charge, is repelled and moves over to B, where it gives up its charge, takes up A— charge and moves back to A.

Confusion sometimes occurs through this double meaning, and the writer himself has been taken to task by a European engineer for stating that pure water was approximately as good an insulator as rubber, the critic having reference, as was apparent, to its ohmic resistance, whilst the original note was principally concerned with its dielectric strength. It is therefore considered best to define the sense in which the word is used, in spite of the fact that attention has previously been called to the distinction to be made between these two properties ; notably and very lucidly by Mr. Steinmetz in this Institute's proceedings, vol. ix., p. 815.

Before entering upon the discussion of the various purposes for which insulation is used and of the substances best suited to each case it may be as well to give a brief account of the manner in which the current passes through materials.

1. By actual connection.—That is by particles of the insulator, or of foreign substances, taking a charge from one electrode and moving with it to the other terminal under the influence of the voltage. This action is similar to that of the moving pith ball between the two knobs of a Holtz machine.

This phenomenon is not known to take place in solids, but it is quite marked in gases, vapors and fluids.

Until recently it was a question of no practical importance in electrical engineering, but with the high voltages now in use or contemplated it may give serious trouble, and apparatus must be designed to check this form of leakage. It was not so long ago that Ferranti's

but the formula so derived is rather long and complicated and I have not had time to work out the numerical results.

It is evident, however, from it, that for a convective current to take place the radius of the particles carrying the discharge must be a quite appreciable fraction of the radius of the charged conductor. Consequently this form of leakage is due to the motion of a portion of the oil as a whole and not of its individual particles, and if we can break up mechanically these currents we can to a great extent stop the leakage from this cause. This may be done in three ways :

1. By using oil of great viscosity, in which case, however, we lose the chief advantage of oil insulation, i. e., its ability to re-insulate quickly after a discharge.

2. By putting pure dry cellulose in some form or other between the charged surfaces loosely, so that the oil can filter through it easily and any air escape readily, but sufficiently close to prevent any rapid flow. Pure cellulose has the great advantage that when well boiled in the oil it has approximately the same specific conductive capacity as the oil. No varnish or shellac should be used in the oil for reasons given later.

3. By dissolving a solid, non-disassociating substance in the oil in such excess that it crystallizes out at ordinary temperatures and forms with the oil a soft, gelatinous mass, not fluid, but yet capable of allowing the oil to ooze through its substance. This has many of the disadvantages of 1, but it has one advantage, in that the substance chosen may be one, like paraffin, having a large specific heat of liquefaction, and consequently an overload

ll not raise the temperature of the oil above a fixed int till the paraffin is all melted.

The effect of points in promoting convective discharges air is well known. It is usually attributed to the great face density of electricity which a point must take in ler to make the potential all over the conductor the ne, and hence, since the repulsive force varies as the iare of its surface density, it is evident that there will a great tendency for discharge from a point from this ise. But there is another and very important one, i. e., fact that, as mentioned above, a particle cannot take harge and move away unless its radius is larger than a tain fraction of the radius of the curvature of the con- ctor at the point where it touches the conductor ; con- juently when the charged surface is a plane only large gregations of atoms can move away ; these move slow- and carry small charges in proportion to their mass. t at points where the radius of curvature is very all, small particles can move away with great rapidity l with relatively large charges. Rounding off or flat- ing the charged surfaces thus acts in a double way, by lucing the surface density and by preventing all but ge-sized particles moving away.

. Conduction in solids.—It is not absolutely certain t all conduction is not by convection, but the terms here used with their usual signification. In solids we not know as yet exactly how the discharge is handed but I have noticed a very remarkable fact, which is te significant and suggestive, i. e., that the conduc- ties of metals are proportional to the quantity

$\frac{\text{lasticity}}{\text{density}} \div$ valency. The following table shows this.

This fact was discovered by the writer in 1892,* as the ult of several years' tedious work in collecting physical a and combining them into formulæ to see if any law ıld be found. Out of the hundreds of combinations d, this and another one (really the same ultimately, expressed in terms of other properties), were the y ones which seemed hopeful. It was stated in the icle referred to that this formula could not be quite rect. This was for the following reason : Silver, gold l aluminium should, as will be seen from the formula en below, have resistances proportional to the square ts of their densities multiplied by their valencies, i. e., the ratio of

$$\sqrt{10.6} \ : \ \sqrt{19.26} \ : \ \sqrt{2.65} \times 3$$

., 100 : 136 : 150.

Now at this time the determinations of the resistance aluminium with which I was acquainted gave it as 193 silver 100. With such a wide discrepancy therefore ween calculation and observation, i. e., 193 instead of , it did not seem probable that the high observed value ıld be modified by subsequent determinations so as to ee with the calculated one. It was, therefore, with isiderable pleasure that I saw the recent determination Messrs. Richards and Thomson (published last year in Journal of the Franklin Institute). Their results for minium, 99.66 pure, were :

Aluminium : Silver : : 163 100,

l they expressed the opinion that the value for pure minium, when hard-drawn, would be 66 per cent. of conductivity of copper. This result is so close to the culated result given in the paper referred to, i. e.,

17 : 27 = 100 : 159,

ugh such a high conductivity for aluminium was con- ered beyond the bounds of probability at that time, t I feel justified in considering that the formula given y be found fairly accurate when more exact determina- ns shall have been made.

This formula throws a certain light on the nature of conductivity in solids, and why some solids are insula- tors. For the formula $\sqrt{\frac{\text{elasticity}}{\text{density}}}$ is the same as that for the velocity of sound in a body. Now, in the con- vective discharge, the electricity was handed on with the same velocity as that with which the particles moved. In fluids, as we shall see, the electricity is handed on with the velocity with which the ions move. In both cases the electricity travels along on the particles of matter.

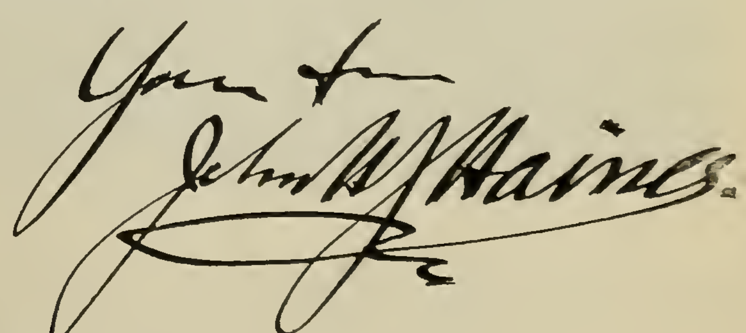
[To be Continued.]

A paper presented at the 123rd Meeting of the American Insti- of Electrical Engineers, New York, March 23rd, 1898.

Science, July 22, 1892.

COILS FOR HIGH-TENSION DISCHARGES.

Beside the many difficulties experienced in insulating coils used for high-tension discharges, I have found that one of the most serious is due to the making of splices within the coil itself ; it having been my experience with soldered splices that the chances of leakage and a disrup- tive discharge between the layers are greatly increased, even though the soldered splice is carefully insulated with more than the usual amount of insulating material. In a coil recently constructed by me which operated in oil and consisted of 15,000 convolutions of No. 34 wire insulated with four layers of silk, the difficulty above described was met with and ultimately caused the total destruction of the coil, which represented labor of at least one week. I mention this for the sake of those that are interested in the construction of secondaries for high-potential dis- charges and would suggest that in place of the ordinary soldered joint they effect a union between two pieces of wire outside of the coil and leave the extremities thus joined external to it and immersed in oil with the coil itself. It has been my experience with a coil operating with the splices inside that a six-inch spark could only be produced, whereas I found that with such splices made as above described the sparking capacity of the coil in- creased to ten or twelve inches. In vacuum-tube lighting, involving the use of coils carrying very high potentials, insurmountable difficulties will present themselves unless this matter of insulation and splicing be carefully attended to. It is very likely that the ordinary spark coil for X-ray work would be greatly increased in capacity if the sec- ondary were immersed in oil and its splices made and kept external to the coil.



NEW YORK ELECTRICAL SOCIETY.

186TH MEETING.

The 186th meeting of the Society was held at the Col- lege of the City of New York, Lexington avenue and 23d street, on Wednesday, March 30th, at eight p. m.

Mr. Frank E. Knight read a paper on "The Influence of Electric Railroads on Population and Land Values in Cities."

After this paper, Mr. J. W. Clarke gave a practical demonstration of the Marconi System of Wireless Tele- graphy by means of an improved apparatus.

On behalf of Mr. John Dennis, Jr., the inventor of the Fluorometer, Mr. Clarke also described the operation of that instrument as a surgical adjunct of the X ray.

THOMAS A. EDISON, JR.

Mr. Thomas A. Edison, Jr.,
96 Broadway, New York City.

Dear Sir:—The sample package of "Edison, Jr., Improved Lamps" was received in A1 condition. Thanks. Have put fourteen of them on and they give a fine white light.

I am well satisfied that the Edison, Jr., Improved Lamp is superior to any lamp which I have used, and I have used over thirty different varieties.

I have one of your lamps which I have had for some time, which is a good recommend. It is a 100-volt, 3-watt, 16 C. P. lamp. When I first purchased the lamp I placed it on a 104-volt circuit alternating current, and by photometric test it emitted a light of over 21 C. P., almost 22 C. P., when compared with lamps that other manufacturers send out and call 16 C. P.

I kept this lamp in circuit for just 600 hours. The voltage has run from 101 to 106, but had been kept at about 104 1-2 by a recording voltmeter. At the end of the 600 hours the lamp was tested for C. P. A light of nearly 19 1-2 C. P. was the result, operating at an efficiency of approximately 2.5 watts. Now, I have tested many a lamp, and never has a lamp shown up as well as this one, although once in a while I get hold of an exceptionally good lamp better than the average run.

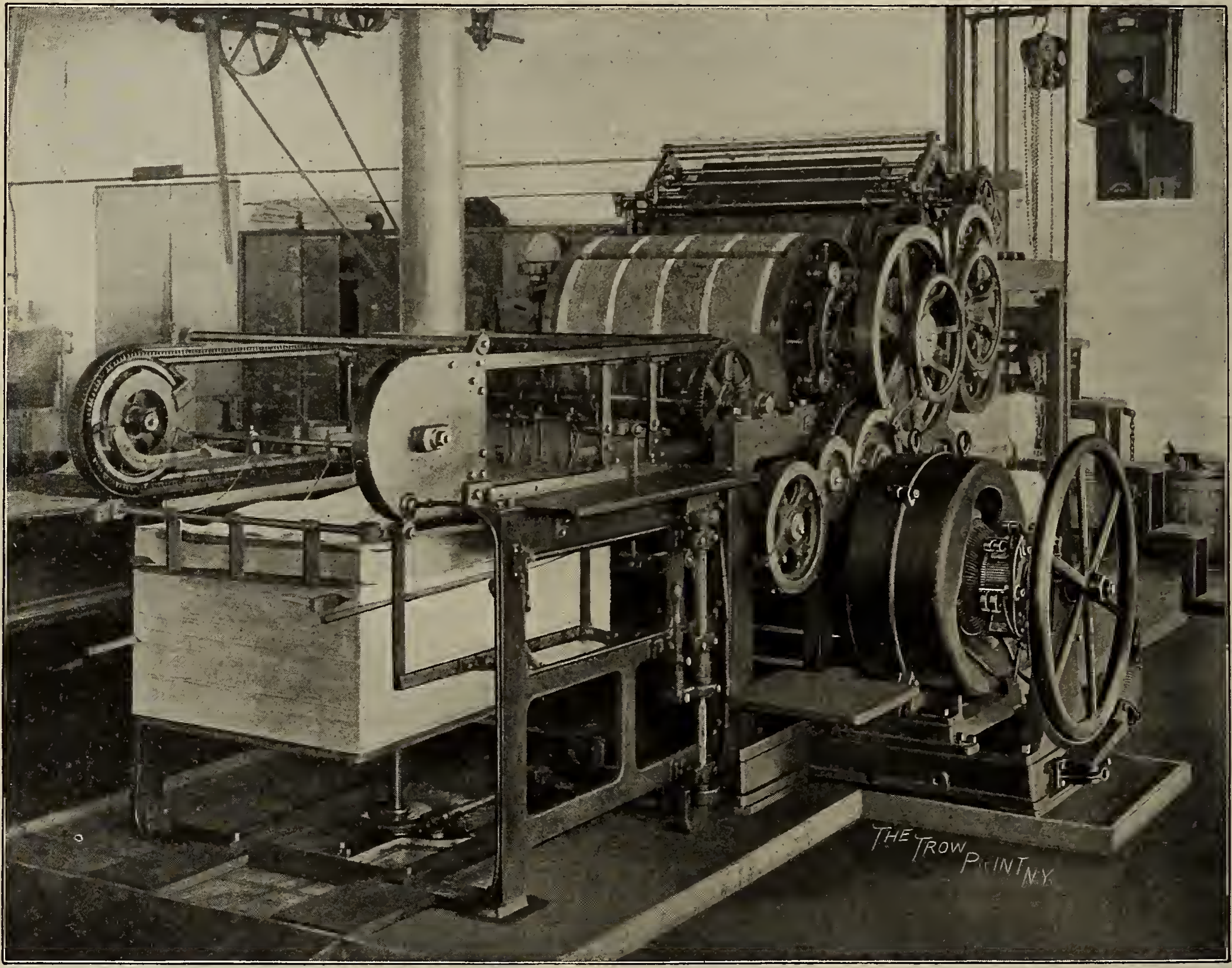
The lamps you sent me show off in great style when burned at normal voltage.

I shall order more of your lamps soon and shall use the Edison, Jr., Improved Lamps on all systems which I wire hereafter. Yours faithfully,

(Signed) Leverett M. Clark,
Electrical Contractor.

PRINTING BY ELECTRICITY.

The printer has had a great deal to contend with in the last decade. Since the art of printing has so developed that it may really and truly be called an art, printers have realized that they belong to a higher and better class of workers than they at first supposed. The printer of to-day must reproduce photographic engravings with an accuracy that is truly wonderful. He uses lithographic stones in producing remarkable color combinations, and he has learned to become an expert in judgment on the various grades of paper employed by him for letter printing, color printing and half-tone work. His trade has become divided up into many departments, and it is almost impossible to conceive of anything more difficult than a close practical study of them all.



Cottrell No. 7 Rotary Perfecting Press with 7½ H.-P. Motor,

One of the great troubles that printers owning their own plant have met with is the irregularity of their power supply or the lack of it when most needed. An observer wandering through printing establishments of moderate size will find that proprietors frequently install gas engines, motors, and, in one case that came under the writer's notice, a vertical engine and boiler on the very floor where the printing was done.

The demands of printers and the requirements of the printing shop have been carefully studied by the Sprague Electric Company, 20 Broad street, New York City. Having long realized that the printers in moderately good circumstances would certainly like to do away with the trouble experienced in handling gas engines, etc., they have manufactured motors specially adapted to the sudden strains experienced when heavy pressures are thrown on. In addition, considering the proprietors of great printing establishments not fully equipped with

The Electrical Age.

Established 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
First Floor, World Building.
NEW YORK.

NEW YORK, APRIL 2, 1898.

CONTENTS.

ELECTRO-MAGNETIC WAVES.

An article with a title of this description is one which the public regard with averted eyes. Few of them know what electro-magnetism is, and fewer still that at all comprehend the meaning of the expression, electro-magnetic waves. It is strange to realize how quickly they fall in line, however, when occasion demands, and grasp the meaning of a phrase which may seem to belong to the scientific and complex. We are now on the eve of a momentous change—a study of the invisible, as some enthusiasts choose to call it, has become an important branch of engineering and threatens to exercise a widespread influence over great fields of work. Prof. Hertz has written a treatise on electric waves, which has been supplemented and commented upon by Profs. Lodge, Jones and others. So far as we have gone, practical men have concluded that the only solution to the problem of economical lighting and telegraphing through space without wires is to be found in the use and proper manipulation of electric waves. Why should not future methods of transmitting power rise superior to the necessity of using wires, when the latest investigations show and prove that electrical energy is really transmitted, not within the wire, but external, in the form of electro-magnetic disturbances of a systematic nature? It is not alone the interesting field of electric signalling that will be considered by those who interest themselves in this department of work, but other great problems of tremendous scope and immediate usefulness; in fact, it seems as though a new era were about to open up in the broad and comprehensive field of electrical engineering, one in which this mysterious force of nature will be guided along great paths of unlimited extent with but little retardation or loss. The apparatus at present in vogue for producing electromagnetic waves consists of spark coils, condensers and other devices creating high potential discharges, such as a combination of transformers, etc. Although so far these waves have merely been produced for experimental purposes and have served the purpose of actuating a distant relay or its equivalent, no attempts have been made to transmit any considerable amount of power by such a system. When ordinary Leyden jars throw out oscillations they are at least one hundred and fifty feet in length. Dr. Hertz invented an oscillator which merely consisted of two brass knobs placed at the terminals of a secondary coil. The capacity of the brass spheres affected the nature of the waves radiated into space. Prof. Lodge has also invented an oscillator similar to the one invented by Hertz, with the difference that the discharge between the two brass knobs passes into an intermediate and larger sphere. By means of this arrangement, waves less than an inch in length were produced. Finally, Marconi used an oscillator well known to the reader of electrical literature. Two large brass spheres plugging up the ends of a cylinder containing oil, and two smaller spheres, from which the discharge passes into the larger two, constitutes the invention of Marconi. Rose, another experimentalist, devised an outfit for producing electrical oscillations which is practically applicable to wireless telegraphy. The receiving device known by the name coherer is of simple construction, and performs its function by merely responding to the influence of electric waves and thereby setting into operation another circuit carrying a powerful current. Waves of this description, though produced in greater number, are used in vacuum-tube lighting, and the success of electric signalling without wires and a system of tube lighting depend upon the number and frequency of these electro-magnetic disturbances. It is the opinion of our most eminent scientists that light is an electro-magnetic phenomenon, and it seems certain that a closer acquaintance with the manner in which it is produced will develop this latest field of investigation, which deals exclusively with the nature and character of electro-magnetic waves.

OBITUARY—NELSON W. PERRY.

Nelson W. Perry, aged fifty-two years, a well-known writer on electrical science, died at his boarding-house, 17 Sidney place, Brooklyn.

On March 26 he experimented all day with an incandescent burner. He had attached the apparatus to the only gas jet in the apartment, and found it necessary to turn off the gas at intervals.

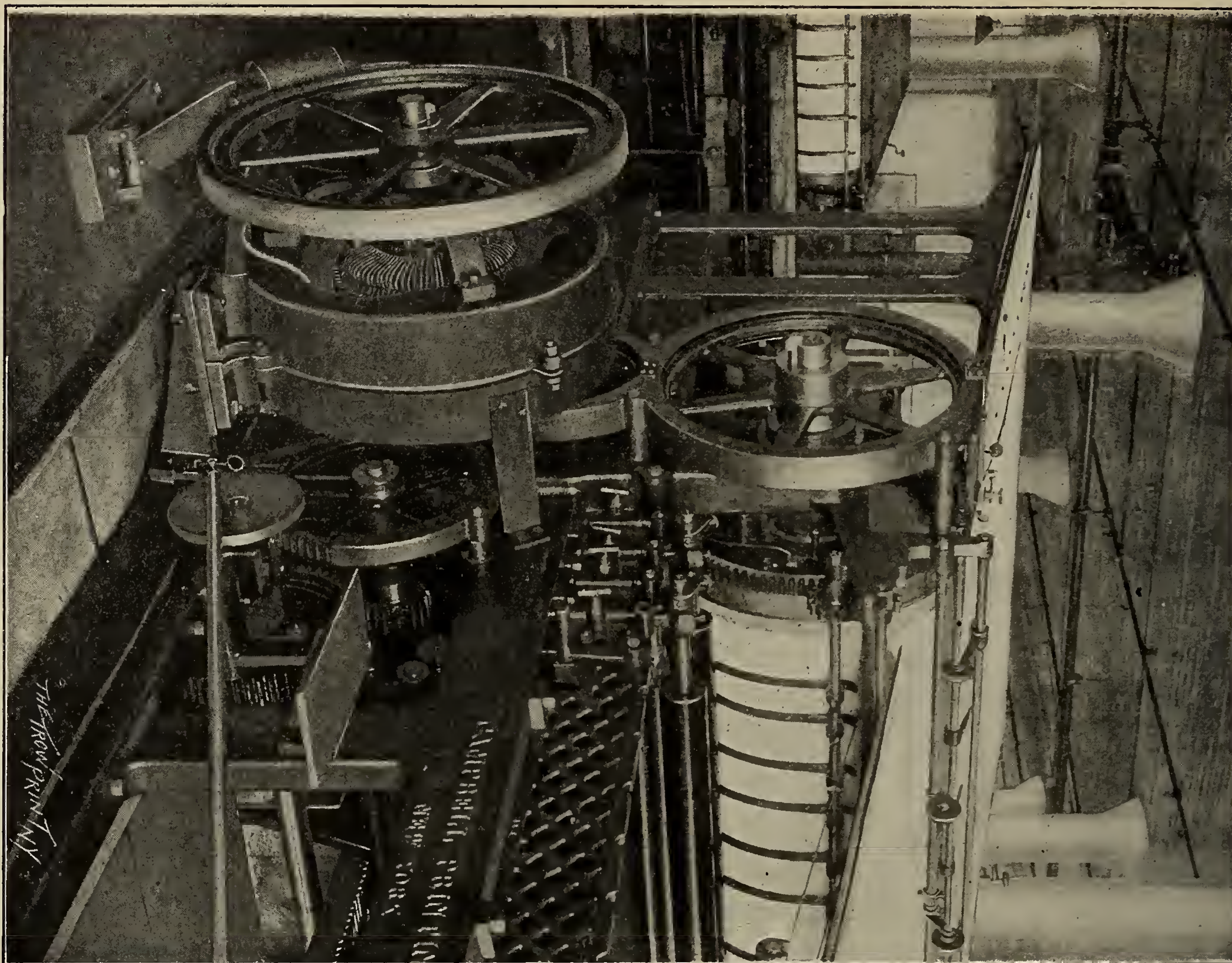
On a table nearby were two glasses, one containing drinking water, and the other the bichromate of potassium. At a time when the room was dark he picked up what he thought was the glass of water and drank it. Immediately he called for help.

Dr. J. E. Truslow, of 186 Clinton street, administered antidotes, but Sunday evening the patient died.

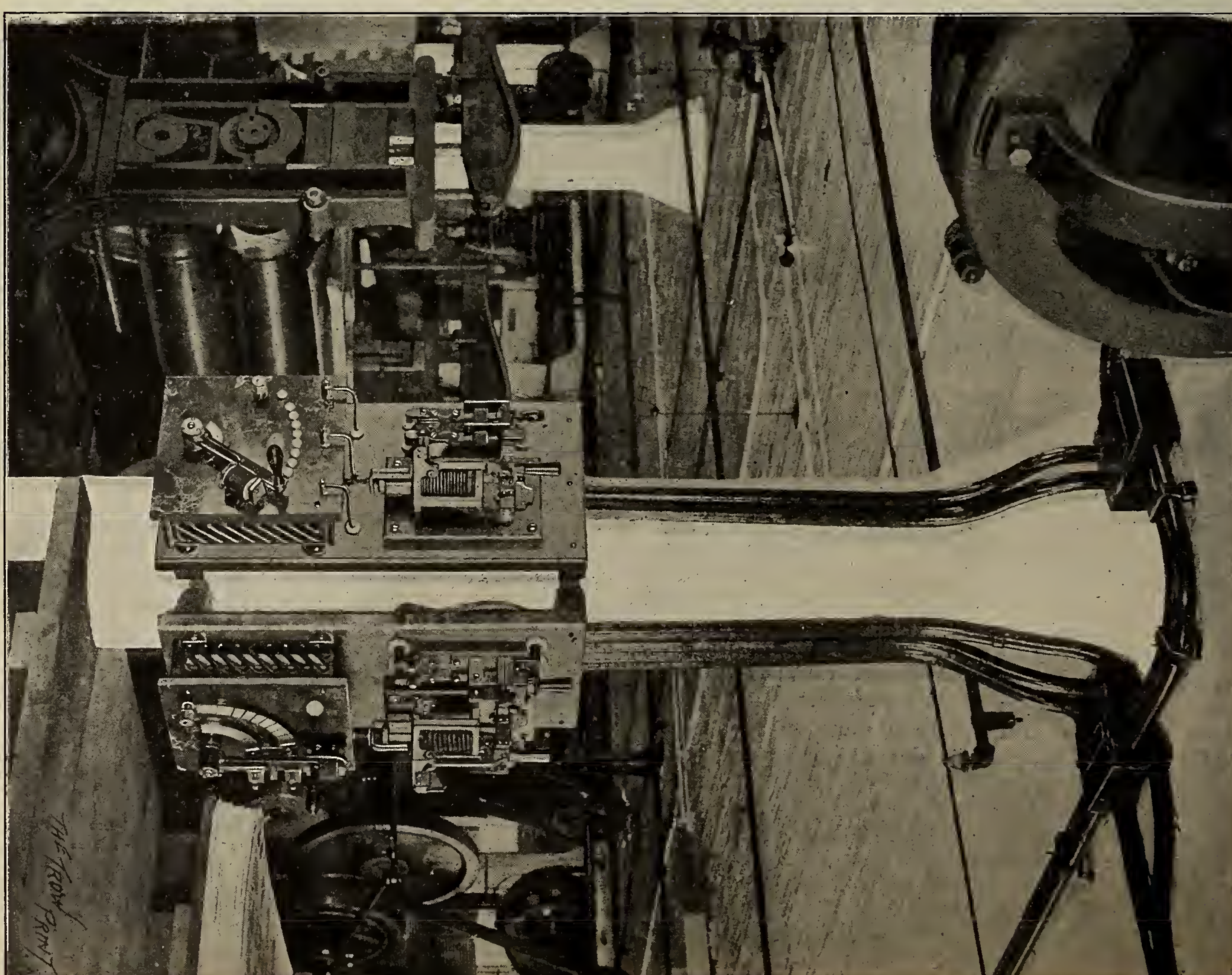
The sick man's wife had been in Johns-Hopkins Hospital, Baltimore, where she was recovering from a surgical operation. She was able to come to the bedside of her dying husband.

The deceased was a native of Ohio. He had lived in Brooklyn for four years. He leaves a widow and three children. His father is a justice of the Supreme Court of Ohio.—N. Y. Journal.

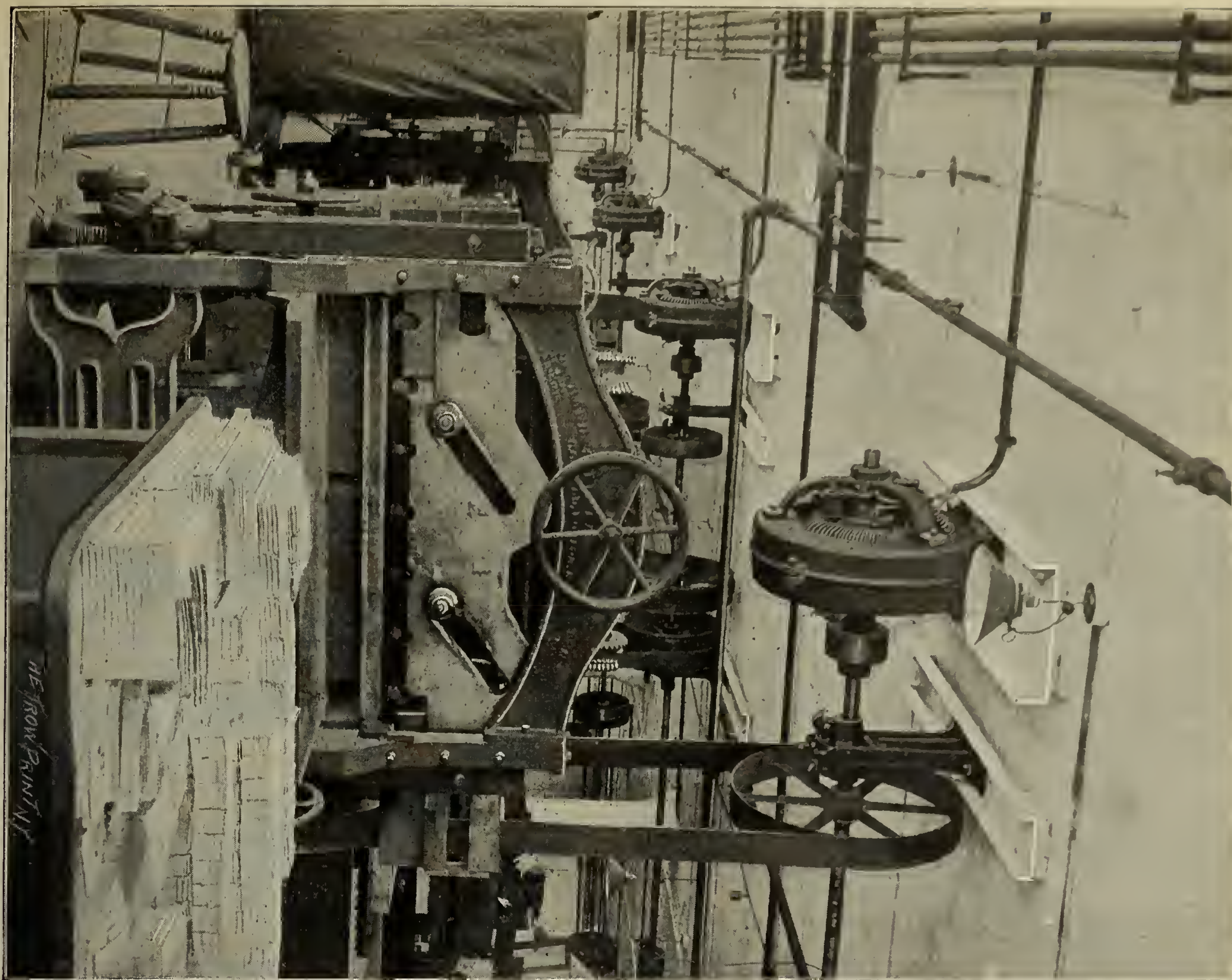
In the article on insulation and conduction by Reginald A. Fessenden, a clear explanation is given and distinction drawn between the meaning of "dielectric strength" and what is regarded as its synonym, ohmic resistance. Mr. Fessenden implies that dielectric strength is a measure of the ability of an insulator to stand the mechanical and electrical stresses due to the voltages used, but the ohmic resistance relates to the character of the insulator, as a conductor, through which a current will pass of negligible quantity or with great volume. In other words, the dielectric property of an insulator differs entirely from its ohmic resistance.



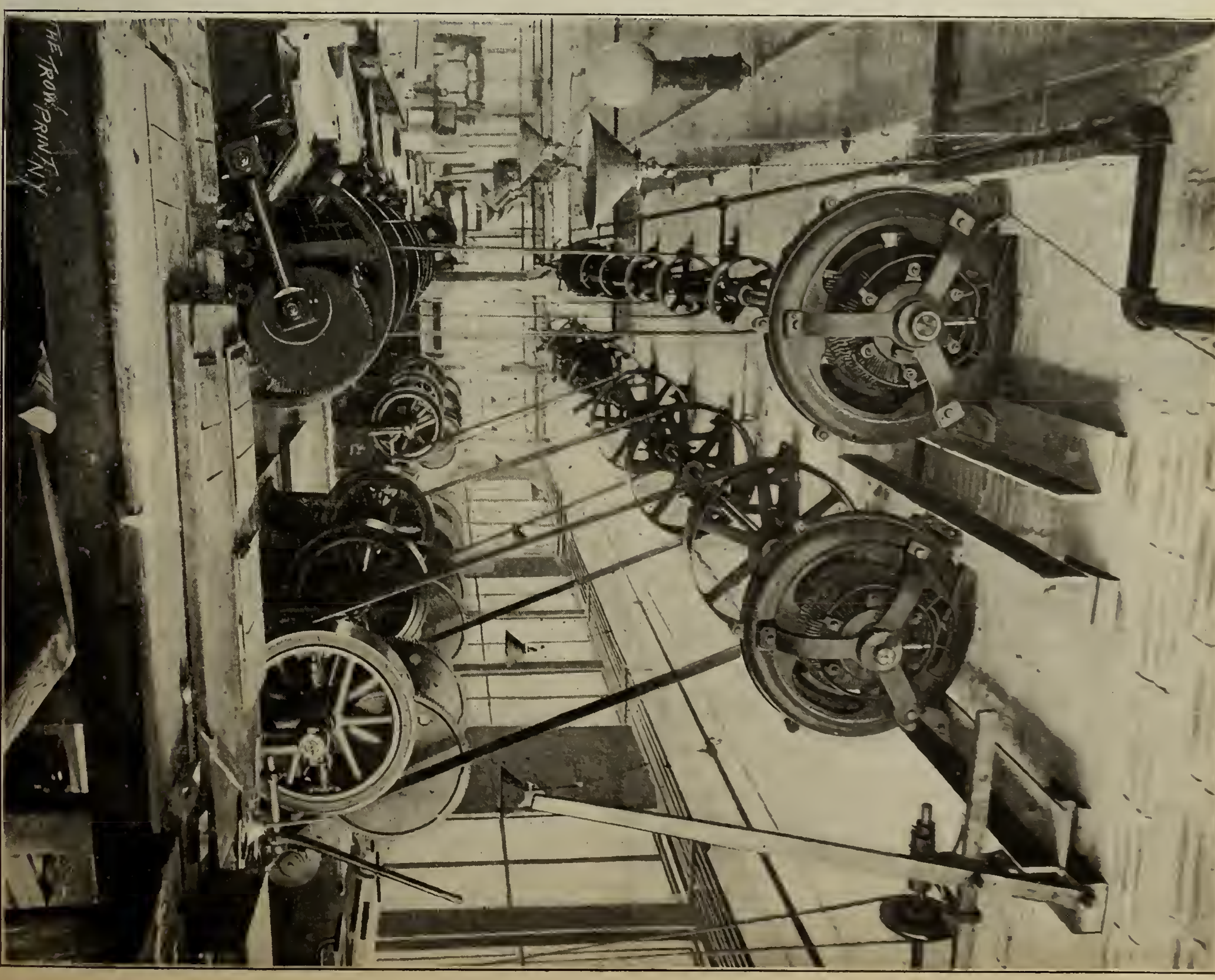
Campbell No. 00 Century Two-Rev., 5 H.-P. Motor.



Shows Method of Control for Ceiling Motors.



Line Shaft Motors Driving Paper-Cutting Machine.



Line Shaft Motors Driving Embossing Presses.

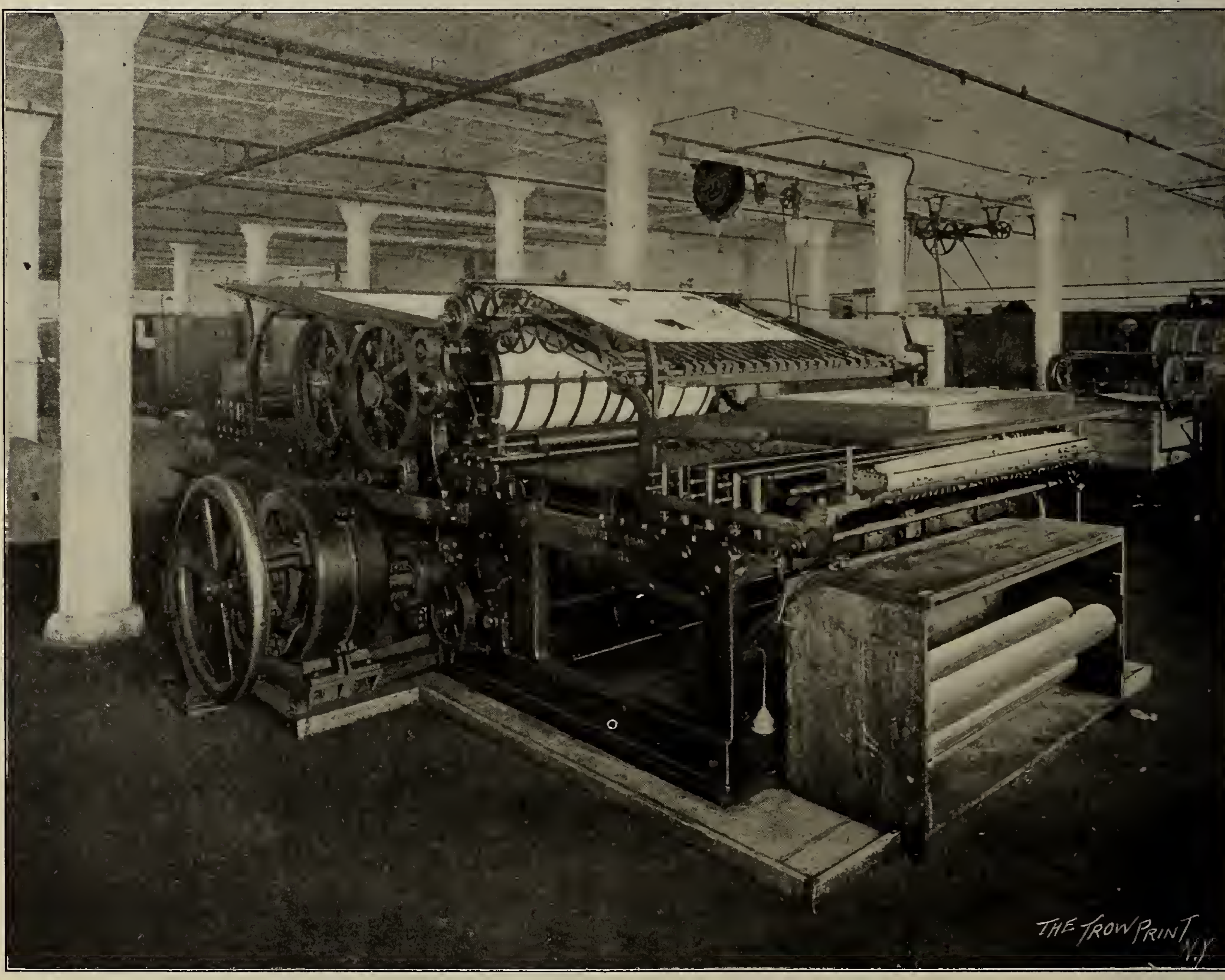
all power proceeding from one or two large motors, they have designed and manufactured special motors which are directly connected to each large press and exercise individual control over it.

In the illustrations shown in connection with this article motors direct-connected to very large presses employed in well-known establishments indicate the practicability of this scheme. The titles are given beneath each illustration, and we can only say that the proprietors have in every case expressed their utmost satisfaction at the celerity with which work is done and ease of control experienced by the operator.

The Sprague Electric Company also manufactures line-shaft motors, which, as seen, may be attached to the ceiling, operating a line of shafting and driving with ease and economy embossing presses or other machinery placed below. Another illustration gives the reader an idea of the method of controlling line-shaft motors or ceiling motors, the automatic cut-out switch and starting-box connecting with each one being placed in a position immediately accessible to those in charge.

When it is realized that the loss in a building from cellar to top floor due to the line of shafting intervening may amount to forty per cent. of the power supplied, the absence of intermediate contrivances and the benefit of directly applying the power where it is to be used makes the use of ceiling motors or motors direct-connected to machines a problem not only interesting technically but financially. The conservative statement may be made that fifty per cent. of the power generated in New York City and transmitted mechanically is wasted. This would represent millions of dollars per annum, yet it seems strange to realize that those apt to be most benefited by the introduction of these devices are often the slowest to adopt them.

The above illustrations have been taken from plants in actual operation, the electrical apparatus being supplied by the above company, and have from the standpoint of efficiency saved the installees thousands of dollars in time, money and convenience.



No. 10 Cottrell Flat Bed Perfecting Press, 10 H.-P. Motor.

LITERARY NOTES.

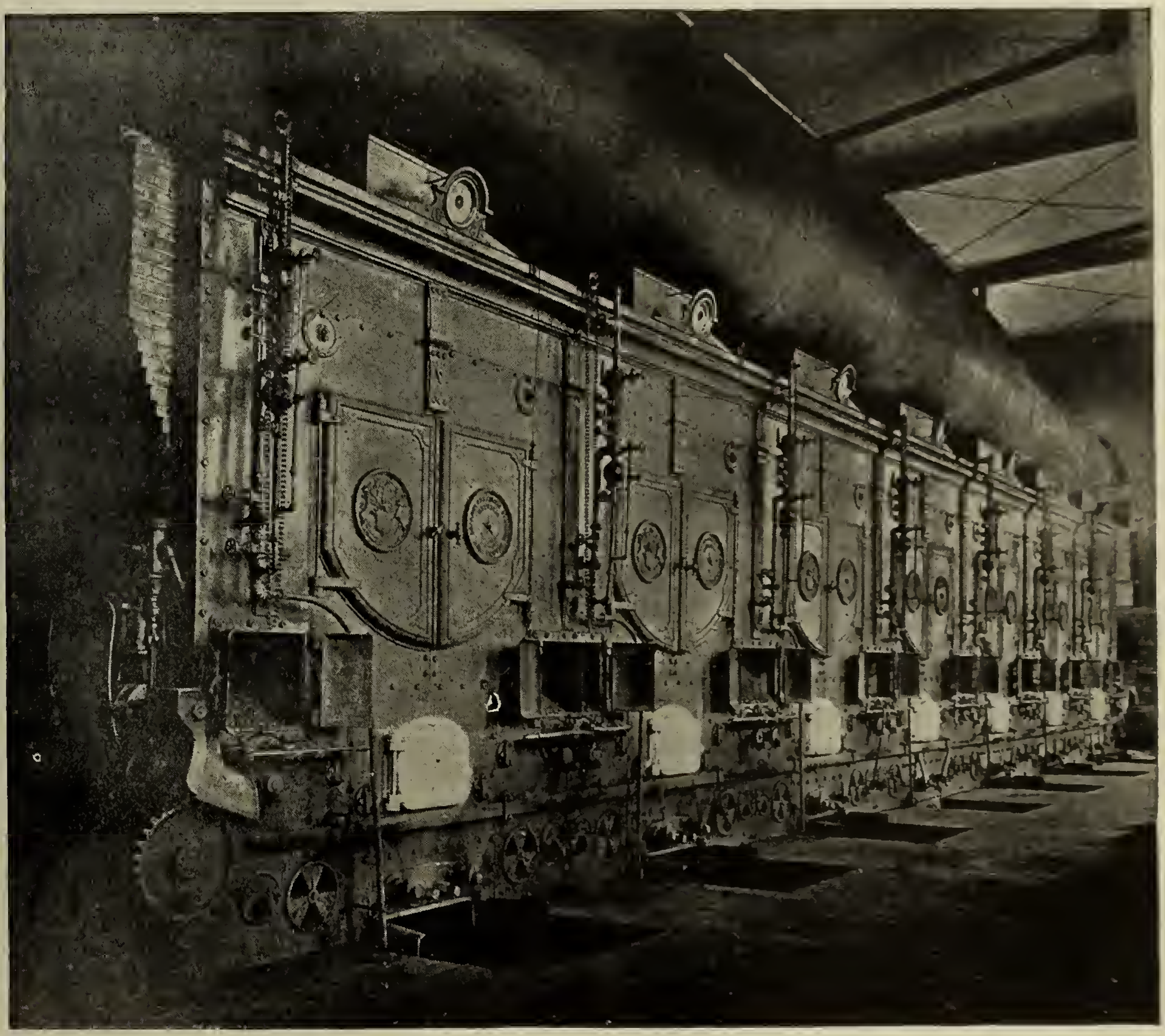
There is a good deal of patriotic interest in the April Home Magazine (Binghamton, N. Y.), just out. It is a special naval number, with a number of elaborately illustrated articles, among them one of keenest interest just now on a new submarine boat, never before described. Then there is "The Building of the Ship," in which many points of naval interest are discussed in a way that will interest any one. "In the Harbor of Fayal" is a story of a gallant sea-fight in the war of 1812. Other illustrated articles are "The Strategic Importance of the Nicaragua Canal," and some interesting facts about "Historical Tobacco Pipes." Henry Chadwick has a timely baseball story entitled "A Chapter of Baseball History." There are short stories in profusion and some poetry—in fact there is something to interest everybody, especially people who travel. Of particular interest to the commercial travelers are the news departments devoted to their interests, wherein is contained an account of the Commercial Travelers' Fair held in New York the first week in March, which unfortunately was not a financial success.

WIRING FOR LIGHT AND POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The generation, transmission and distribution of power are problems that have occupied the attention and called upon the skill of engineers from time immemorial. There is every evidence to prove that some of the attempts made in early days were none the less worthy of the name of transmission plants than those of modern times — elaborate with improvements and bristling with devices for the safe transference of power.



Boiler Room of Central Station.

The transmission of power is merely the name for a system by means of which energy may be transferred from point to point conveniently and without much loss. Ultimately the power transmitted assumes the form of mechanical energy and is therefore to be looked upon as the result which, by its value in foot pounds, determines the superiority of one system over another. To speak of lighting and power circuits is simply to reconsider the conditions which, in a milder form, are met with when power is to be transferred. The generation of power may be carried on with alternating or continuous currents, but its transmission is not a problem of the same ease of solution.

Alternating Current Circuits.—The peculiarities of an alternating current manifest themselves very quickly under certain conditions. An alternating current is different from the continuous in one striking respect. It oscillates in commercial circuits at the rate of perhaps 100 times a second back and forth. Therefore if any retarding effect ensues it is likely to become highly developed and possibly so affect the line as to render ready transmission a matter of considerable difficulty. The distribution of power by alternating currents gives rise to certain other features of considerable interest to the reader. When power is ordinarily distributed we are not apt to consider the source of power, but merely the fact that it is to be sent from house to house as required.

When power comes from a long distance, the pressure generally is very much higher than it would be were it simply generated in the centre of a very large city. The processes of transformation are more numerous in such a case than would be expected. The Ferranti system in London puts the current through two processes —

Generation at 10,000 volts.

(1) Transformation to 2,000 volts.)

(2) Retransformation to 50 or 100 volts.

It is but necessary to understand that these changes only occur on account of the peculiar system in use, and not because the alternating current must be transformed.

In transmitting power by continuous current the same kind of apparatus is used throughout. To reduce an alternating current either up or down requires the use of transformers. A continuous current can only be changed in pressure by means of motor transformers or storage batteries. To distribute either alternating or continuous current we are forced to use two entirely different systems. They bear a certain relationship, due to the fact that both are for the distribution of electricity, but in technical features they are entirely dissimilar. Power from either continuous or alternating currents means the use of special circuits, special motor and special precautions.

Continuous-current circuits do not show other than the most common features of distribution. A generating plant either employs dynamos for the distribution of light, or of both power and light.

(To be continued.)

NEW YORK NOTES.

Anti-Trust Incandescent Lamp Co. have opened an office at 15 Cortlandt street, room 52, for the sale of their lamps in this market. They are made in all voltages and candle-power, and are fully guaranteed to meet all the requirements of a first-class lamp. Write for prices and oblige the Electrical Age.

Elmer P. Morris has removed his offices to Rooms 50, 51, 52, No. 15 Cortlandt street, where buyers of railway, electric light, power, and all kinds of electrical supplies will find it to their advantage to call and leave their orders.

C. W. Hunt Co., 45 Broadway, N. Y., manufacturers of electrical and mechanical coal, elevating and distributing systems, have been awarded some big contracts by the U. S. Government for the War Department at Key West and Dry Tortugas.

Mr. F. Fleck, formerly foreman for Freedman, Rennard & Co., has succeeded to their business at 136 Liberty street, city.

E. J. Fenton, representing the National Conduit and Cable Co. of N. Y., has just returned from an extended trip West and South. He reports a very good outlook for an active spring business.

ELECTRIC RAILROADS IN SEOUL.

I have the honor to inform you that a company has been formed in the city of Seoul for lighting the streets and residences with electricity and for operating electric street railroads through the principal thoroughfares. Only the latter will be begun at once.

The company, known as the Seoul Electric Company, is composed entirely of Koreans, with the governor of the city as president. They have an exclusive franchise from the Department of Public Works, Agriculture and Commerce, and have paid in about one-half of the capital of $300,000.

This company has made a contract with Mr. H. Collbrann, of Denver, the American contractor for the construction of the Seoul-Chemulpo Railroad, for the construction and equipment of an electric trolley street railroad of the latest and most improved design. The railroad will be about six miles in length, and will run from the station of the Seoul-Chemulpo Railroad through the south gate of the city, along the broad streets, past the new palace and foreign quarter, through the busiest part of the city and the great east gate, to the Tomb of the Empress.

Mr. Collbran has received a cash payment of $100,000 with his contract, and the work will be rapidly prosecuted.

It is regarded as a profitable enterprise, since, with a city of 300,000 people and no amusements, there will probably be enough passenger traffic from curiosity seekers to make it pay for a year so, while the people are being educated to the point of regarding the road as a necessity.

At present all the financial ventures of importance in Korea are in the hands of Americans.

Horace N. Allen,
Seoul, February 15, 1898. Consul-General.

Charleston, W. Va.—The Wilson Spring & Telephone Co. has been incorporated by Jos. T. Stubbs, Vernon M. Pierce, Prentice H. Manning, Josiah Hinckley and George G. Hackett. Capital stock, $100,000.

BOOK REVIEWS.

The new Pocket Electrical Dictionary of Prof. Edwin J. Houston is the fourth edition of his extensive, popular and standard work. This little volume contains over six thousand new electrical words, terms and phrases that have come into use since 1898. The entire volume contains in all about 15,000 definitions. It is certainly the most complete book of its kind in existence and it will be impossible for the electrical engineer to feel up-to-date without a copy of this handy book for reference. It is sold at $3.00 retail with leather binding and $2.50 cloth.

"Lubricants, Oils and Greases," by Iltyd I. Redwood, is a new book published by Spon & Chamberlain, 12 Cortlandt street, New York. This English volume contains a great deal of information on the use of lubricating material. It will certainly find a place in the library of all practical engineers and may serve to modify some of the opinions entertained by certain manufacturers of lubricating oils. The subject is treated in a plain and straightforward manner and shows the composition of many standard lubricants. The subject is treated theoretically and practically and is contained within the scope of seven chapters. Some valuable tables will prove a handy reference and the general classification and tests a source of wholesome instruction.

"A System of Easy Lettering," by J. H. Cromwell, whose editions have now reached the fourth thousand, represents one of the simplest and most easily acquired methods in vogue. Architects and draughtsmen of all descriptions will find this modest little volume of the greatest value to them.

"Algebra Made Easy," by Edwin J. Houston, Ph. D., and Arthur E. Kennelly, Dr.Sc., published by the American Technical Book Company, 45 Vesey street, New York, is exactly what its collaborators call it, a "clear explanation of the mathematical formulæ found in Prof. Thompson's 'Dynamo-Electrical Machinery and Polyphase Electric Currents.'" The earnest student will find that the use of this book "Algebra Made Easy," in connection with Thompson's work, will prove a great aid and save considerable time in the interpretation of the varied formulæ contained therein.

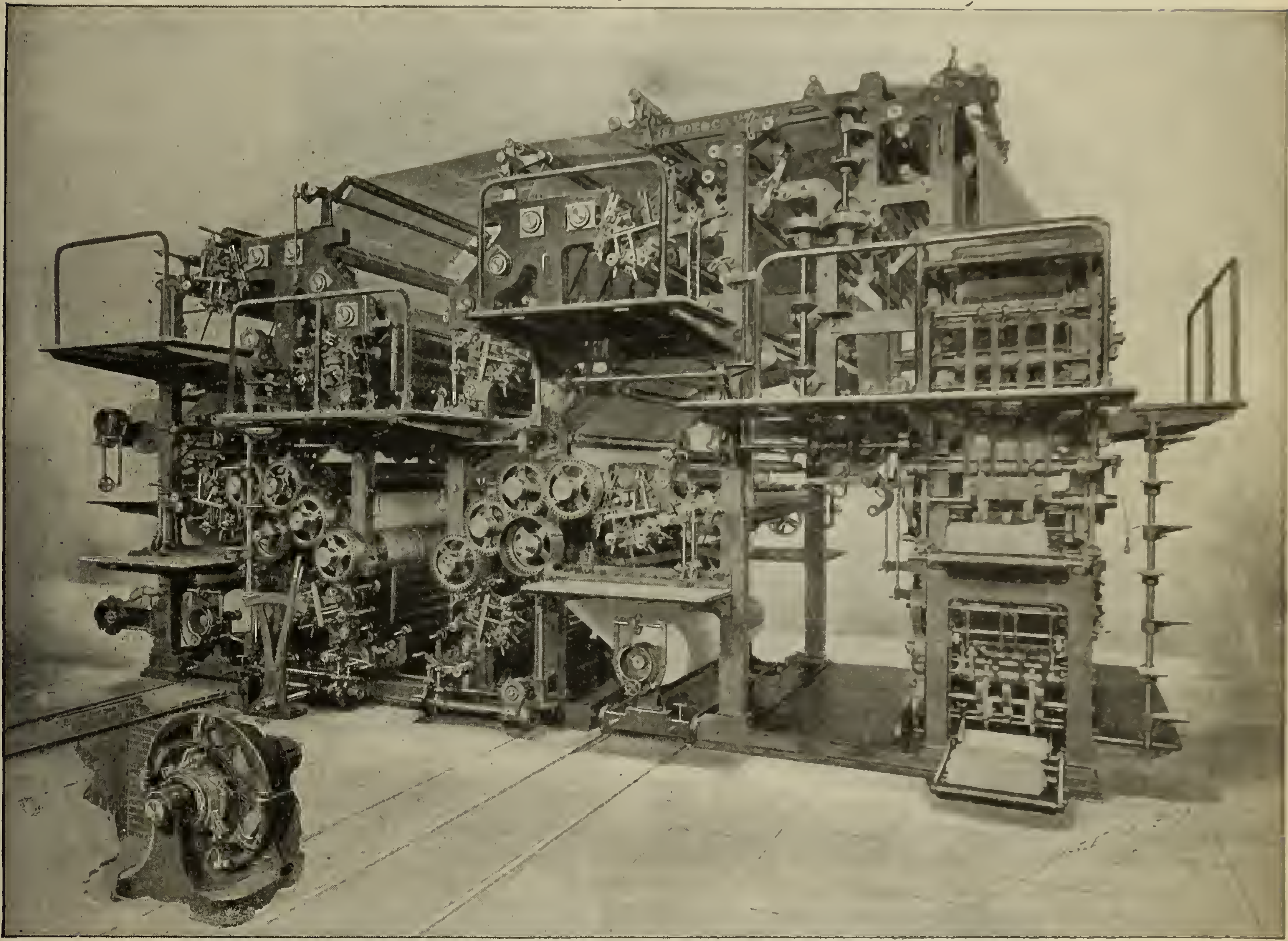
Winnsboro, S. C.—The Winnsboro Electric Light and Power Co. has been fully organized, and will erect a $3,000 electric light plant of 750 incandescent lamps.

Wheeling, W. Va.—The Wheeling Street Railway Co. will increase the power of its electric power plant, putting in new machinery, etc.

Bristol, Tenn.—The telephone system is to be extended.

The Electrical Age.

Vol. XXI—No. 15 NEW YORK, APRIL 9, 1898 Whole No. 569



The Largest Printing Press Ever Built.—Driven by a Crocker-Wheeler Motor. Octuple Stereotype Perfecting Press and Folder, by R. Hoe & Co.

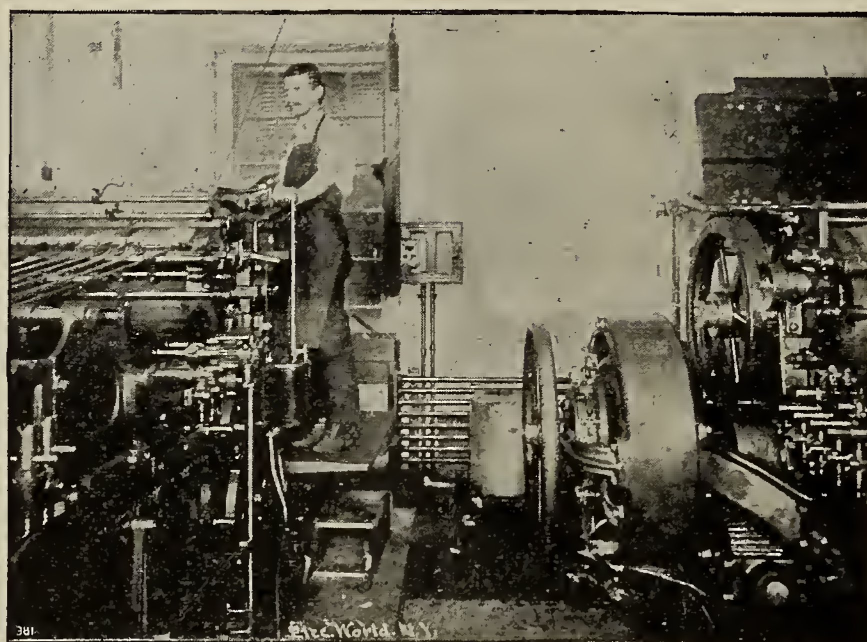
SOME APPLICATIONS OF CROCKER-WHEELER MACHINERY.

The development of electrical or mechanical energy two great classes of machinery—dynamos and motors; and we find as circumstances arise in industrial life requiring special applications of either one or the other, that the mere design and construction of an ordinary motor or dynamo would not suffice. We may regard the Crocker-Wheeler Electric Company as representing the spirit of true progress, not only in the manufacture of many varieties of electrical machines, but in discovering original applications of them. For many years in the past, when the science of electrical engineering was incomplete, this concern pursued its most conservative policy and kept in mind with remarkable persistence this object. Since then a vast field of experimental work has been passed and its nooks and crannies carefully explored, so that it may now be said that a period of maturity has been reached, and the ripened products of a well-established growth are at hand ready for public service or individual use. The spirit of the times demands a constant wakefulness on the part of electrical manufacturers, for the future growth and prosperity of those engaged in the art depends entirely upon themselves. In looking over the advances made in the course of the last ten years, examination will show that even in the lesser departments of work, as well as the higher, the above company has always been to the front.

Some illustrations have been attached to this article for the purpose of showing in a slight degree the nature of the work now undertaken by the Crocker-Wheeler Electric Company. The largest printing press ever built is being driven by a Crocker-Wheeler motor. This press was constructed by R. Hoe & Company, and is an octuple, stereotype perfecting press and folder. It prints, folds, counts and delivers 96,000 eight-page newspapers in an hour. As seen in the illustration, a 75-horse power motor built by the Crocker-Wheeler Electric Company, of Ampere, N. J., and 39-41 Cortlandt street, New York, has been installed under the floor for direct connection to the gigantic press above it. Relative sizes of both are well represented. This plant was installed by Blackall & Baldwin, 39-41 Cortlandt street, New York, selling agents for the Crocker-Wheeler Electric Company.

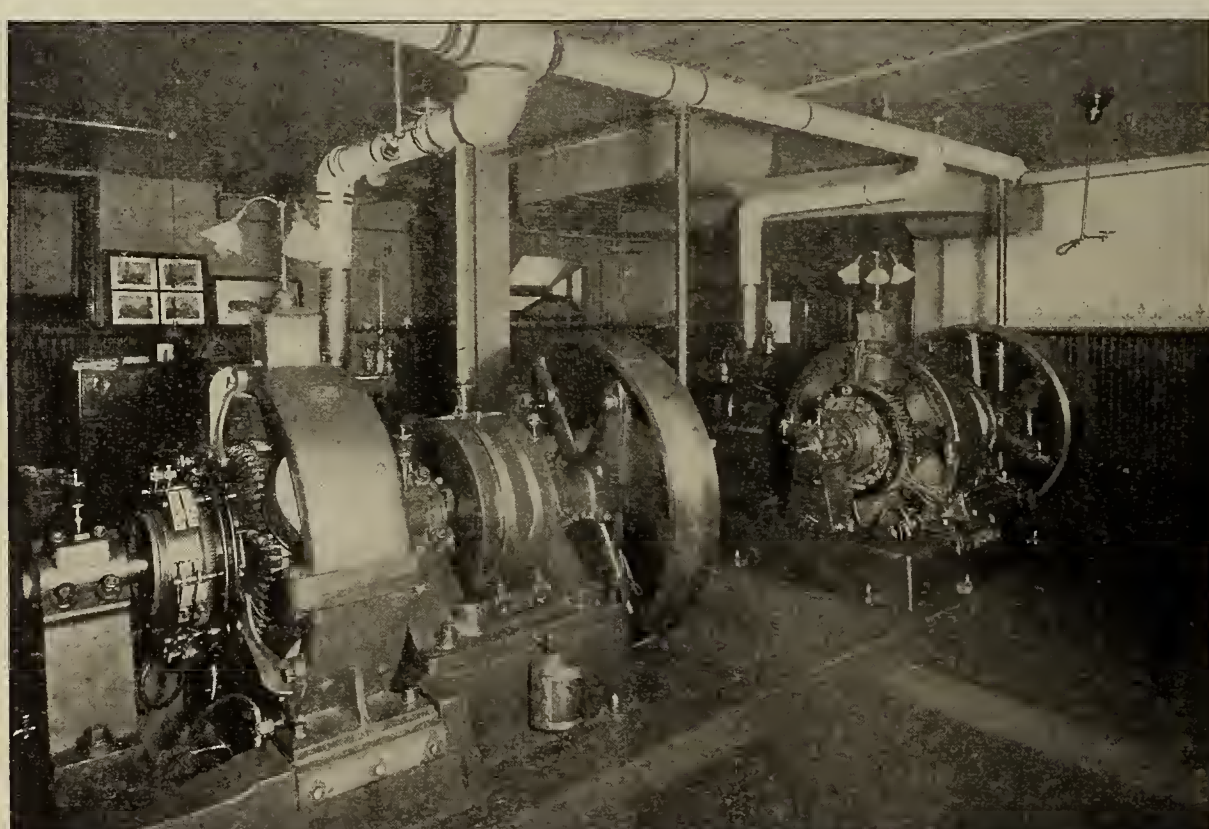
In connection with printing, it may be well to state that the greatest strain comes upon a motor at the instant of starting, and the motor must be well designed to stand the load at that and for a few moments after. In this case absolute satisfaction has been given, and this mechanical monolith owes its living force to the electric motor beneath. In other cases smaller presses have been operated; a size 2 Huber color press is being driven by a Crocker-Wheeler motor; another operating a number 9 Scott press, with the bed 42 by 60 inches.

The Crocker-Wheeler Electric Company have excelled themselves in the construction for electric lighting. Illustrations show a 6½-K. W. bi-polar direct-connected to a Case engine operating at a speed of 550 revolutions per minute, and a lighting plant installed at the Bartram in Philadelphia with direct connection; engines of the Woodbury style. This is one of the finest plants in Philadelphia, and has operated like a watch ever since installation. The Crocker-Wheeler Electric Company have had occasion to design motors for heavy work, and as seen in illustration one of their automatic break motors is to-day in operation at the Granite City Steel Company, moving a great blooming mill roll. Other cases could be cited in which this apparatus has found a place either for the generation of power or electricity. On all occasions the machines installed perform their function without aggravation to either manufacturer or purchaser.



Size 2 Huber Single-Color Press, Bed 36x54, Showing Controller Side, Operated by Size 3-100 Crocker-Wheeler Motor, and Size 3-100 Motor Operating No. 9 Scott Press, Bed 42x60.

The Crocker-Wheeler Electric Company were the first in this country to attach a special motor to each tool in their shop, thereby becoming independent of any main shaft, saving the loss of power consumed in its mechanical transmission, and giving each tool an independence of action which only necessitated its operation when required for use. Large machine shops requiring an equipment of a most advanced order will find that the experience of the engineers of the Crocker-Wheeler Electric Company is invaluable in this respect, and can have their own machinery driven in the same manner with the consequent economy which naturally results.

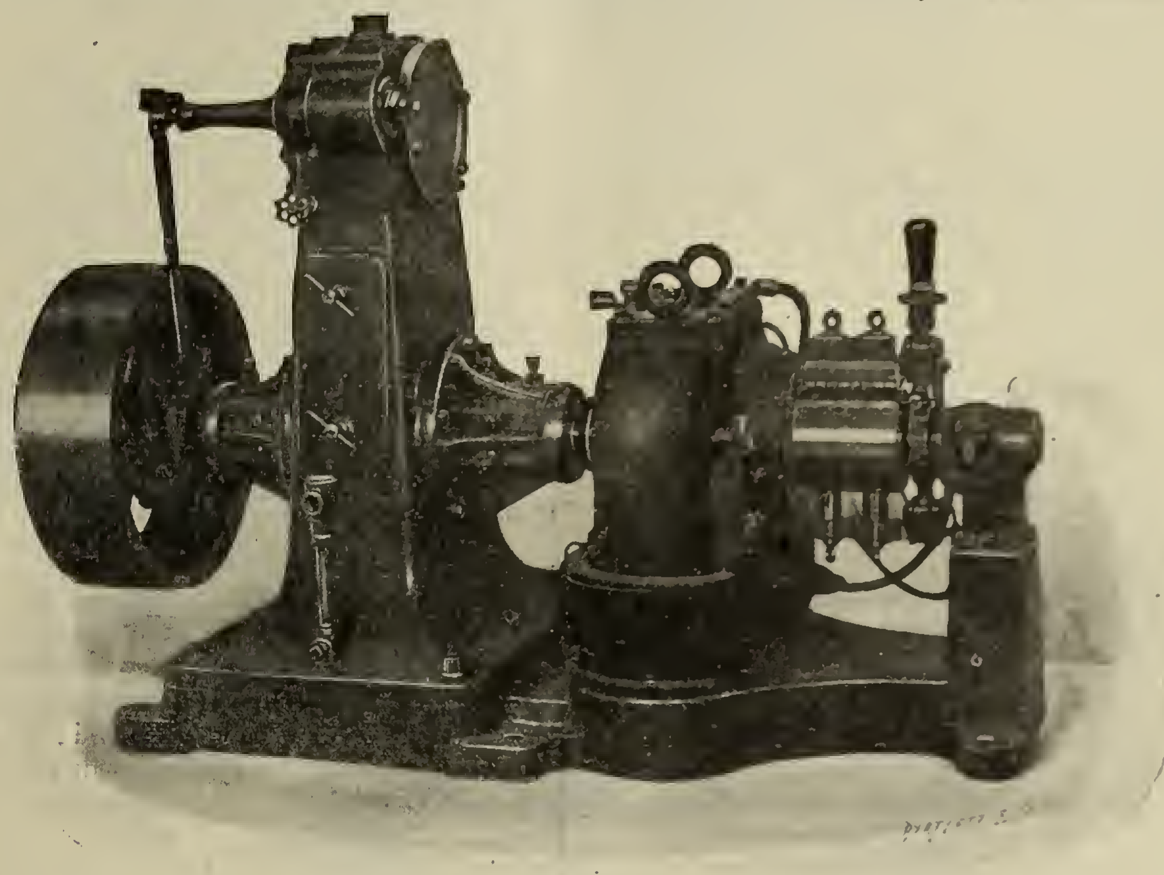


Lighting Plant at "The Bartram," Philadelphia, Pa. Two Size 56 C.-W. Dynamos Direct Connected to Woodbury Engines.

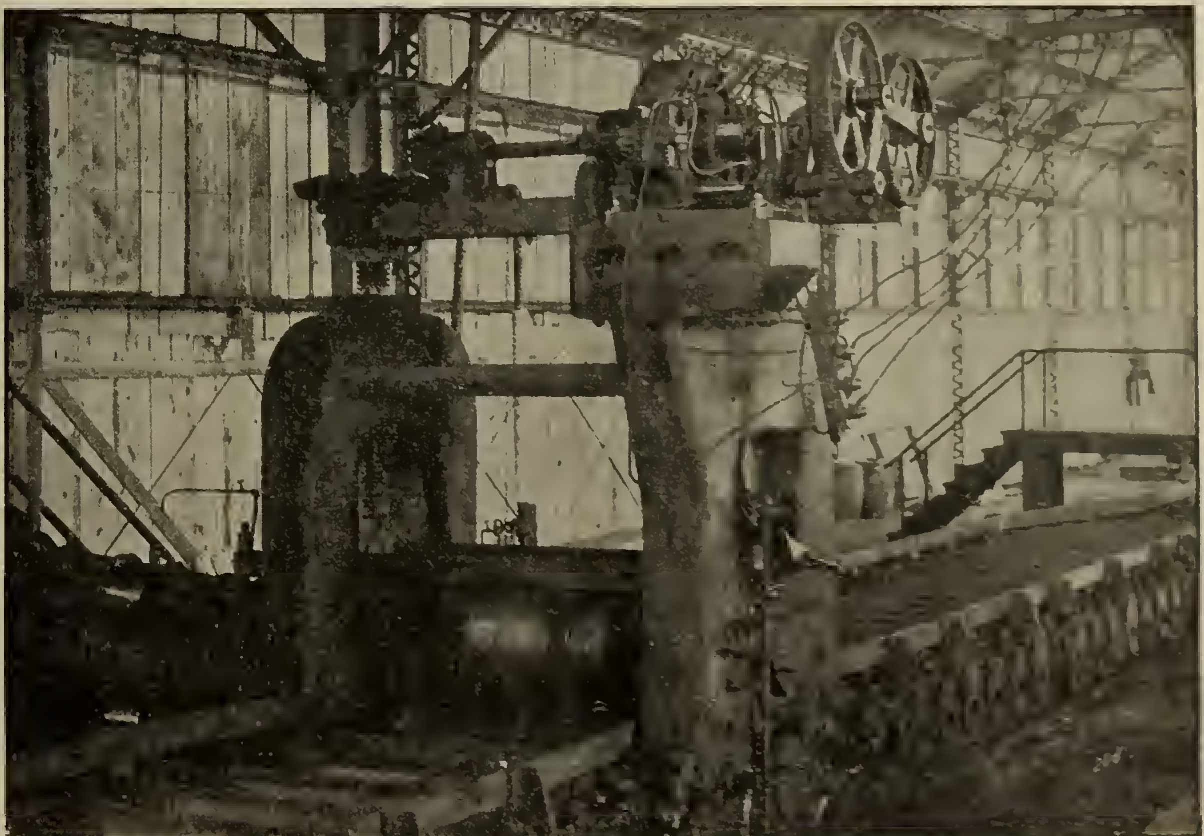
PRIZE ESSAYS.

A special committee of the Auxiliary and Educational Committee has just drawn up, on behalf of the Exhibition, a plan whereby prizes to the value of not less than $100 are offered to the pupils in the public and private schools in New York and its vicinity for essays on the Electrical Exhibition. This committee, comprising Prof. F. B. Crocker, Mr. G. H. Guy and Mr. T. C. Martin, has realized the fact that a great many young people will visit the Exhibition not merely from idle curiosity, but from a desire to learn, and it is believed that many such visitors will be encouraged in this way in their intelligent study of electrical principles, phenomena and inventions. The essays will be limited to 1,500 words, and will be accepted up to May 18th, the awards being declared and prizes presented not later than May 28th. No contestant is to be over sixteen years of age, and the judges will be selected chiefly from the staff of the college and schools of New York City. Copies of the circular will be ready this week.

The desire of the society to promote the welfare of electrical applications is recognized as highly laudable, and has elicited not only many words of commendation but has brought the largest numbers of applications for membership within a given time that the society has known in its history. Last month the secretary announced a list of a round score of new members, and he now states that the applications for March should reach close upon fifty. In almost every instance the new members inquire as to the Exhibition and express the wish to aid it in any way possible.



Size 10 C.-W. Dynamo, Direct-Connected to No. 5 Case Engine. Output, 6½ Kilowatts. Speed, 550 Revolutions per minute. Weight, 1700 Pounds.



C.-W. Automatic Brake Motor, with Counter-Shaft Through Base, Geared to "Screw Down" on Blooming Mill Rolls, Granite City Steel Co.

One of the most striking evidences of the general interest that the Exhibition is awakening is to be found in the remarkably large accession to its membership which the New York Electrical Society has enjoyed since the Exhibition was announced under its auspices.

Washington, D. C.—The Electrical Railway Equipment Company has been incorporated, with Archibald Greenlees, of Washington, as president, for the manufacture and equipment of electric railways. Capital stock, $100,000.

THE LATEST FANS AND VENTILATORS.

We enjoy to-day a luxury of which our forefathers knew nothing. The electric fan has entered the home, the theatre, the restaurant and business office; in the hospital, the fever patient has felt its grateful breeze and heard its busy hum with inexpressible gratitude. It is not many years since the electric fan or ventilator was a luxury that might be more expected in the sumptuous chambers of some magnate than in the home of the middle class, yet we find, since the various applications of electricity have been recognized and appreciated, that the great middle class may have electric lights and fans without great expense. In fact, we find that the use of fans for the expulsion or introduction of air has become so universal that the fan industry may be regarded as a permanent institution, one that has branched out suddenly and successfully as one of the great departments of electrical engineering.

We find now that manufacturers all over the country are running full blast to meet the coming demand for electric fans, and it is necessary for those dealers expecting heavy orders to place their own with the manufacturers proper months before the hot season sets in.

Fans, as we find them, driven by electricity, are divided up into three general classes. First, fan motors running at a very high speed; second, long-bladed ceiling fans; third, exhaust or pressure fans. The high-speed fan motor finds its place in offices, homes and dining apartments. The long-bladed ceiling fan is a familiar sight to those visiting either shops, hotels or restaurants. Exhaust and pressure fans, or blowers, as they are sometimes called, may be discovered in basements, engine rooms and other places where a forced draught is necessary in order to provide circulation and expel the hot air.

GENERAL ELECTRIC CO.'S FANS.

The '98 models of the General Electric Company's fan motors are announced as the latest of a long line of successful designs. These fan motors are built for both alternating and direct-current circuits.

That for alternating currents is an induction motor, as carefully proportioned in all its parts as are the larger machines which this company builds, excessive wear and heating under continuous operation being as absent from the small as from the large. To the cast-iron frame, which supports a single long bearing, are bolted the soft iron laminations which make up the field core, provided with inwardly-projecting teeth to form the poles on which are placed the field coils wound with an ample quantity of wire and thoroughly insulated. The armature is built up, also of soft iron laminations, assembled on a brass spider, but has no insulated wire. Bare copper rods run through the core, and are rivetted into disks at each side. Rotation being produced by inductive action, no commutator or brushes are required. The armature overhangs the bearing, and, with the fan, rotates well-balanced on the single bearing. An automatic oiling device gives perfect lubrication without oil-throwing, and this, together with the long bearing, ensures continuous cool operation.

The alternating fan motor is built for 52 and 104 volts, 60 and 125 cycles, and is provided with a speed-regulating device consisting of an inductive resistance cut in or out by a three-point switch. Movement of the switch over the first two points gives full speed and half speed and on the third cuts the motor out of circuit. No additional switch is necessary.

The direct-current fan motor is as equally compact and carefully designed as that for alternating currents and in appearance and general construction closely resembles it. Laminated soft iron of the best quality is used throughout for the magnetic circuit; all windings are thoroughly insulated, and commutator connections carefully made. As in the alternating motor, fan and armature revolve in a single, long, self-oiling bearing. The commutator is completely enclosed, and the carbon brushes encased in small tubes, readily unscrewed for inspection. A regulating switch provides for variation of speeds. The alternating current fan motor may be, if desired, mounted on trunnions to allow of adjustment of the fan to blow in any direction.

The motors are finished in black enamel; the fan guard and trimmings in polished nickel.

EMERSON ALTERNATING CURRENT FAN MOTORS.

The Emerson Electric M'f'g Co., of St. Louis, Mo., are placing on the market a complete line of alternating current fan motors, both for desk use and ceiling fans. The desk fans are made in two sizes, 12 and 15-inch, and two styles of ceiling fans are made; one two-bladed, making from 200 to 210 revolutions per minute, and being for 60-cycle systems; the other, a five-bladed type, making 500 to 600 revolutions per minute, being for high alternations from 125 to 133 cycles per second.

Ceiling Fan for Low Alternation Systems.—This ceiling fan is a direct-acting, slow-speed, induction motor without speed-reducing gear of any kind, and also without commutator or brushes. It is absolutely noiseless, the only wearing part being a single ball bearing which is run in a cup of oil.

After being placed in position, this fan requires absolutely no attention for the entire season, if the oil-cup is filled at the beginning of the year. The finish of this fan is very tasteful and rich, the body of the fan being in expensive black enamel with gold decorations, hanger and trimmings being finished in highly polished and lacquered brass. This fan is regularly furnished in the above-described finish adapted for 12-foot ceilings without light fixture, but can be furnished promptly in nickel or oxydized copper finish with light fixtures for 2, 3 or 5 lights, as ordered, and can also be furnished with hanger rods for any desired height of ceiling.

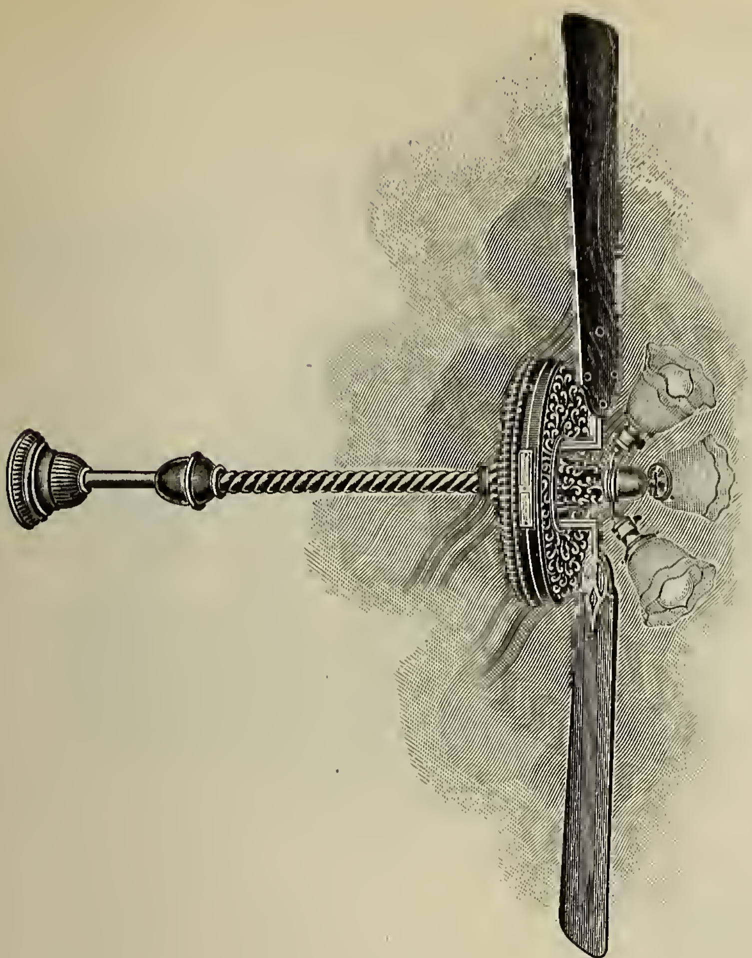
The current consumption of this machine running at the highest speed (210 revolutions per minute) is 125 watts. A second speed is also provided for by which the motor runs at 150 revolutions per minute, with a current consumption of 100 watts. This is the type of machine which is regularly furnished. For special uses, we are prepared to furnish this machine with a current consumption of 150 watts on the high speed, giving a correspondingly large volume of air.

Twelve-inch Desk Fan Motors.—The general appearance of this motor has been changed entirely from their former type, and the mechanical construction has been changed in a way which the manufacturers believe will be a decided improvement.

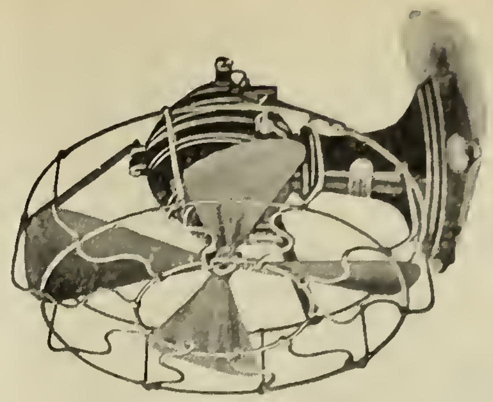
The shaft of these motors is pressed firmly into the back cover and is made of ½-inch bicycle tubing, which is case-hardened and ground accurately to size. The armature hub is composed of a large piece of bicycle tubing, into which is pressed at either end a brass bushing. This bushing is reamed out to accurately fit the hardened steel shaft. This shaft being of much larger size than has ever been used in fan motors in the past, and from the fact of its being hardened steel will wear for an indefinite time, thus avoiding all rattle and noise.

Another improvement lies in the switch-plate, which is made of porcelain, the binding posts being so concealed that it is absolutely impossible for inexperienced persons to receive a shock in handling the motor. The 12-inch size of desk fan is carried regularly in stock for any voltage and number of alternations.

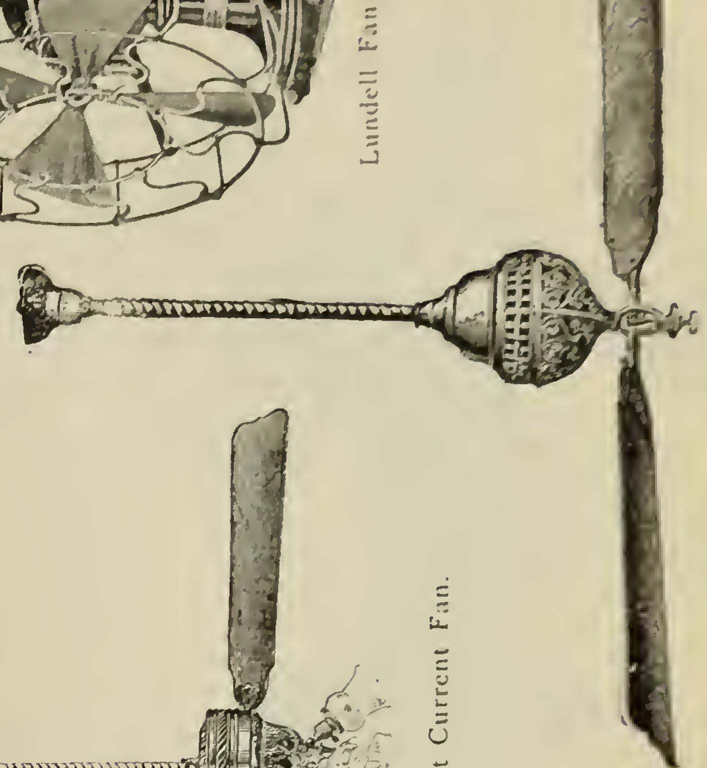
The current consumption of this motor is the same as their 1897 type, the 12-inch motor consuming on the



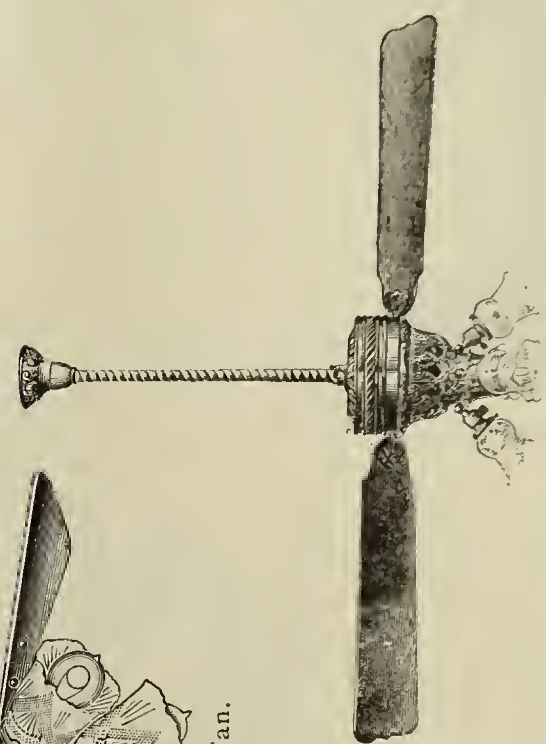
Meston Ceiling Fan.



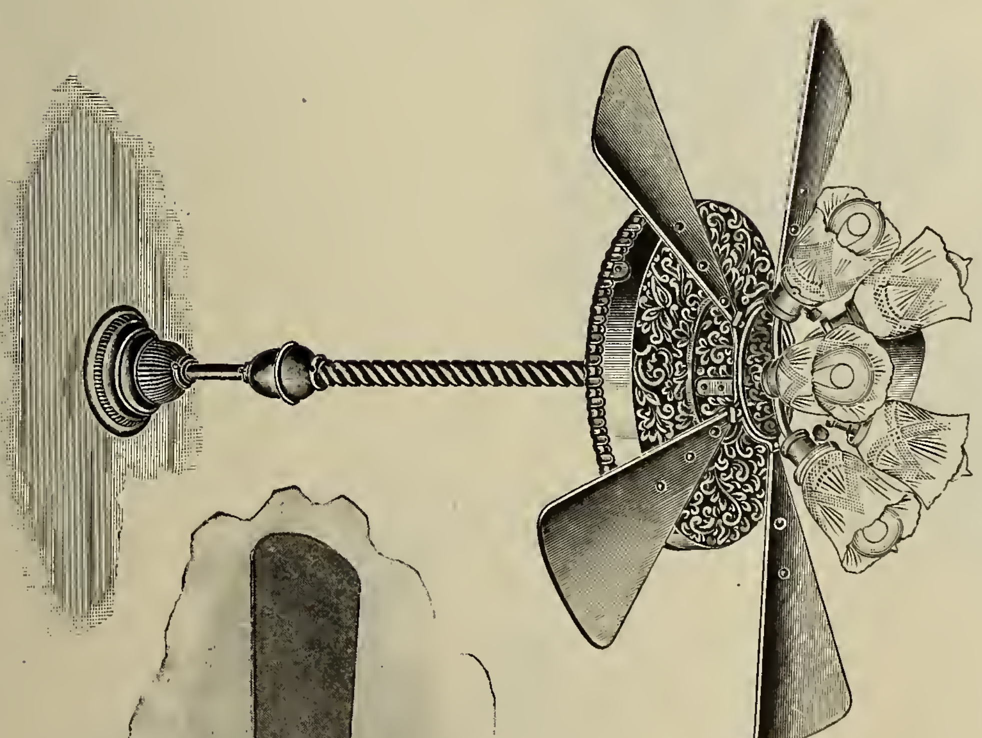
Lundell Fan Motor.



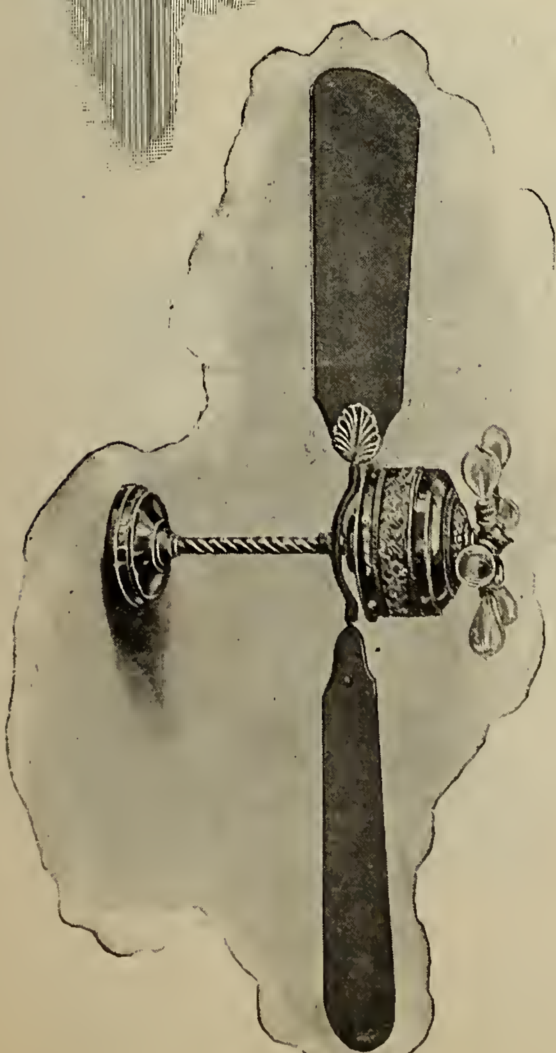
Latham Alternating Current Ceiling Fan.



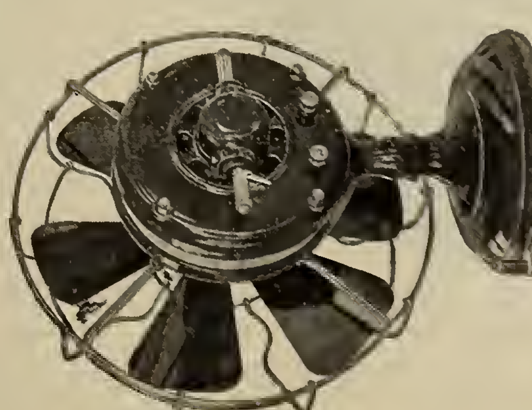
Latham Direct Current Fan.



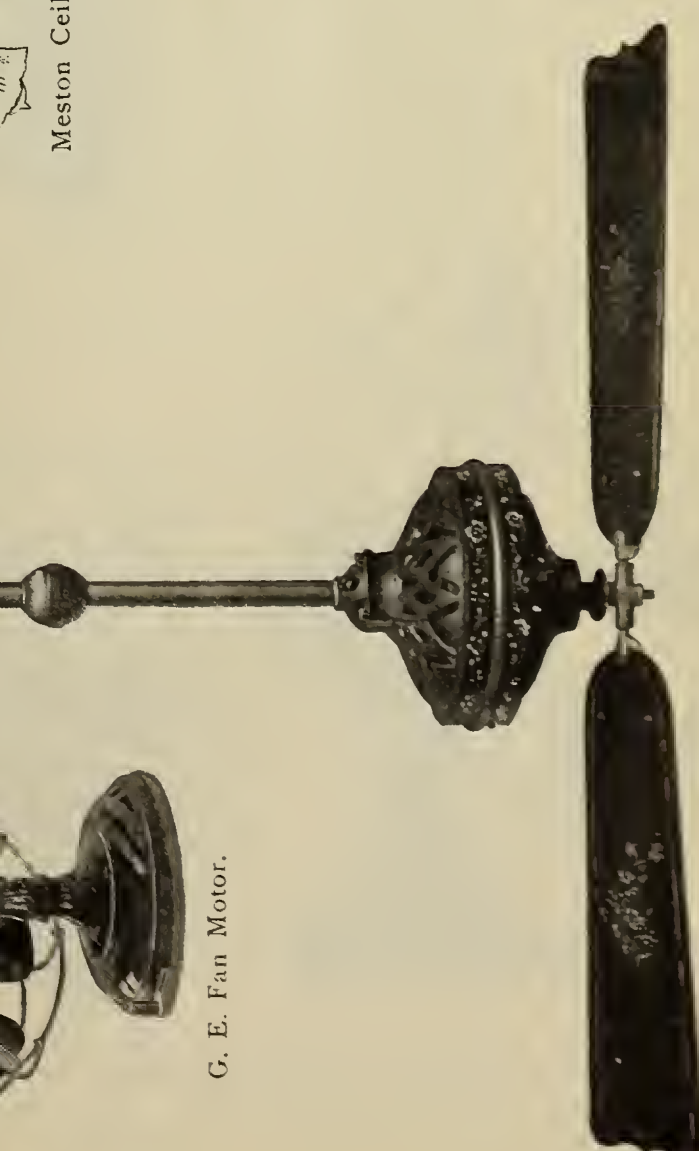
Meston Ceiling Fan.



Lundell Ceiling Fan Motor.

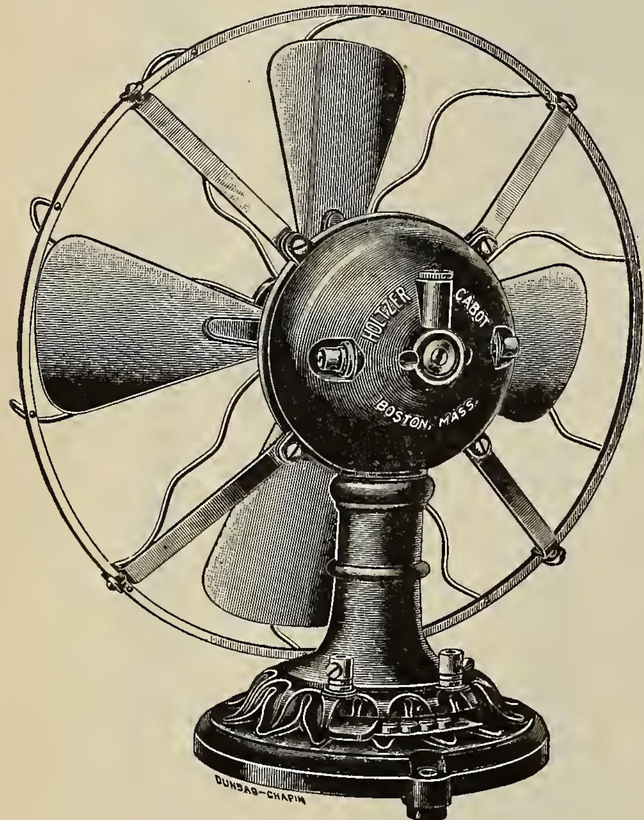


G. E. Fan Motor.

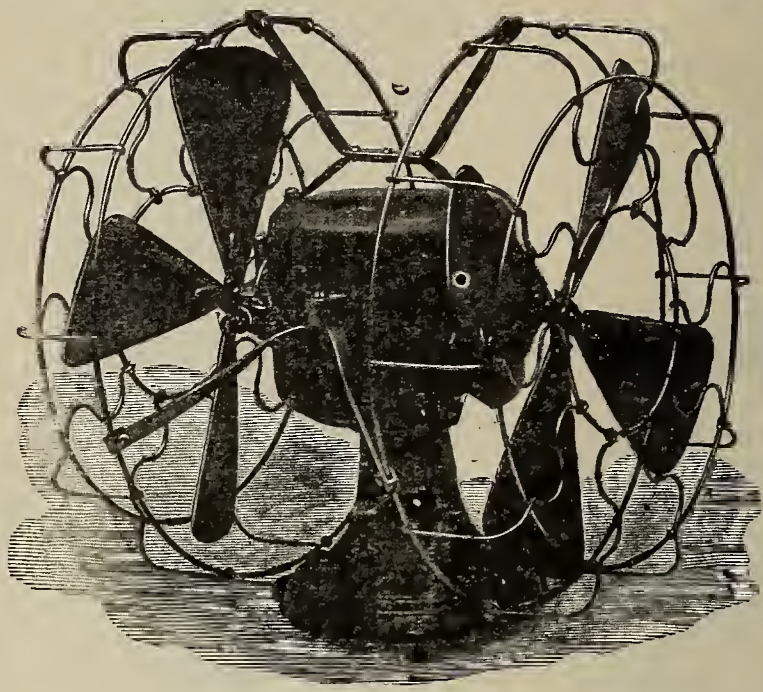


Paragon Ceiling Fan.

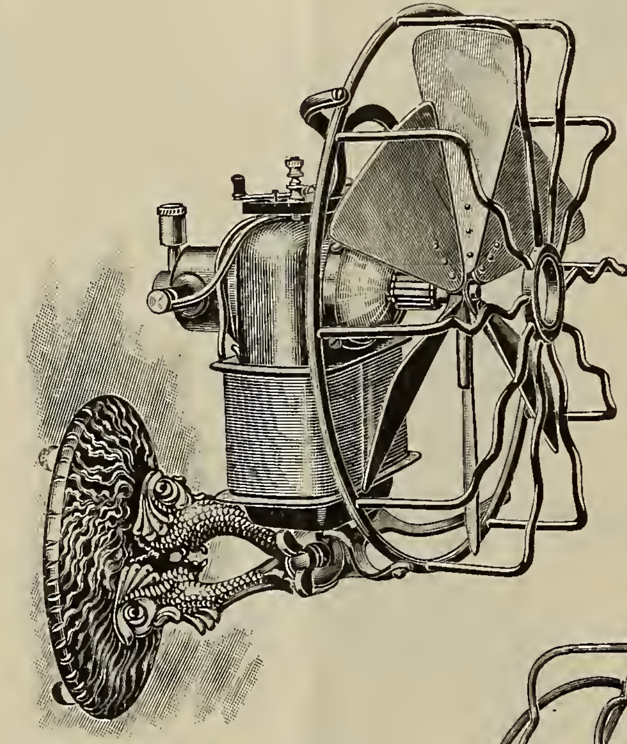
start from 65 to 70 watts, running at about 1,550 revolutions per minute. By turning the switch over to the position marked "ON," the consumption of current is cut down to 50 watts, while the speed remains almost the



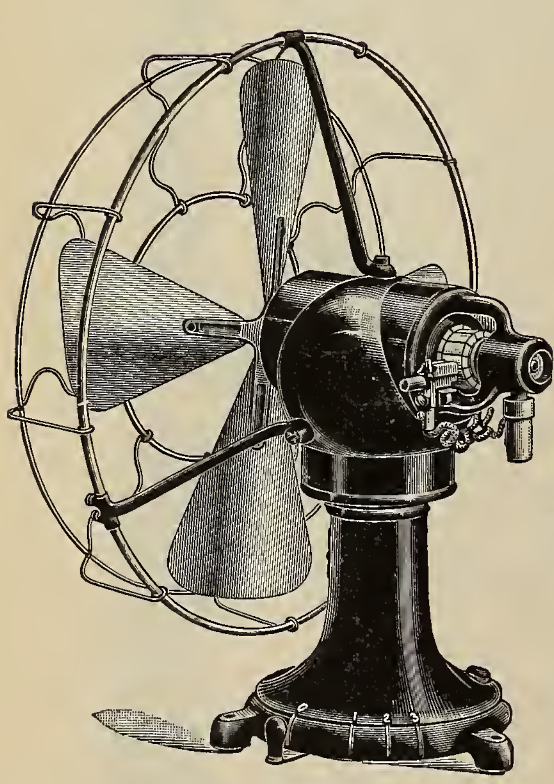
Holzer-Cabot Electric Co.



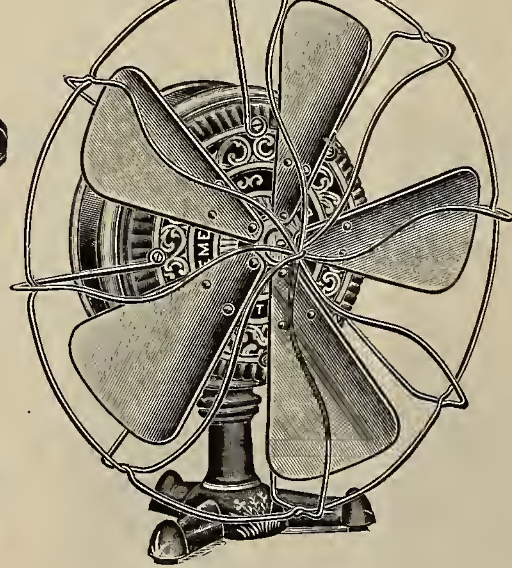
"Paragon" Fan Motor.



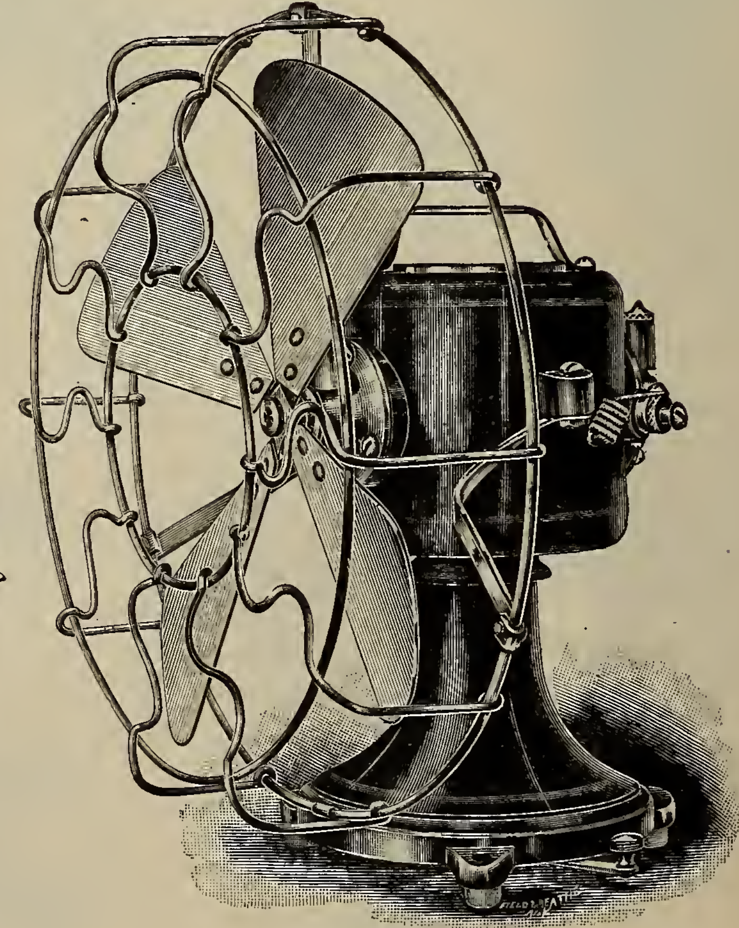
"Noxall" Fan, Vance Elec. Co.



"Hurricane" Fan Motor.



"Meston" Fan Motor.



"Paragon" Fan Motor.

same; while by moving the switch to the position marked "SLOW," the current consumption is cut down to about 35 watts and the speed to about 950 revolutions.

Fifteen-inch Desk Fan Motors.—The 15-inch fan has four blades, while the 12-inch has five. In other ways, the appearance of the two machines is identical. This 15-inch motor is carried regularly in stock for 7,200 and 16,000 alternations, and for 52 and 104 volts. Machines, however, can be furnished for any voltage or number of alternations. The current consumption of the 15-inch motor is 110 watts on the starting point, with revolutions of about 1,550 per minute. Moving the switch over to

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, APRIL 9, 1898.

CONTENTS.

SUBMARINE WAR VESSELS.

The Holland submarine boat, invented by Mr. John P. Holland, has awakened wonderful interest in this country for several reasons. It shows the tremendous advantage possessed by a vessel of this description over one floating on the surface of the water. It proves that the construction of submarine vessels which can be perfectly controlled is no longer a matter of experiment, and in addition shows that warfare in the future, when carried on at sea, may be like the battles of great cetaceans.

The subject of submarine vessels should certainly be an interesting one to electrical engineers, experience having shown how necessary electrical apparatus is for driving the boat and performing other important functions in relation to manœuvring. The Holland submarine boat is probably the most successful of its kind in existence. It is the only one under such control as to be able to dive, rise, turn or move with absolute certainty of action. Many attempts have been made in the past to construct submarine boats.

Considerable furore resulted from the construction of an electric boat of this kind in 1888, invented by Lieut. Peral, of the Spanish navy. It was 72 feet long, was operated by storage batteries and moved at a speed of 11 knots an hour. The "Gymnóte," invented by M. Zédé, chief engineer of the Forges et Chantier de la Méditerranée, working under the French Government was another. In this vessel electricity was the motive power, the total length being 59 feet, the maximum speed 10 knots an hour. It was presumed by the French Minister of Marine in 1891 that the "Gymnóte" left nothing to be desired in submarine navigation. It was then proposed to build a new vessel equipped with armaments which would cost about $250,000.

In many respects the Holland submarine boat possesses features similar to those combined in the operation and construction of the Baker boat, invented by George C. Baker, of Chicago. It was tried in 1892 and was operated by storage battery when under water and steam power when at the surface. When descending, the smoke stack was pulled in and the air-tight doors closed, the fires shut off, and the dynamo, previously charging the storage batteries, was operated by them and drove the boat. This unique vessel at a certain test remained nearly three hours under the water, with several men on board, including the inventor, and is mentioned by the U. S. Navy Department in flattering terms.

The Holland, which embodies the results of twenty years' experience, is fifty-five feet long and moves at a speed of eleven knots an hour. It is driven, when on the surface, by a gas-engine, and a motor propels it when submerged. Tanks filled with compressed air supply the vessel when under water, and in this case, as in that of the Baker boat, the motor is used to charge the storage batteries with when the vessel rests upon the surface. This triumph of engineering will project a hundred pound gun-cotton shell three-quarters of a mile through the air or two hundred yards under water. A vessel of this description is more formidable than the largest ironclad afloat, because of the wonderful facility with which it can approach unseen and the unerring precision with which it delivers its projectile against the unprotected bottom of unfortunate vessels. Mr. Holland utilizes the Whitehead torpedoes for purposes of attack, which carry their own motive power with them and cannot fail to strike at whatever they are directed when set off at a distance of six hundred yards from the object to be destroyed.

The U. S. Navy has been greatly impressed in the past with the necessity for adding to her naval force such vessels as these, and the Holland submarine boat, perfected at this opportune moment, will certainly lead at once to the immediate construction of several others. In fact, the protection of any sea-port by means of a few submarine electric torpedo boats would absolutely prevent the approach of even the most powerful vessel built, for advance in such a case would mean inevitable destruction. For military and naval purposes the applications of electricity have increased in number year by year to such an extent that the future of any nation when engaged in war will depend entirely upon the inventive power of its citizens as much as upon their wealth, bravery or patriotism. There is no better means of protecting the coast of the United States than a line of submarine vessels stretching from Maine to Florida and from Washington to Lower California.

THE ABSOLUTE DETERMINATION OF RESISTANCE.

The first absolute determination of resistance was probably that made by Kirchhoff about fifty years ago. Weber published his method in 1852, and then came the B. A. determination by Maxwell, Stewart and Jenkins in 1863. Neither of these were very exact, but they paved the way for the splendid exhibitions of experimental skill which followed. Among those to whom we are most indebted for this later work may be mentioned Kohlrausch, Rayleigh, Glazebrook, Rowland, Wiedemann, Mascart, etc. The greatest step in advance in recent years has been the invention of the revolving disk method of Lorenz of Copenhagen, and its subsequent improvement and application by himself and J. V. Jones. The determinations made by the latter by this method are probably almost absolutely correct. [From "The Development of Electrical Science," Prof. Thomas Gray.]

Manwaki, Que.—A company has been formed for the purpose of supplying electric light. The directors are Charles Logue, J. P. Tremblay, Dr. Mulligan and Rev. Father Laporte.

the point marked "ON," reduces the current consumption to 90 watts and the revolutions to about 1,500.

For the accommodation of such patrons as used their 1897 type of motor and prefer that type, they will also manufacture their last year's type of motor, and are prepared to furnish either style promptly on short notice.

LUNDELL FAN MOTORS.

The direct and alternating-current fan motors now being manufactured by the Sprague Electric Company, 20–22 Broad street, New York, have met with such popularity in this and other large cities that they have now become a most familiar accessory to the equipment of hotels, restaurants, cafés, etc. These fan-motor outfits are beautifully decorated with black japan and gold stripes. The method of regulating them is very simple; a switch giving three speeds of 1100, 1400 and 1800 revolutions per minute in the one-twelfth horse-power model and of 800, 1200 and 1500 in the one-sixth horse power model. They are wound for 110 volts and possess automatically lubricated bearings which are self-aligning and therefore require little or no adjustment. The exposed metal parts, including the fan guard, oil-cups, etc., are either polished or nickeled, thus making the machine, when complete, a handsome, compact and quiet running motor. The efficiency of these machines is high and the convenience with which they may be set up either on the desk, ceiling or wall, leave nothing to be desired.

The brushes of the Lundell fan motors are automatically fed forward, and an even pressure sustained by means of a spiral spring fitting within the brush-holder. By writing to the company a catalogue will be sent containing sketches of each part, and thus illustrating the detailed finish of each part. The Lundell ceiling fan motor outfits dispense with shafting and belting and operate at a slow speed.

The fan from base to tip are four to five feet long, or longer if so ordered. The average speed is thirty-five revolutions per minute the voltage ranging from 110 to 250 in the one-sixth horse-power size. The electrolier ceiling fan motor performs the function of giving a breeze and light at the same time. The blades are made of varying lengths and widths to suit.

The column fans of Lundell design have been installed in many prominent places throughout the city. They are supplied with hooks, if so desired, for clothing, hats, etc., and are made any height required. The Lundell alternating fan motor outfits are designed for wall and desk use, operate at a pressure of 52 and 104 volts, having a speed of 1200, 1400 and 1600 revolutions per minute. The frequency of the alternating current to be supplied to them is between 14,000 to 16,000. The speeds are controlled by means of a switch, and the general mechanical details correspond to those of the continuous-current motor. The Sprague Electric Company report an unusual demand for their goods from all over the country.

TUERK'S ELECTRIC CEILING FANS.

Ceiling fans constructed for use on alternating as well as direct-current circuits are being manufactured by E. B. Latham & Co., of 136 Liberty street, New York. The direct-current ceiling fan is made for two speeds, 135 and 190 revolutions per minute. The blade sweeps through sixty inches and its width is eight inches. They run noiselessly and produce a strong, even gust of air. They are wound for 110, 170, 220 and 500 volts pressure; ornamenting with or without electrolier as desired.

The direct-current fans have self-oiling bearings. A switch at the bottom, within handy reach, will start or stop them at the proprietor's pleasure. It is almost unnecessary to say that their great efficiency has made them very popular with current consumers because those having experience have found out that with an equal consumption of current they will move more air than any other fan on the market.

The Tuerk alternating ceiling fan of the 1898 model rotates at a speed of 150 revolutions per minute. It has a five-foot sweep of blade, the blades being eight inches wide. These fans are made for 140, 125 and 60 cycles per second and wound for a pressure of 52 and 120 volts.

Both the direct and alternating-current ceiling fans are handsomely ornamented, and when once installed require little or no attention during the season. The purchaser will discover by consulting the ammeter or wattmeter that both of these fans take but little power and run with a cheapness and economy that, commercially speaking, cannot be excelled.

E. B. Latham & Co. will send catalogues, prices and further information to those desiring to correspond.

"PARAGON" FAN MOTORS.

Many manufacturers expressed considerable curiosity in the fall of 1897 as to which would be the handsomest and most popular fan motor in 1898. The motors exhibiting all these good qualities are the "Paragon," especially their handsome new ceiling fan. It is not alone the durability of a motor which counts in the long run, but likewise a certain internal quality which in motors, as in men, creates differences between them. The "Paragon" fan motors possess very high efficiency, which, of course, follows from the nature of its design. It is a motor whose appearance, construction and economy of operation are in perfect harmony with each other.

No word of criticism has ever been passed against the appearance of the "Paragon" fan, and as regards its construction its manufacturers guarantee a perfect interchangeability of parts, so that if by chance or accident renewals are necessary of either brush-holders, brushes, bearings, commutator, etc., a note to the company will immediately bring back that which was required to be immediately applied where needed.

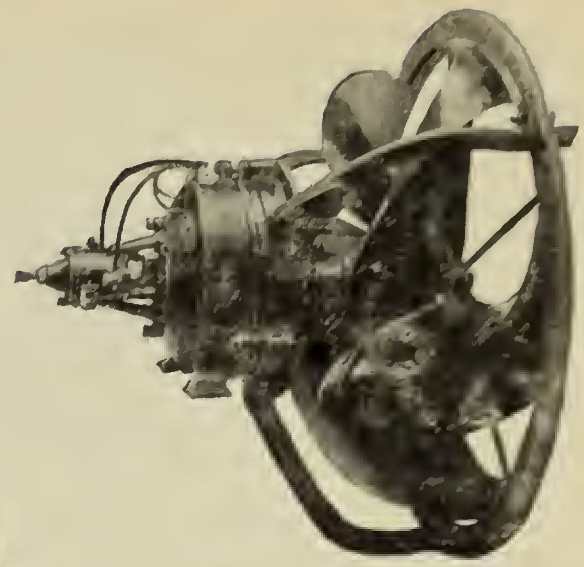
The "Paragon" fan motor driving a 12-inch fan consumes the current of an ordinary incandescent lamp; the 14-inch outfit and the 16-inch but very little more. The frames of these machines are made of soft-grade cast iron; its armatures built up of the best Swedish wrought iron. The brush-holders produce upon the commutator, through the medium of flat carbon brushes, a uniform pressure, being automatic in this respect. Being entirely enclosed within its own shell or frame, the "Paragon" motor is dust-proof and free from external injury. The windings are so proportioned that excessive heating is impossible, and the "Paragon" fan motor more than deserves its name, because in its history it has never burned out.

Mr. J. P. Williams, general agent for the "Paragon" fan and power motors, of 39 and 41 Cortlandt street, New York, also handles the "Paragon" ceiling fan motor, with a 60-inch sweep, wood blade, ball bearing, switch on bottom, of both the 110 and 220-volt type. The 110-volt ceiling fan takes six-tenths of an ampere at 175 revolutions per minute. A unique type, called the "Paragon" duplex fan, operates two fans at once. It is made for 12 and 14-inch desk and bracket outfits. The fan motors proper, driving 12 and 14-inch fans, are built for 110 and 220 volts respectively. The "Paragon" 16-inch fan motor is wound, if ordered, for 500 volts.

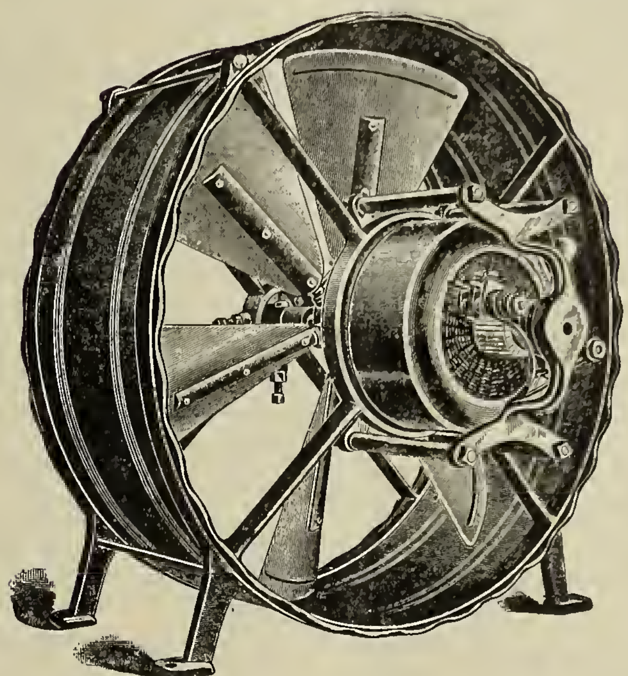
Trade in these motors has grown to great proportions in the last year, and one of the most familiar sights to cafe frequenters, commercial travellers and business men is the "Paragon" fan motor.

Williamsport, Md.—J. Thompson, Mayor, may be addressed concerning electric lighting.

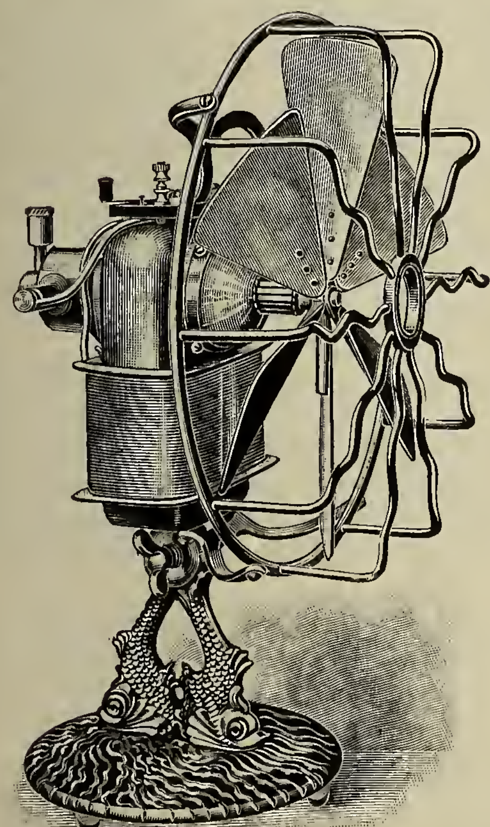
Lundell Motor, Blackman Fan.



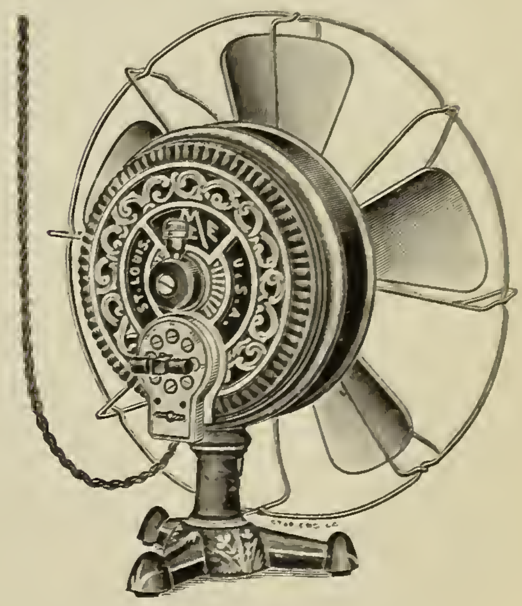
Lundell Motor, Davidson Fan.



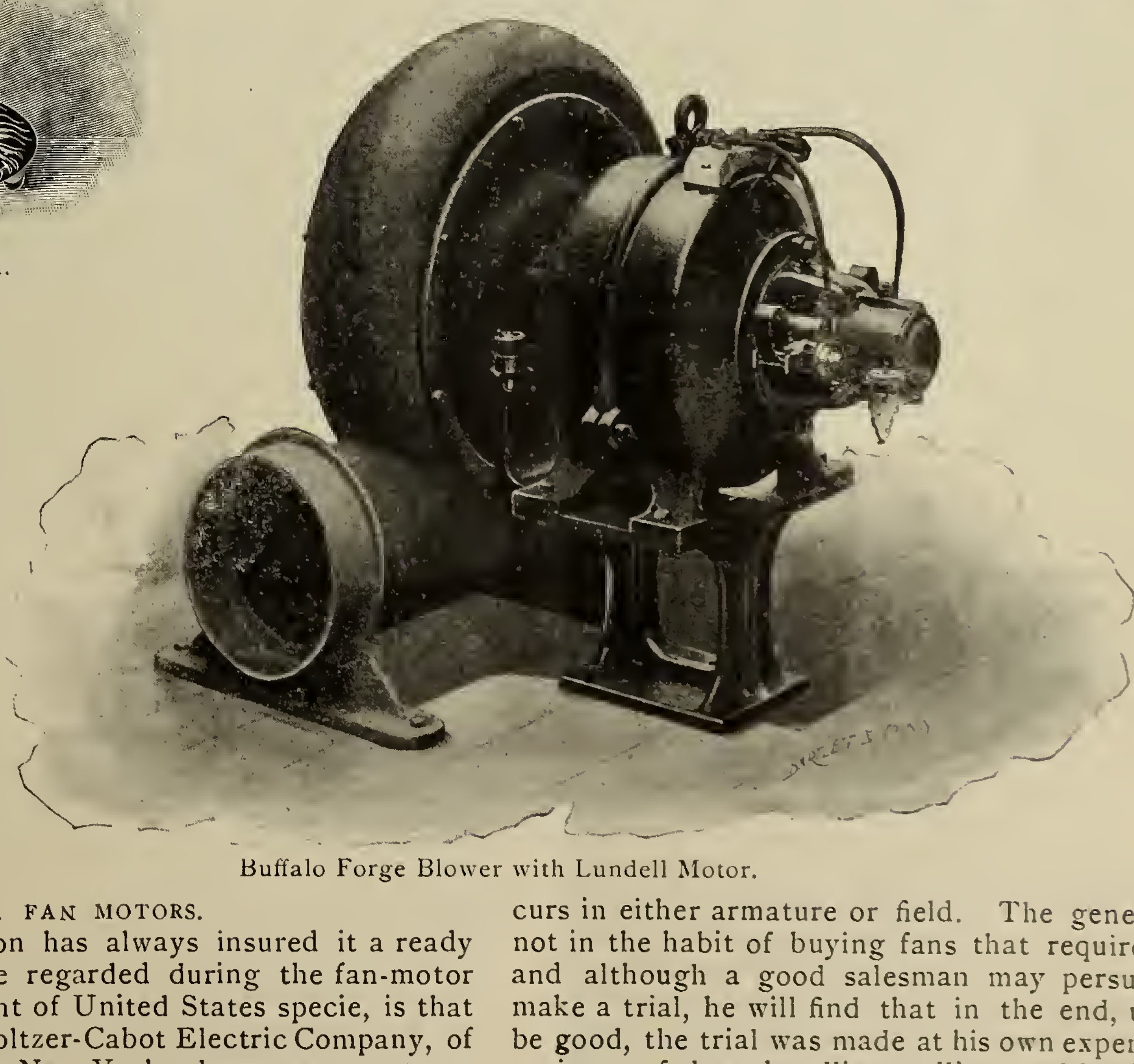
Wing Disc Fan with Diehl Motor.



Noxall Fan.



Meston Desk Fan.



Buffalo Forge Blower with Lundell Motor.

H. C. FAN MOTORS.

A fan whose reputation has always insured it a ready e, so that it may be regarded during the fan-motor ason almost in the light of United States specie, is that nufactured by the Holtzer-Cabot Electric Company, of ookline, Mass., whose New York salesrooms are at 114 berty street. To speak plainly, its greatest character-ic is that of requiring no attention during a season's n. It operates with a gentle hum, and does not throw t a heated blast, because the winding is so propor-ned that no rise of temperature of any consequence occurs in either armature or field. The general public are not in the habit of buying fans that require much care, and although a good salesman may persuade them to make a trial, he will find that in the end, unless the fan be good, the trial was made at his own expense. The experience of those handling, selling and buying the H.-C. fan has been of so satisfactory a nature that it is safe to say that in every case the fans have done their duty and been a letter of recommendation to the manufacturers wherever installed.

Dealers in electric fans frequently hunt for low prices instead of good quality. Those that do are not far-sighted. Those that do not, but only touch fans which are compact, noiseless, efficient and handsome are certain to acquire a trade which will develop in the future to large proportions. The Holtzer-Cabot Electric Company, in placing their goods before the public, do so with full confidence in the superior quality of their fans and a knowledge that all they claim in connection with them will be proven to the letter.

Their latest types, consisting of wall motors and desk fans, are selling so rapidly that they expect unusual sales before the season is over. They will be pleased to give full information to prospective purchasers if their correspondence is directed to the above address.

"Noxall" Fan Motors.—One of the handsomest fan motors on the market at present is the 1898 model "Noxall," manufactured by the Vance Electric Company, of 136 Liberty street, New York. The same combines art, symmetry and true mechanical principles, without losing sight of the essential element of perfect design. The motor is mounted on a heavy base, thus insuring rigidity, and at the same time admits of an adjustment to 30 degrees. The motor proper is secured to the base by two dolphins of a grotesque design and of the proper length in order to give the fan and guard the necessary clearance from the base. The two supports admit of and provide ready means of adjusting the inclination of the motor. This adjustment also allows the converting of the fan from a pedestal to a bracket type and vice versa, proper means being provided in the base to secure the fan to the wall. The Vance Electric Company will supply a revolving base for a slight addition in price.

The pole pieces of the motor are of mild steel, all exposed parts being highly polished and nickel-plated. The armature is of the iron-clad, slotted, Paccinotti type. The commutator is constructed of hard-tempered copper, several features in the same securing long life and reducing the possibility of sparking to a minimum. The bearing case at the commutator end carries the brush holders, the carbons used securing even contact and self-lubrication. The journals are long and self-lubricating, there being enough grease in the cups to last one season. A six-blade fan is used, with extra large spider carefully secured to the shaft by set screws. The guard is heavy and strongly made, and easily removed from the motor frame, if desired. The switch is mounted on hard rubber across the pole pieces, on the top of the machine, and allows of three speeds, namely, 900, 1,400 and 1,800 revolutions per minnte. Lower speeds are also supplied, if desired, on special order.

All fans have exposed parts, except base, which is oxy dized bronze, nickel-plated, which give them a very rich appearance. The efficiency of the fans is of the very highest, the following table showing efficiency of the various sizes: Twelve-inch fan at maximum speed, 43 watts; 14-inch fan at maximum speed, 70 watts; 16-inch fan at maximum speed, 96 watts.

The Wing Disk Fan.—The Wing disk fan has made an enviable reputation for itself as one of the earliest pioneers in the art of ventilating. The electric motors which drive them are practically part of the fan they operate and consume the least possible power. When inserted in windows the light is not interfered with, and their noiseless operation makes them extremely desirable. The Diehl Manufacturing Company of Elizabethport, N. J., have adopted this excellent fan in connection with their motor, making an extremely efficient combination. The blades of this fan, as may be seen in the sketch, are attached so firmly to the radial driving arms that they can never fly out and can be set at any angle. Their solidity of attachment also prevents vibration and sends forward a powerful blast of air. The Wing fans are used in innumerable places. A few of them are hotels, restaurants, laundries, mills, mines, cold storage rooms, etc. Address 109 Liberty street, N. Y.

WIRING FOR LIGHT AND POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The Edison Illuminating Company employ a special system or network of conductors. The current is generated at 110 volts pressure and two dynamos are connected in series for the purpose of supplying the outside line. This receives current at 220 volts pressure in consequence, but it has the added peculiarity of having three wires, between each two of which, that is to say, the first and second and the second and third, a dynamo is placed. Motors are fed from the two outer wires, which supply 220 volts, and lights are lit between the others. The insulations as well as the installation of continuous-current lines is not in any respect complicated. There are several methods of conveying the current in actual use. But before this department of the work is considered, the fact that the wiring of a building and the system employed in having it reach the building are entirely dissimilar in certain cases may be realized.

Subways are used for the transmission of current from the station to the building. Upon reaching the house the paths the current enters into are those which lead to motors and lights. Usually the subway systems are made of iron pipes ending at the corners in manholes, bricked carefully and othewise protected from the drainage of the neighborhood.

Both the alternating and continuous-current people employ this system of pipe conduits, although in the case of the Edison Illuminating Company, where continuous current is used, the use of three wires introduces a feature which has made this system valuable to all large cities.

Balancing the Load.—On account of the fact that three wires are used, the lighting occurs between either the first and second or the second and third wires. The general practice followed out by the Edison Illuminating Company is that of balancing the lamp load between these three in equal portions.

If 100 lamps are used between the first and the middle wire, to balance the line 100 lamps or their equivalent must be placed between the middle and third wire. The details of this system are quite interesting, as they exemplify the development produced by any departure from the ordinary in the pursuit of an improved method of distribution.

The Edison Company call the middle wire the neutral wire, because it is connected to both a positive and negative wire.

Advantages.—Some of the advantages of this Edison network lies in its reduction of the drop of potential to almost a minimum and the saving of a fourth wire. Also in the employment of two pressures convenient for both motors and lamps. There are certain excellent points in the application of this system alike to both street and house, which have given it a permanent hold on the public.

The Edison network is built in such a manner that centres of distribution are supplied with wires which indicate at the station the exact pressure at that point. Each junction of conductors is kept at the same potential, as far as possible, as every other. The immense system of wires enables them to preserve an almost equable pressure at all times. It is worth noting that if the pressure supplied to the feeders running along the streets is 240 volts, the drop occurring in the line can be so limited that at least 230 is

This will be sufficiently high to enable us to wire a ...ding and still have a working pressure of 220 volts in ... house.

...he problem of distribution consists in the preserva... of the pressure at given points and not in the main...nce of it at a fixed pressure throughout. A station ...rating 100 volts may expect to lose 25 volts in the ...way distribution, but it will be necessary for them to ...erve the potential at the centres radiating to houses ... fixed value. If the allowance thus intentionally lost ...emeditated, the new points in the street service from ...h the current is fed into the houses will remain at a ...tant pressure provided means are taken to effect the .... The value of a system depends upon the per...age of change going on; the less this is, the more ...the lamps will have burned in its circuits.

...ne distribution of alternating current could in certain ...ects be carried on the same as by continuous. The ...-pressure wires at 2,000 volts could lead to centres in ...treets at which transformers could be placed and thus ... as centres of distribution. The reduction of pressure ... 2,000 volts need not be carried out in this case to less ... 100 volts, and in this respect approach in technical ...il the appearance of an Edison network as regards ...centres of pressure and the wiring of the building.

QUESTIONS FOR REVIEW.

...) What is meant by transmission of power ?

...) How do continuous and alternating currents differ ?

...) What is the general scheme of high-pressure alter...ng current transmission and distribution ?

...) Why do the Edison Illuminating Co. use a network ...ires ?

...) State the problem of distribution ?

INSULATION AND CONDUCTION.

(Continued from page 187.)

...ne idea that electrical flow in solid conductors might ... be a simple handing on from one atom to another ...ested itself nearly a decade ago to Prof. Lodge. ... brilliant and careful reasoner and experimenter, who ... cleared up so many patches of scientific jungle, gives ...ry clear description of the manner in which this ...d happen if such were the case. I cannot do better ... quote him, as it will show how well this idea agrees ... all the facts then known, but one.

But if we are not satisfied with this vague analogy, ...wish to penetrate into the ultimate nature of heat ...the mode in which it can be generated, then we can ...n to the consideration of a multitude of oscillating ... colliding particles, moving with a certain average en..., which determines what we call the temperature of ...body. If now one or more of these bodies receives a ...k, the energy of the blow is speedily shared among ...ne others; and they all begin to move rather more ...getically than before: the body which the assem...e of particles constitutes is said to have 'risen in ...erature.' This illustrates the production of heat by ...ow or other mechanical means. But now, instead of ...ing one of the balls, give it an electric charge; or, ...er still, put within its reach a constant reservoir of ...ricity from which it can receive a charge every time ...rikes it, and at the same time put within reach of ... other of the assemblage of particles another reser... of infinite capacity which shall be able to drain away ...he electricity it may receive. In practice there is no ... of infinite reservoirs; all that is wanted is to con... two finite reservoirs, or 'electrodes,' as one might ... call them, with some constant means of propelling ...ricity from one to the other, i. e., with the poles of ...ltaic battery or a Holtz machine.

"What will be the result of thus passing a series of electric charges through the assemblage of particles? Plainly, the act of receiving a charge and passing it on will tend to increase the original motion of each particle; it will tend to raise the temperature of the body. In this way, therefore, it is possible to picture the mode in which an electric current generates heat.

"But, although this process may be used as a possible analogy, it cannot be a true and complete statement of what occurs; for it is essentially the mode of propagation of sound. Sound travels at a known and definite velocity, being a mechanical disturbance handed on from particle to particle in the manner described. But heat, being some mode of motion, must also be handed on after some analogous fashion, so that when heat is supplied to one point of a mass it spreads or diffuses through it. It is difficult to suppose the conduction of heat to be other than the handing on of molecular quiverings from one to another, and yet it takes place according to laws altogether different from those of the propagation of the gross disturbance called sound. The exact mode of conduction of heat is unknown, but, whatever it is, it can hardly be doubted that the conduction of electricity through metals is not very unlike it, for the two processes are the same laws of propagation: they are both of the nature of a diffusion, they both obey Ohm's law, and a metal which conducts heat well, conducts electricity well also."

I have said, "with all the facts then known but one." This because, as mentioned in the abstract given above, there seemed to be no good evidence for the view that there was any connection between the conduction of sound and of electricity. The reason for this lay in the fact that very few determinations had been made of the velocity of sound in the pure metals, though a considerable number had been made on alloys and commercial materials. †

Consequently, no general law could be discovered, though it cannot be doubted but that had the formula for the relation between Young's modulus and atomic volume discovered by the writer ‡ been known at that time this evidence of a still more intimate connection between sound, heat and electricity would have been discovered by Dr. Lodge.

The formula referred to is:

$$\text{Young's Modulus} = \frac{78 \times 101^2}{(\text{atom. vol.})^2}$$

Hence it is possible to predetermine the velocity of sound in wires by the formula:

$$\text{Velocity in cms. per sec.} = \frac{833 \times 10^4}{\text{atom. vol.} \times \sqrt{\text{density}}}$$

and the electric resistivity is given roughly by:

$$\text{Resistivity} = 45 \times 10^{-9} \times \text{atom. vol.} \times \sqrt{\text{density} \times \text{valency}}$$

This formula possesses a general interest, inasmuch as it would seem that while the strain in the dielectric is propagated with the velocity of light, i. e., $\sqrt{k\mu}$, the actual electricity in the wire were handed on with the velocity of sound and is proportional to

$\sqrt{\frac{k}{\mu}}$ The significance of this will be treated of elsewhere.

DEVELOPMENT OF ELECTRICAL SCIENCE to be continued next week.

Orillia, Ont.—The town council has still under consideration the question of obtaining power from the Ragged Falls. It is estimated that the necessary electrical plant for developing 1,500 horse-power and transmitting it 15 miles would cost from $60,000 to $75,000.

CHAS. W. HOLTZER, president of Holtzer-Cabot Electric Co., of Brookline, Mass., was in town this week.

JOHN C. GRANT, representing the Holtzer-Cabot Electric Co., Boston, Mass., and 112 Liberty street, New York, was in town, looking after the interests of his company.

NEW ELECTRICAL CORPORATIONS AND BUSINESS CHANGES.

Glens Falls, N. Y.—The Glens Falls, Sandy Hill and Fort Edward Electric Railroad Co. will erect a new power-house.

Stuttgart, Ark.—The Stuttgart Water & Electric Co. will assume the franchise granted to Charles Williamson, and arrange for the construction of plants and lighting and water supply.

McComb, Miss.—An electric-light plant will be established.

West Plains, Mo.—The West Plains Telephone Co. has been incorporated by D. W. Reese, Charles H. Gale, F. O. Hines and others. Capital stock, $20,000.

Canadian, Tex.—The Canadian & Cheyenne Telephone Co. has been incorporated by George Gerlach, Robert Moody and D. J. Young. Capital stock, $2,500.

Grafton, W. Va.—The Wickwire Telephone Co. has been organized with Dr. Alex. Leeds, president; Richard Wood, vice-president; Z. B. Knotts, secretary, and Edward Luzatter, general superintendent, and is constructing its lines.

NEW YORK NOTES.

PARAGON NEW POWER MOTORS, of 39 Cortlandt street, now running the big exhibit of eleven bicycles, all operated by figures of noted riders, are shown in one of the windows of H. C. F. Koch & Company, 125th street, west, N. Y. This exhibit is made in commemoration of the opening of bicycle department.

WIDESPREAD INTEREST IN ELECTRICAL EXHIBITIONS.—The interest taken in Electrical Exhibitions is by no means limited to Greater New York, but extends in every direction. Numerous comments have been made by the foreign press, and by journals in different parts of the country. Prof. R. B. Owens, director-general of the electrical work at the Omaha Exposition, beginning in June, has been specially instructed to visit this city in May and acquaint himself with the exhibits and the work being done. Many inquiries have come from foreign managers and manufacturers, as to the time and nature of the exhibition, and it is a fact beyond question that a stimulus will be given to export trade. As was the case at the exhibition in 1896, many of the exhibits will go straight from the floor to foreign countries.

M'CULLAGH POLICE SIGNALLING SYSTEM.—One of the universal complaints in regard to a policeman is that you can never find him when he is wanted. Chief McCullagh, the head of the police force of Greater New York, has studied this problem intimately, and has evolved a system of communication which marks a new departure in the police supervision of any large community. He proposes to establish a certain number of policemen at stated points all over the city, connecting their booths or sentry boxes by telephone with the police station of the precinct. No matter what happens, any one who wants the help of the police can go at once to these well-known points and obtain the service of the officer there, he, in turn, notifying his headquarters of the call and securing a relay, in the shape of one officer or a dozen, as the case may need. It will be obvious that such a system not only gives instantaneous police help, but by establishing a series of trochas, makes it very hard for a fugitive criminal to break through, as he is liable to interception in whichever direction he goes. Chief McCullagh has kindly promised to have on exhibition at the Garden in May, one of those novel and interesting booths, which, in the course of a few years, will doubtless stud the sidewalks of all our great cities.

WRITER MADE A VISIT to our sister city of Newark, N. J., and found the Backus Water Motor Company very busy preparing their electric ceiling fans for the spring trade.

GEO. ZIMMERMAN, of Market street, the electrical specialist contractor, is actively engaged on some very unique and difficult electrical installments. He carries the largest stock of fine goods for interior electric light effects and call systems.

HANSON-VAN WINKLE COMPANY, the world-famous electro-platers, dynamo specialty outfitters, make preparations to flood the market with a new catalogue which they have under way.

THE EASTERN ELECTRICAL SUPPLY CO., of 26 Cortlandt street, N. Y., have a fine supply house on Market street, Newark, and the electricians of Newark are finding it a very convenient place to get everything they need.

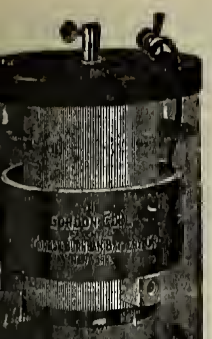
STUCKY & HECK, of 35 N. J. R. R. avenue, are the largest manufacturers of electric goods and specialties. The repairing and reconstruction of electric railway and power motors and dynamos, rewinding of armatures and refilling of commutators form a great part of their industry. They will make up stock orders from models as standard supplies at the best attainable rates.

C. M. McINTIRE CO., 15 Frauklin street, are actively engaged filling big orders received daily from Mr. McIntire on the road. Their McIntire patent commutators and terminals, fuse wire, fuse links and strips are growing in demand every season.

GOULD & EBERHARDS, the big machine tool makers, were shipping a big order to Austria and France when writer called. They are doing a big export trade.

J. JONES & SON, 67 Cortlandt street, N. Y., one of the most popular supply houses in this section, have secured the whole building at 64 Cortlandt street. The main floor will be fitted as a model supply store, and you will get just what you want at the right price. Their works in Brooklyn are kept busy in making their special electric light and power switches, switchboards, panel boards, etc. W. T. H.

Welland, Ont.—The Welland Aqueduct Power Company has been organized with a capital of $25,000 to supply electricity for light, heat and power.



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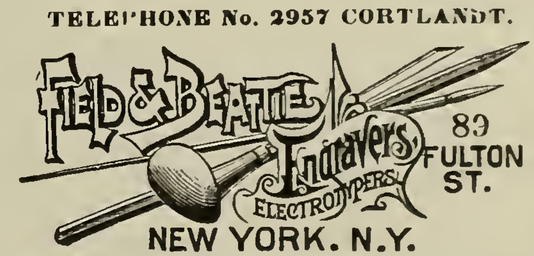

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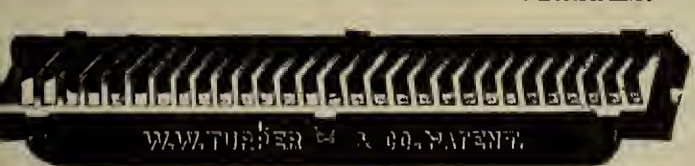

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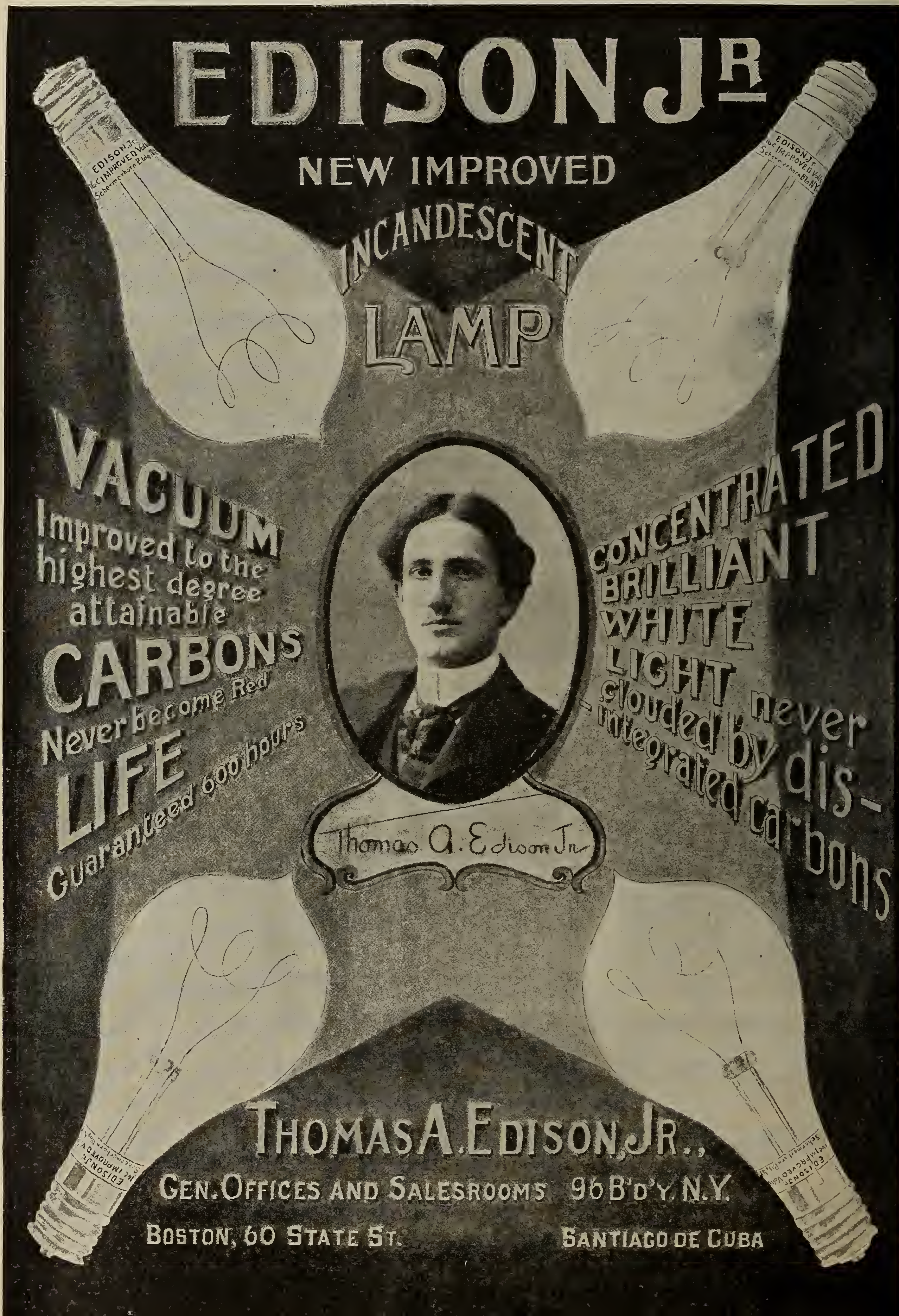
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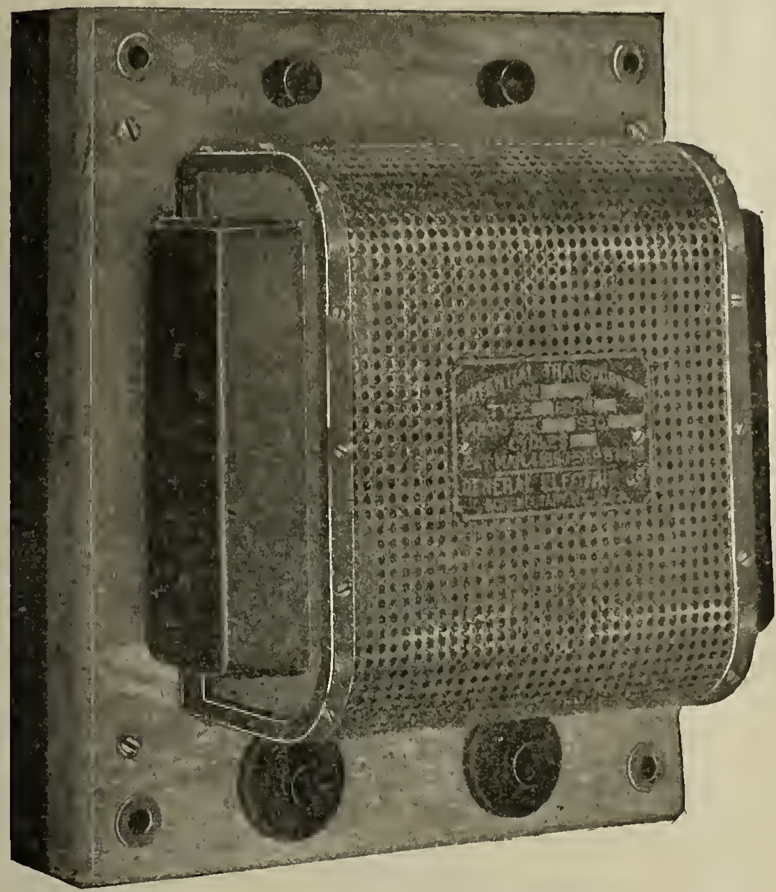
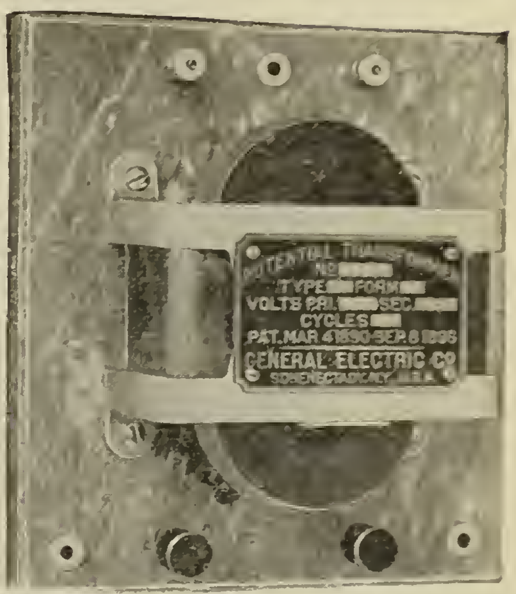
Vol. XXI—No. 16 NEW YORK, APRIL 16, 1898 Whole No. 570



New G. E. Transformer. 1040 Volts Primary, 52 Volts Secondary, 60 to 25 Cycles.



G. E. Transformer. 1040 Volts or 2080 Volts, 60 to 125 Cycles.

G. E. Monocycle Motor.

Field.

Armature.

Bearing.

A NEW POTENTIAL TRANSFORMER.

To meet various conditions the General Electric Company has designed five different potential transformers. The first wound for 1,040 volts primary and 52 volts secondary, for frequencies 60 to 125 cycles, is intended for use on circuits, the voltage of which does not exceed 1,250 volts, to supply current to indicating voltmeters reading to 75 volts and to primary recording wattmeters.

The second, wound for 1,040 or 2,084 volts primary and 52 or 104 volts secondary, for frequencies of 60 to 125 cycles, furnishes current for indicating voltmeters reading to 75 or 150 volts, and is so wound that coupling the coils differently for use on different voltages is unnecessary. It has ample carrying capacity in the winding to give its full output on the lower voltages when only one-half of the winding is in use. Three primary and three secondary terminals are provided. If the transformer is used on 2,080-volts circuits, the two outside primary terminals are connected to the line. If, however, it is used on 1,040-volt circuits, the middle terminal and either outside terminal are connected to the line. By making similar connections on the secondary side either 52 or 104 volts can be obtained.

The third, wound for either 1,040 or 2,080 volts primary and 57½ or 115 volts secondary, for frequencies of 60 to 125 cycles, is identical in its construction and use with the second, except that it is wound for stations using a ratio of transformation of 1 to 9 or 1 to 13 in place of 1 to 10 or 1 to 20.

The fourth is so designed that it can be wound for any primary voltage up to 6,000 volts and any secondary voltage up to 115 volts, for frequencies between 60 and 125 cycles. As parts of this transformer are kept in stock, it can be wound on short notice.

The fifth is similar to that just described, but slightly larger. It can be wound for the same voltages, but has a range of frequency from 25 to 60 cycles.

These transformers are designed to supersede all station and meter transformers which have been built by the General Electric Company up to the present time.

INSULATION AND CONDUCTION.

(Continued from page 207.)

Suppose a wheel, with elastic spokes and a heavy rim bound outside with a band of horsehair. the horsehair rubbing against a series of violin strings mounted parallel to the axis of the wheel, as shown in Fig. 2. Suppose each violin string has mounted upon it a small metallic bead charged with electricity, so that when the strings vibrate the beads can touch. Then on grasping the wheel at B, after a time depending upon the elasticity and mass of the wheel, a spark will be seen at A, but the actual velocity with which the electricity moves round the circuit of violin strings will depend upon the elasticity and mass of the strings. In passing, we may note several things :

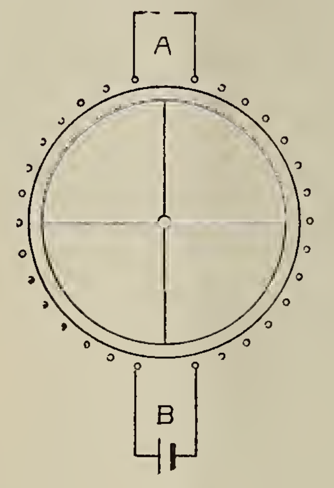


FIG. 2.

1st. That for this analogy to hold good at all, the atoms must be charged even in a conductor not carrying current; which is significant when taken in connection with the fact pointed out by the writer in the papers above referred to, that if we calculate the tensile strength, rigidity and Young's modulus on the assumption that these effects are due to charges on the atoms, we get results agreeing very closely with experiment.

2nd. That in a circuit having many atoms in the cross-section the energy could be handed on without actual contact by electro-dynamic process.

3d. That if one part of the circuit were composed of violin strings tuned to a different note-period from the other, we would get effects similar to those of thermo-electricity. §

4th. That the reversal of the point of greatest drop of potential in a circuit of air and carbon from the + to the — electrode as the pressure is reduced may be due to the fact that, as shown by the beautiful experiments of J. J. Thomson, the molecular conductivity of air at low pressures is extremely high, the electrode heated thus depending upon whether the solid conducts better than the gas, or vice versa.

5th. That this same formula would also be applicable to a diffusion phenomenon, and indeed the presence of valency in the formula makes it exactly analogous to that for the diffusion of heat. Moreover, Roberts-Austen, in a series of striking experiments, has shown that diffusion can take place in solids at ordinary temperatures. If a current be, however, a diffusion, it may be shown that for fairly large current densities the atoms must move several cms. per second, and we might therefore expect interpenetration when brass and zinc terminals are joined. But this does not occur to any considerable extent. We may also take it as an electrolytic diffusion, as is suggested by J. J. Thomson, in his "Dynamics Applied to Physics and Chemisty," but in this case, even assuming the theory suggested by him to account for some atoms preferring a plus to a negative charge, I find it difficult to imagine the manner in which the atoms could be charged and discharged at the surface of the conductor. It is to noted that in gases the phenomenon of diffusion, sound velocity and heat conductivity are all linked together.

It will be noticed that in the table given, while the metals follow each other in the order they should from calculation, yet the agreement is in some cases not so close as in others. This may arise from several causes :—1. The conductivities of but few of the metals are accurately known. 2. The elasticities of but few of the metals are accurately known, and the formula given for the Young's modulus only roughly takes temperature into account. 3. The temperature coefficients of the metals are not the same. For instance, that for copper is over .4 : .415, having been obtained by Swan and Rhodin, and .404 by Kennelly and the writer, whilst silver is only .38 and gold .36. Consequently, the ratio will vary with the temperature, and at higher temperatures the ratio, resistivity of copper : resistivity of silver will be less. This, it is interesting to note, holds true for the velocity of sound, for from Wertheim's results we have, velocity of sound in silver : velocity in copper = 1.35 at 20° C., and only 1.19 at 200° C., and hence, just as in the case of electrical conductivity, the sound conductivity of copper diminishes at a faster rate than that of silver.

The magnetic metals, as iron and platinum, are very difficult to obtain pure. Their true resistance is therefore at present doubtful.

What has been mentioned thus far concerning the resistance of solids has had no immediate bearing on the subject of insulation. It was necessary, however, in order to introduce the following considerations.

(To be continued.)

† I am here moved to again call attention to the fact that an immense amount of physical experimental work is misdirected. It is no doubt quite gratifying to ascertain, after several years' laborious work, that a particular piece of brass or steel of not very definitely known composition and in a quite indefinite physical state has a temperature coefficient of expansion expressed by five significant figures, but such information must be considered as pieces of philosophic virtu, intrinsically worthless, but possibly possessing a value by reason of their uniqueness and associations. I have pointed out elsewhere (Jour. Frank. Inst.) that at the present time, in spite of the fact that much has been done, notably by Matthiessen, Roberts-Austen and others, we have not at present any data in regard to 90 per cent. of the more important properties of the simpler metals used in the arts. The importance of having a standard state for solids; of a central bureau to furnish pure materials in a standard physical state to experimenters, and the exclusive use of such materials by experimenters, cannot be overestimated.

‡ Elec. World, Aug. 22, 1891; Science, July 22, 1892.

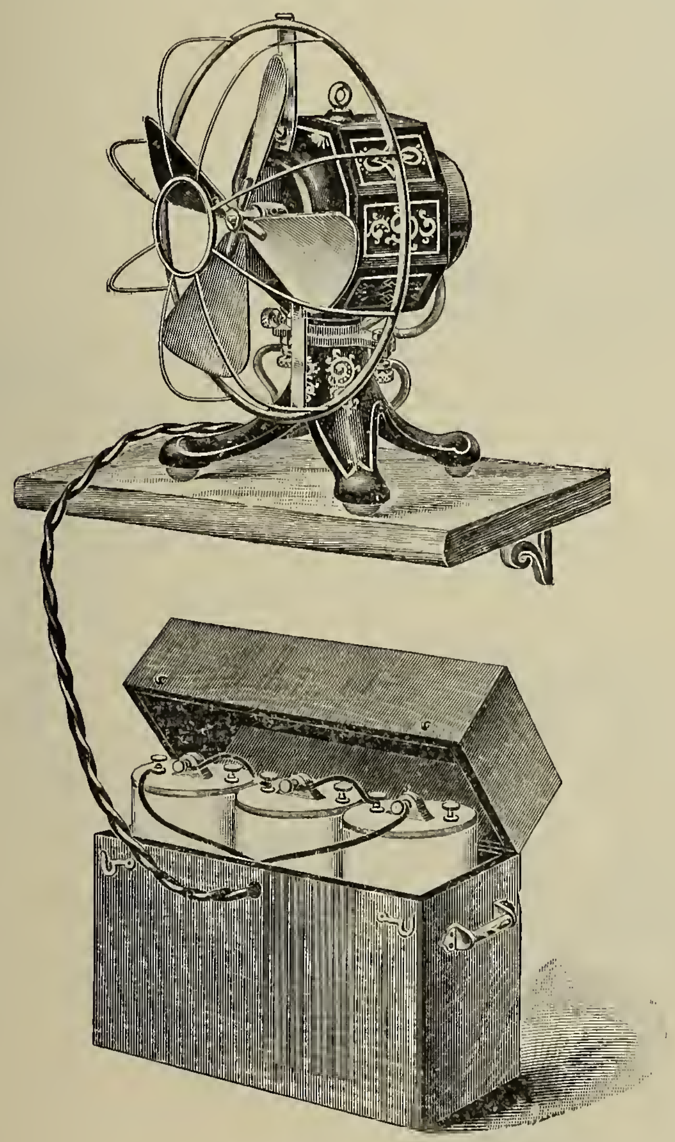
§ Compare the analogous problem of two portions of gas of different densities in a closed ring tube, and junctions heated. Neuman, Jahrberichte f. Chem., 1874, p. 15.

THE NEW EDISON FAN MOTORS.

The problem of designing a fan motor which will give good ventilation and run economically by battery power is one that has engaged the serious attention of the whole electrical world, and we are pleased to be able to record some very great advances which have recently been made in this direction.

The Edison Manufacturing Co., of New York and Orange, N. J., are about to place on the market a battery fan outfit, which is greatly superior to anything that has been produced up to the present time. The 9-inch battery fan outfit, manufactured by this concern, deserves special notice.

The motor is of the Paccinoti ring type, and runs on ball bearings. A series of most elaborate tests, extending over several months, were made before this innovation was finally decided upon, and the results obtained fully justify the change which has been made. When this outfit was first placed on the market, some five years ago, the motor had a 6-pole armature and a battery consisting of 4 Edison-Lalande cells, type "S," in oak box, which ran the motor for 100 fan hours at a speed of about 700 r. p. m. before needing to be renewed.

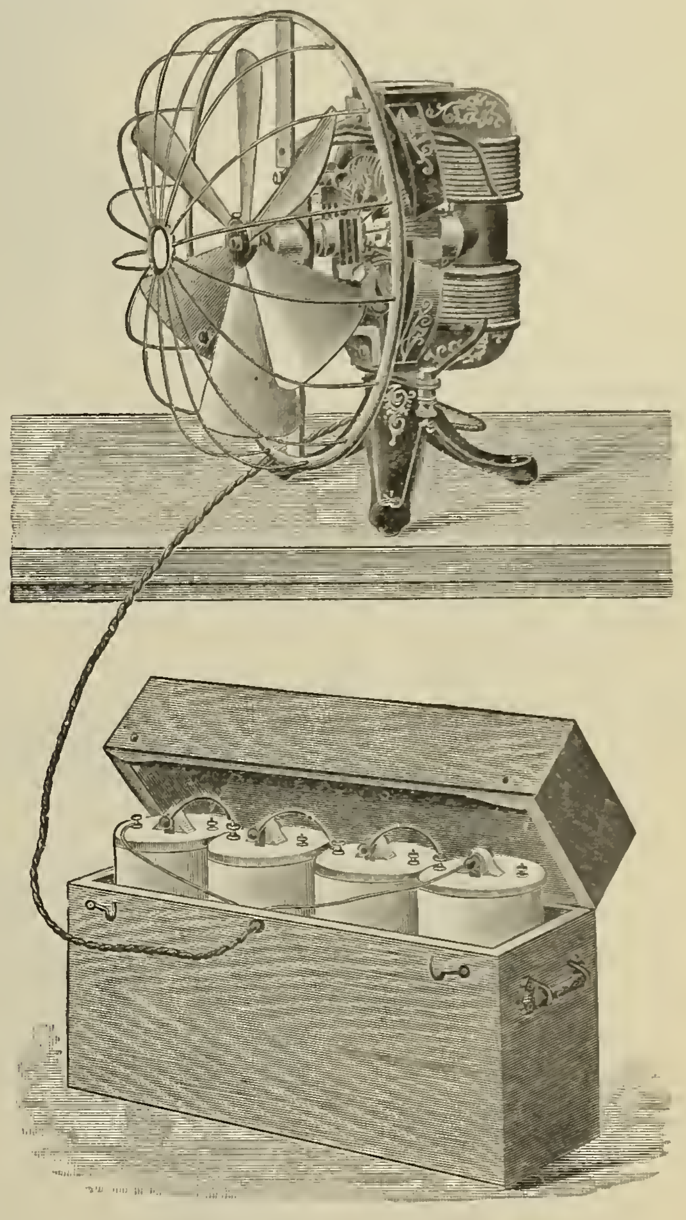


Three Cell Battery Outfit.

In the spring of 1897 a new motor was designed, having a Paccinoti ring armature, which was considerably more efficient than the old-style motor, as the working current was reduced so that the battery would last for 125 fan hours, and the speed of the fan was increased to about 800 r. p. m.

The new ball-bearing motor, which is now furnished with this outfit, takes only 1.75 amperes of current, and runs fan upwards of 850 r. p. m. As the capacity of the battery is 300 ampere hours, it follows that it will run the fan for 170 fan hours before needing renewal. It will thus be seen that the efficiency of the new motor in saving of battery power is 33⅓ per cent. over that of the 1897 model, and 70 per cent. over that of the original model, which is a most satisfactory showing. This does not take into account the increase in speed of the fan from 700 r. p. m. to 850 r. p. m., which is even more remarkable. (See Fig. 1.)

The Edison iron-clad battery fan outfit, manufactured by the same concern, has also been greatly improved. The motor, which carries a 7-inch fan and is furnished with 3 Edison-Lalande cells, type "S" (300 ampere hour capacity), in oak box, has been greatly simplified in construction. The improvement consists in the substitution of a small drum commutator for the disk commutator, formerly used in this motor, and the extension of the rear shaft support (carrying the brushes) beyond the iron-clad field, so as to enable the [brushes to be easily adjusted. The motor runs the fan at 1,200 r. p. m., and the battery will last for 150 fan hours before being exhausted. (Fig. 2.)



Four Cell Battery Outfit.

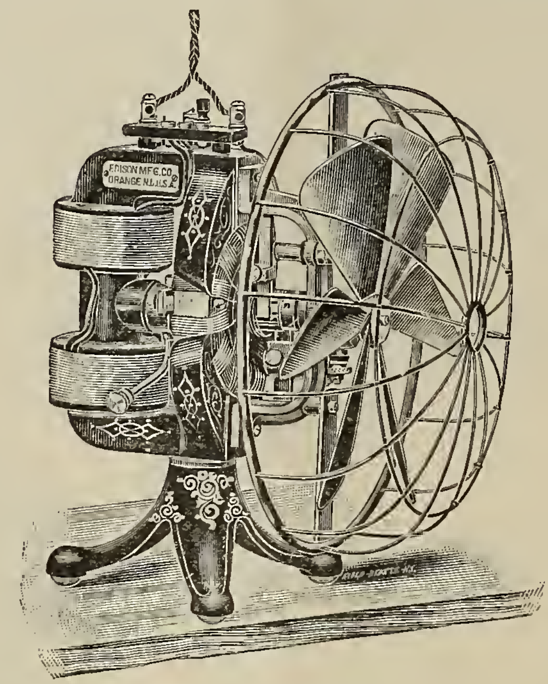
The great success that has attended the exploiting of both these battery fan outfits has induced the Edison Manufacturing Co. to enter the field of the 110-volt direct-current fan motors, and they are now placing on the market a very satisfactory fan motor for this current, furnished with 12-inch fan and guard. (Fig. 3.) This motor is similar in construction to the 9-inch Edison battery fan motor, but is furnished with a 3-speed switch, running the fan at 1,000, 1,200 and 1,400 r. p. m. respectively. The efficiency of this instrument is very high, and the workmanship of all the outfits is of the very first grade.

Baltimore, Md.—The Heat, Light and Power Company has been incorporated by Joseph P. Smith, Bertram S. Morrill, John W. Kaiser, Bernard T. Warthen, and Theodore E. Dollard, to construct and operate overhead wires for illuminating purposes, and to furnish motive power for machinery and such other purposes as electricity may be used. Capital stock $10,000.

THE BACKUS ELECTRIC VENTILATING FAN.

One of the oldest concerns engaged in the manufacture of electric fans is the Backus Water Motor Co., of Newark, N. J. The fans manufactured by the above require no attention, use very little current, and combine mechanical perfection with a handsome appearance. The 1898 fan and ventilating outfits leave but little to be desired either in the pressure blower proper, ceiling or column fans.

The ventilating fans operate with two speeds when desired and require no attention after installation. There are no copper brushes to wear out and no oil to drip. The ceiling fans are supplied with or without switch, are finished with polished brass basket and crown, and highly ornamented stem and blade holder. The use of a switch at the bottom of the fan saves extra wiring. Other fans supplied with electric light represent a useful, practical and highly ornamental combination. In winter the blades may be removed and the chandelier remain. The column fans, constructed with hooks and umbrella stands, have become very popular in high-class dining-rooms. They are finished in brass, nickel, oxydized silver, old gold or ivory, and look very beautiful when in-

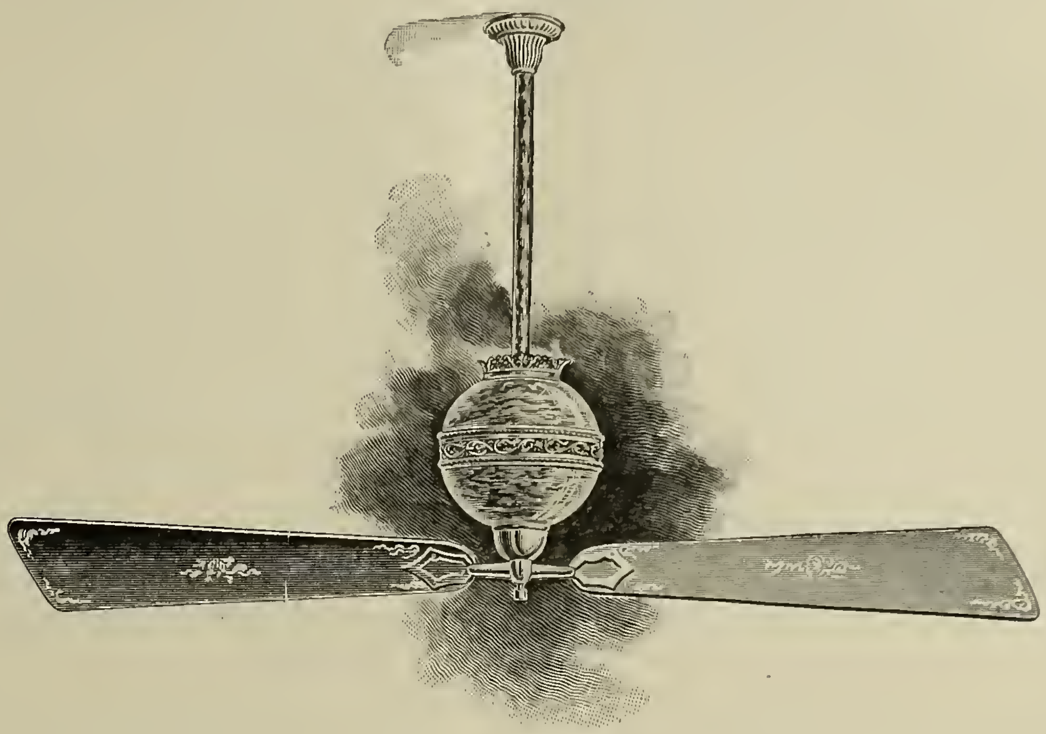


Edison Fan Motor.

Backus Factory.

stalled. The motor and pressure blower combination require but a minimum of attention. The blades deliver air without loss of any consequence, and the motor does not heat or spark. The remarkable superiority of the Backus outfit can be attested to by all customers. The simplicity of construction and excellence of appearance have always secured for Backus ventilating apparatus a ready sale.

tion. The plant to be erected and maintained with duplicate machinery, under the borough franchise for public and commercial light, heat and power, and to be of sufficient power to permit the use of additional arc or incandescent lights as may be required by the borough from time to time, at same or less price than that named in the original contract, the poles, wires and lights to be located and erected under the direction of the borough council.



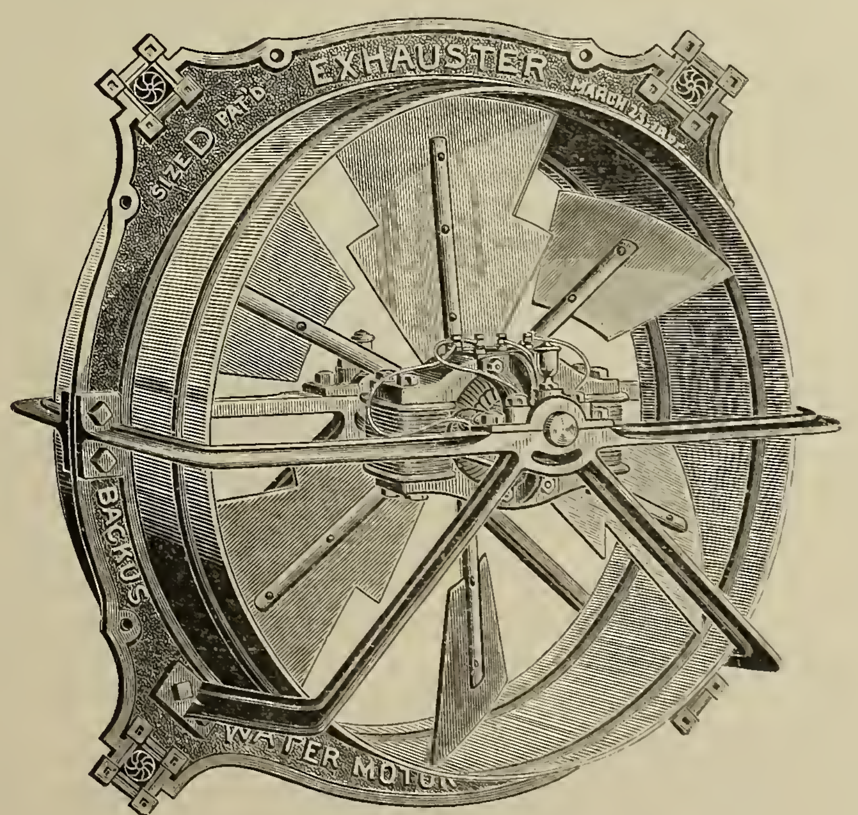
Backus Ceiling Fan.

PROPOSALS FOR ELECTRIC LIGHTING.—Sealed proposals will be received until 12 o'clock, noon, May 10, 1898, for the lighting of the streets of the borough of Mechanicsburg, Cumberland county, Pa., by electricity, as follows, to wit :

First—By 47 or more arc lights, 1,600 candle power, and 12 or more incandescent lights of 32 candle power to burn every night and all night.

Bidders to name place plant is to be located. If not in borough of Mechanicsburg, Pa., where?

The successful bidder will be required to give a satisfactory bond as a guarantee that the plant will be put into operation by September 1, 1898, if one should be made under this proposal, and that the same will be maintained and operated during the full term of the contract.



Backus Exhaust Fan.

Second—By 47 or more arc lights, 1,600 candle power, and 12 or more incandescent lights of 32 candle power to burn every night until 12 o'clock.

Both bids to be on a one-year contract, allowing the borough the privilege of renewing contract annually for two years additional.

Bids in all cases to give price per light per year. The lights to be of the most modern and approved construc-

The borough reserves the right to reject any and all bids. Proposals to be marked "Bids for Electric Lights," and addressed to C. N. Owen,
Chairman Light Committee,
Mechanicsburg, Pa.

Markham, Ont.—Steps have been taken by the village to rebuild the water-works and electric light plant.

LIQUID AIR.

At the March meeting of the Franklin Institute, Philadelphia, Mr. Chas. E. Tripler, of New York, made an interesting demonstration of some of the properties of liquid air. The fluid is, of course, intensely cold. It is of a milky white color when exposed to ordinary air, and in ordinary temperature it keeps up a continuous boiling. Touched by the hand it gives the very peculiar sensation of being a "dry liquid," and unless the hand is held in the liquid for a little time no moisture clings to it, and the only sensation is one of intense cold. The odor of the liquid air is peculiar.

The effect of the fluid on various substances is curious. Rubber, eggs, onions, oranges, beef-steak, iron and tin-plate were rendered very brittle by being immersed in it, and the speaker performed many very curious experiments with these substances. Mercury is rendered very hard, having a tensile strength while under the influence of the liquid air about equal to that of cast-iron under ordinary conditions. A hammer made of mercury treated with the liquid was used to drive nails through a board, and a bar of mercury treated in a similar manner held in suspension a fifty-six-pound weight for a period of twenty minutes before the threads about the screw-eyes in either end of the bar melted sufficiently for the screw-eyes to pull out. Gold, silver and other of the higher metals were unaffected by the material, and leather and some other substances showed no radical change.

Cotton waste, Mr. Tripler explained, when soaked with the liquid and fired with a match, develops an explosive power greater than gun-cotton, and small pieces of copper pipe and steel bicycle tubing were shown in which cotton so treated had been placed without packing. Both were split and torn as if they had been simply pasteboard.

As to the practical uses of the substance, only suggestions can yet be made. The high explosive power of cotton treated by the liquid suggests one use. Its intense cold, its temperature being about —191 degrees C., suggests its use as a refrigerating agency. Mr. Tripler suggested its possible application as a power developer by showing that water poured into a tea-kettle partly full of the liquid caused an evolution of power apparently as great as would be given off by a pot of boiling water. One of the most important uses of the liquid, it is expected, will result from the fact that metals treated with it offer practically no resistance to electricity, and as a result it is claimed that by treating dynamos their power can be enormously increased. Prof. Elihu Thomson, of Schenectady, is now experimenting with the liquid used for this purpose. Mr. Tripler is still working on experiments in the liquefication of gases, and he predicts that the liquefication of hydrogen in appreciable quantities is only a matter of patient application, although he expressed some doubt as to what the actual accomplishment of that feat would be except as a scientific triumph.

SECOND ELECTRICAL AND KINDRED INDUSTRIES EXPOSITION.

The above exposition is to be held at Madison Square Garden, under the auspices of the New York Electrical Society, from May 2nd to May 31st, 1898. The management of the Electrical Exhibition Company, conducting the Second Electrical and Kindred Industries Exposition, is determined that even though further complications with Spain should arise, the holding of the exposition will not be interfered with in any respect, as the enclosed list of exhibitors guarantees a splendid show. The following list of exhibitors will show how great an interest has already been awakened in the coming exposition by many of the most prominent manufacturers in the United States:

REVISED PARTIAL LIST OF EXHIBITORS.

Armorite Interior Conduit Co., Pittsburg, Pa.
American Rheostat Co., Milwaukee, Wis.
American Pulley Co., Philadelphia, Pa.
American Watchman's Time Detector, 234 Broadway, N. Y.
American Engine Co., Bound Brook, N. J.
Adams-Bagnall Electric Co., Cleveland, Ohio.
Armington & Sims Co., Providence, R. I.
American Electrical and Maintenance Co., 451 Greenwich street, N. Y.
American Electrician Co., New York.
American Electrical Works, Providence, R. I.
American Electric Novelty and Manufacturing Co., 231 Broadway, N. Y.
American Circular Loom Co., Boston, Mass.
Bullock Electric Co., St. Paul Building, N. Y.
Bossert Electric Construction Co., Utica, N. Y.
Baylis Co., The, 99 Cedar street, N. Y.
Borne, Scrymser Co., 80 South street, N. Y.
Belknap Motor Co., Portland, Me.
Brewster Engineering Co., 27 Thames street. N. Y.
Barrows & Co., C. H., 302 West 53d street, N. Y. (Electric Vehicles.)
Broomell, Schmidt & Co., York, Pa.
Boston Electro Duct Co., Boston, Mass.
Burhorn & Granger, 136 Liberty street, N. Y. (Woodbury Engines.)
Babcock & Wilcox Co., 29 Cortlandt street, N. Y.
Crocker-Wheeler Electric Co, 39 Cortlandt street, N. Y.
C. & C. Electric Co., 143 Liberty street, N. Y.
Corey, R. B., 26 Cortlandt street, N. Y.
Coho & Co., H. B., 220 Broadway, N. Y.
Card Electric Co., Mansfield, Ohio.
Camp Co., H. B., Aultman, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Crouse-Tremaine Carbon Co., Fostoria, Ohio.
Crown Woven Wire Brush Co., Salem, Mass.
Cook's Sons, Adam, 313 West street, N. Y.
Cutter Electrical and Manufacturing Co., Philadelphia, Pa.
De La Vergne Refrigerating Machine Co., 138th street and East River, N. Y. (Hornsby-Akroyd Oil Engine.)
Diamond Electric Co., Peoria, Ill.
Diesel Motor Co. of America, 11 Broadway, N. Y.
Edison, Thomas A., Orange, N. J.
Edison Electric Illuminating Co. of N. Y., Duane and Elm streets, N. Y.
Eddy Electric Manufacturing Co., Windsor, Conn.
Electric Storage Battery Co., Philadelphia, Pa.
Excelsior Electric Co., Brooklyn, N. Y.
Edison Manufacturing Co., Orange, N. J.
Edison, Jr., Thomas A., 96 Broadway, N. Y.
Electrical Engineer, New York.
Electrical Review, New York.
Electrical Age Publishing Co., New York.
Electricity Newspaper Co., New York.
Electrical World, New York.
Elliott & Hatch Book Typewriter Co., 253 Broadway, N. Y.
Electrical Engineer Institute of Correspondence Instruction, 120 Liberty street, N. Y.
Fischer Foundry & Machine Co, Pittsburg, Pa.
Fort Wayne Elec. Corporation, Fort Wayne, Ind.
Fuel Economizer Co., Matteawan, N. Y.
Fostoria Incandescent Lamp Co., Fostoria, Ohio.
Fiberite Co., Mechanicsville, N. Y.
Fairchild & Sumner, 39 Cortlandt street, N. Y.
Francis Bros., Philadelphia, Pa.
Gold Car-Heating Co., Cliff & Frankfort streets, N. Y.
Garton-Daniells Electric Co., Keokuk, Ia.
Garvin Machine Co., Spring & Varick streets, N. Y.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, APRIL 16, 1898.

CONTENTS.

MAGNETIC BLOW OUTS.

Many interesting inventions have come into existence which make use of a device for blowing out the electric arc. One of the most interesting experiments that can be tried with simple apparatus is the blowing out of an arc by means of a magnet. If two carbons between which an arc has been started be utilized for demonstratiug this phenomenon, and a strong electro-magnet brought near the source of illumination, the arc will move away, lengthen out and finally disappear. The reason why an electric arc is affected by a magnetic field is simple enough. The arc represents part of a turn and develops magnetic polarity; the approaching electro-magnet necessarily affects it, repelling it and ultimately destroying its continuity.

The Thomson-Houston lightning arrester makes use of this principle in blowing out the arc which would be started by a flash of lightning. The curious case then occurs of an electrostatic charge leaping between two terminals, starting thereby an arc due to the current and pressure in the line. This arc would continue unless means were taken to destroy it. The influence of a powerful electro-magnet is therefore of the utmost practical value when serving merely in this capacity.

The Walker Company have constructed a solenoid blowout controller in which the tearing and wasting of metal whenever circuits are opened is entirely obviated. Being built on scientific principles, care is taken to prevent the magnet from becoming saturated, so that the current about to be discontinued will, when circulating through the coils provided with the controller, effectively destroy the arc formed at the instant of separation. The lines of force proceeding from the solenoid emanate in straight lines, which affect the arc at once, the arc being forced away from the contact neither sideways nor forward, but as though it had been removed by invisible fingers directly away from the parting extremities. In controllers the sudden breaking of a circuit may cause destruction to the winding of either armature or field. It is necessary, therefore, to gradually reduce the current before breaking the circuit. The effect of the solenoid is to gradually lengthen the arc without any sudden detonation when it ceases.

Other cases might be cited in which the magnetic wind, as it is sometimes called, is made use of, but whenever such a case does occur it must be known that the purpose for which the magnet is used is a simple one—the destruction of an injurious arc.

THE LIQUEFACTION OF FLUORINE.

In 1670 Schwankhardt, of Nuremburg, discovered a liquid which possessed remarkable properties. The famous chemist, Scheele, remarked in 1771 that the discovery of Schwankhardt was that of fluorine. Moissan, the famous French chemist, produced fluorine in a free state by using a powerful current of electricity. Mr. C. F. Townsend, F. C. S., states in "London Knowledge," that in his opinion the liquid sought for as a universal solvent by the alchemists of past ages finds its nearest approach in liquid fluorine. If a piece of flint is placed within the vapor of fluorine it becomes a scintillating mass of incandescence. One of the few metals that will withstand its influence is platinum, and in its manufacture by M. Moissan the apparatus was constructed of the same.

For many years the gas fluorine was all that chemists could hope to experiment with, but since the invention of powerful machinery for producing liquefied air Professors Dewar and Moissan have succeeded in condensing the gas into pure liquid fluorine. The activity of this corrosive liquid will greatly diminish at a very low temperature, although its boiling point is 187 degrees below zero, Centigrade. This is almost the nearest approach to absolute zero reached by man. Prof. Moissan found it impossible to isolate fluorine from its combinations except by employing a current of electricity.

The liquefaction of fluorine is a wonderful achievement, involving the use of tremendous pressure, cold in comparison with which the North Pole would be a warm summer's day, and a current of electricity. Since mankind has learned to control and transform the forces at his command, experiments that will immortalize this age have been successfully conducted. Their usefulness from a commercial standpoint is not always apparent, but as a triumph Science will never cease speaking of them.

THE BROOKLYN POLYTECHNIC INSTITUTE and Dr. Samuel Sheldon, its professor of physics and electrical engineering, have kindly loaned the Electrical Exhibition several interesting units and standards upon which precision in electrical measurements is based. Even the electric public, while it hears a great deal of such standards, rarely sees them, and this exhibit, therefore, will be at once of technical and popular interest. The exhibit will include, especially, some standards from the German Imperial Physico-Technical Institute (Reichsantalt), whose celebrated work has been done under the guidance of such men as Helmholtz and Kohlrausch; and it is probable that these standards have never before been exhibited in public in this country. Dr. Sheldon will show the Reichsantalt form of the standard Clark cell, the Reichsantalt pattern of photometer with Hefner Amyl-acetate standard lamp and Lummer Brodhun contrast screen, standard .01 ohm for carrying heavy currents, large standard compensation set for the precise comparison of voltages from .01 to 1,200 volts and currents of any magnitude, standard Wheatstone bridge, Thomson's double bridge for conductivity measurements, standard Carhart-Clark cell, etc. The exhibition of such apparatus and the explanation given as to its use will do much to bring electrical measurements within the comprehension of the public, and to demonstrate the wonderful refinement of accuracy that modern electricians aim at in their apparatus.

General Incandescent Arc Light Co., 33d street and 1st avenue, N. Y.
Griffing Iron Co., A. A., Jersey City, N. J.
Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa.
Highland Chemical Co., Connellsville, Pa.
Haines Co., Wm. S., Philadelphia, Pa.
Haring Steam Plant Equipment Co., 26 Cortlandt street, N. Y.
Hope Electric Appliance Co., Providence, R. I.
Ideal Electric Corporation, 13th & Hudson streets, N.Y.
Imperial Porcelain Works, Trenton, N. J.
India Rubber & Gutta Percha Insulating Co., Glenwood, N. Y.
International Arc Lamp Co., Mercer & Houston streets, N. Y.
Jones & Son, J., 69 Cortlandt street, N. Y.
Keuffel & Esser Co, 127 Fulton street, N. Y.
Kelley & Sons, B. F., 91 Liberty street, N. Y.
Keystone Electrical Instrument Co., 9th street and Montgomery avenue, Philadelphia, Pa.
Keiley & Mueller, 7 West 13th street, N. Y.
Kosmic Oil Filter Co., Easton, Pa.
K. & W. Co., Pittsfield, Mass.
Katzenstein & Co., L., 357 West street, N. Y.
Kensington Engine Works, Ltd., Philadelphia, Pa.
Kirkland, H. B., 120 Libertystreet, N. Y.
Lewis Tool Co., 44 Barclay street, N. Y.
Lynn Incandescent Lamp Co., Lynn, Mass.
Morris, Elmer P., 15 Cortlandt street, N. Y.
Machado & Roller, 203 Broadway, N. Y.
Mowrey, P. M., & Co., 318 Broadway, N. Y.
Monarch Manufacturing Co., Waterbury, Conn.
Niles Tool Works, Hamilton, Ohio, and N. Y.
National Meter Co., 118 Chambers street, N. Y.
Nowotny Electric Co., Cincinnati, Ohio.
National Carbon Co., Cleveland, Ohio.
Nash Gas Engine Co., 99 Cedar street, N. Y.
New Britain Machine Co., New Britain, Conn.
N. Y. Safety Steam Power Co., 30 Cortlandt street, N.Y.
N. Y. Car Wheel Works, Buffalo, N. Y.
N. Y. Telephone Co., 18 Cortlandt street, N. Y.
Oswego Boiler Works, Oswego, N. Y.
Otis Electric Co., 38 Park Row, N. Y.
Onondaga Dynamo Co., Syracuse, N. Y.
Paragon Arc Lamp Co., Boston, Mass.
Peru Electric Manufacturing Co., Peru, Ind.
Peckham Motor Truck & Wheel Co., 26 Cortlandt street, N. Y., and Kingston, N. Y.
Partrick, Carter & Wilkins, Philadelphia, Pa.
Paragon Electric Fan Motor Co., 39 Cortlandt street, N. Y.
Porter & Remsen, 39 Cortlandt street, N. Y.
Prindle Pump Co., 136 Liberty street, N. Y.
Partridge Carbon Co., Sandusky, Ohio.
Pope Manufacturing Co. (Motor Carriage Department), Hartford, Conn.
Platt Manufacturing Co., O. S., Bridgeport, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Riker Electric Motor Co., 45 York street, Brooklyn, N. Y. (Electric Vehicles.)
Safety Insulated Wire & Cable Co., 229 West 28th street, N. Y.
Stephenson Co., Ltd., John, 47 East 27th street, N. Y.
Silex Insulation Co., 39 Cortlandt street, N. Y.
Sprague Electric Co., 20 Broad street, N. Y.
Simonds Manufacturing Co., Pittsburg, Pa.
Sinclair, D. J., Caledonia, N. Y.
Street Railway Journal Co., New York.
Street Railway Review, Chicago, Ill.
Shaw, H. M., 126 Liberty street, N. Y.
Samson Cordage Works, Boston, Mass.
Translucent Fabric Co., Quincy, Mass.
Thomas & Sons Co., R., East Liverpool, Ohio.
United States Electrical Supply Co., 141 East 25th street, N. Y.
Universal Electric Co., 126 Liberty street, N. Y.
Vacuum Oil Co., Rochester, N. Y.
Van Horne, Burger & Co., Dayton, Ohio.
Worthington, Henry R., N. Y.
Walker Co., Cleveland, Ohio.
Weston Electrical Instrument Co., Newark, N. J.
Warren Electric Mfg. Co., Sandusky, O.
Williams & Co., J. H., Brooklyn, N. Y.
White, J. G., & Co., 29 Broadway, N. Y.
Western Electrician, Chicago and New York.
Worthington Water Tube Boiler, 30 Cortlandt street, N. Y.
Williams, J. P., 39 Cortlandt street, N. Y.
Warren-Medbery Co., Mechanicsville, N. Y.
Wilday, J. H., 23 Duane street, N. Y.
Warren Electric and Specialty Co., Warren, Ohio.
Zimdars & Hunt, 127 Fifth avenue, N. Y.
Ziegler & Co., Boston, Mass.

TROLLEY PATENTS.

News comes to us from Cleveland, O., on April 11th, through the columns of "The Brooklyn Daily Eagle," as follows: "The Walker Manufacturing Co. received notice of a decision from the New York Court of Appeals, which, it is claimed, makes the electric street trolley patents public property. Under patents granted to Van de Poel, the General Electric Co. has for years held the exclusive right of manufacturing trolleys. Some time ago the Walker Co. began the manufacture and sale of an electric trolley on an extensive scale, resulting in a series of suits against that company by the General Electric Co. In his last statement of the assets of the General Electrio Co. President Coffin included an item of $1,000,000 as the value of the Van de Poel trolley patents."

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Contiuued from page 185.)

The effect of electrificatio on the flow of water has received considerablc attention from eminent authorities in recent years, and that of the effect of electrification on the growth and composition of vegetable is at present attracting attention in the form of systematic investigation.

The contributions of Franklin are by far the most important which mark the middle portion of the 18th century. Franklin's experiments were begun about the middle of the year 1747, and seem to have been inspired by the receipt of a Leyden jar from a friend, William Collinson, of London. He propounded the theory of positive and negative fluids, which has lately, in a modified form, been brought so prominently into notice again by the writings of Lodge, and he made an investigation of the principle of the Leyden jar, but the most important of his researches relate to the identification of electricity and lightning. The probabl identity of the two phe nomena had been hinted at, as we have seen, by several observers, but Franklin went systematically to work to test the hypothesis. Under date of November 7, 1749, the following passage is found in his note-book: "Electric fluid agrees with lightning in these particulars: (1) Giving light. (2) Color of the light. (3) Crooked direction. (4) Swift motion. (5) Being conducted by metals. (6) Crack or noise in exploding. (7) Subsisting in water or ice. (8) Rending bodies in passing through. (9) Destroying animals. (10) Melting metals. (11) Firing inflammable substances. (12) Sulphurous smell. The electric fluid is attracted by points; we do not know whether this property is in lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable that they agree likewise in this? Let the experiment be made." The hypothesis was elaborated and sent to his friend Collinson, who communicated it to the Royal Society. This Society rather ridiculed Franklin's ideas at first, but his paper was published in London and also in France, and attracted considerable attention.

The experiment was first made in France by M. d' Alibard, at Marli, on May 10, 1752, and it was repeated shortly afterwards by M. de Lor, in Paris. The results of what were called the Philadelphia experiments were communicated to the Royal Society and caused quite a stir in scientific circles. It is right to say, with regard to the Royal Society, that Franklin's claims to scientific recognition were championed by Sir William Watson, and fully endorsed by the Society by his election to a fellowship and the award of the Copley Medal, together with the free donation of the Society's Transactions during his life.

Franklin's own experiments with kites are well known, as is also the method of protecting buildings from lightning which was introduced by him and is still very widely used, although it has been greatly abused by the lightning-rod man.

During the next decade Canton discovered the now commonly-known difference between vitreous and resinous electricity. Beccaria experimented on the conducting power of water. Symmer made a number of interesting experiments on the electrification of different kinds of fabrics by friction, and propounded a theory of two electric fluids. Contemporaneous with these were a number of other experimenters who added to the stock of knowledge of this class of phenomena.

The experiments of Aepinus and others on the pyroelectric properties of tourmaline now began to attract attention. The experiments of the Abbé Haüy are perhaps the most important in this connection at this stage of the subject. He found the polar properties of the crystal and showed that similar properties were possessed by a number of other crystals. Aepinus made experiments in other branches of electriciy, but he is chiefly noted for his ingenious single-fluid theory of electricity.

Between the years 1770 and 1780 the electrical organs of the torpedo were one of the principal topics of discussion. The experiments of Walsh and Ingenhousz were the first to definitely settle the character of the peculiar power of the fish.

The experiments of Cavendish belong to this period and were remarkable as being quantitative in their character. Considering the means at his command, the measurements made by this experimenter of the relative conducting powers of various substances must always excite admiration. Cavendish also proved the composition of water by causing different proportions of oxygen and hydrogen to unite by means of the electric spark.

We now come to the classical experiments of Coulomb, who established the law of the variation of the electric force with distance to be that of the inverse square—a law which had previously been inferred from experiments on spheres by Dr. Robinson, who, however, did not publish his results. Coulomb made an elaborate series of experiments on the distribution of electricity over charged conductors as influenced by shape and the proximity of other charged bodies. His theoretical and experimental work formed the basis of the mathematical theory as developed shortly afterwards by Laplace, Biot and Poisson, the work of the latter being particularly important.

Toward the end of the 18th century were made the important researches of Laplace, Lavoisier and Volta, and of Sausure in the electricity produced by evaporation and combustion. This is a subject destined to figure prominently again in the future, and in its rise there is in all probability involved the rapid decline in the importance of the steam-engine. I should not be surprised if many of those present should live to see the steam engine practically a thing of the past.

In the 18th century also we must assign the discovery of Galvanic electricity, as the famous frog experiments were made in 1790. Practically no development was made, however, until Volta's work attracted the attention of the scientific world.

At the beginning of the 19th century, then we find the subjects of greatest interest were the discoveries of Volta and the invention of the voltaic pile. There followed almost immediately the discovery by Nicholson and Carlisle of the decomposition of water by the voltaic current. This discovery was followed a few years later by those of Sir Humphry Davy on the decompositiou of the alkalies and the separation of metallic sodium and potassium. Thus the subject of electrolysis was fairly launched, and what it has grown to be we will see later.

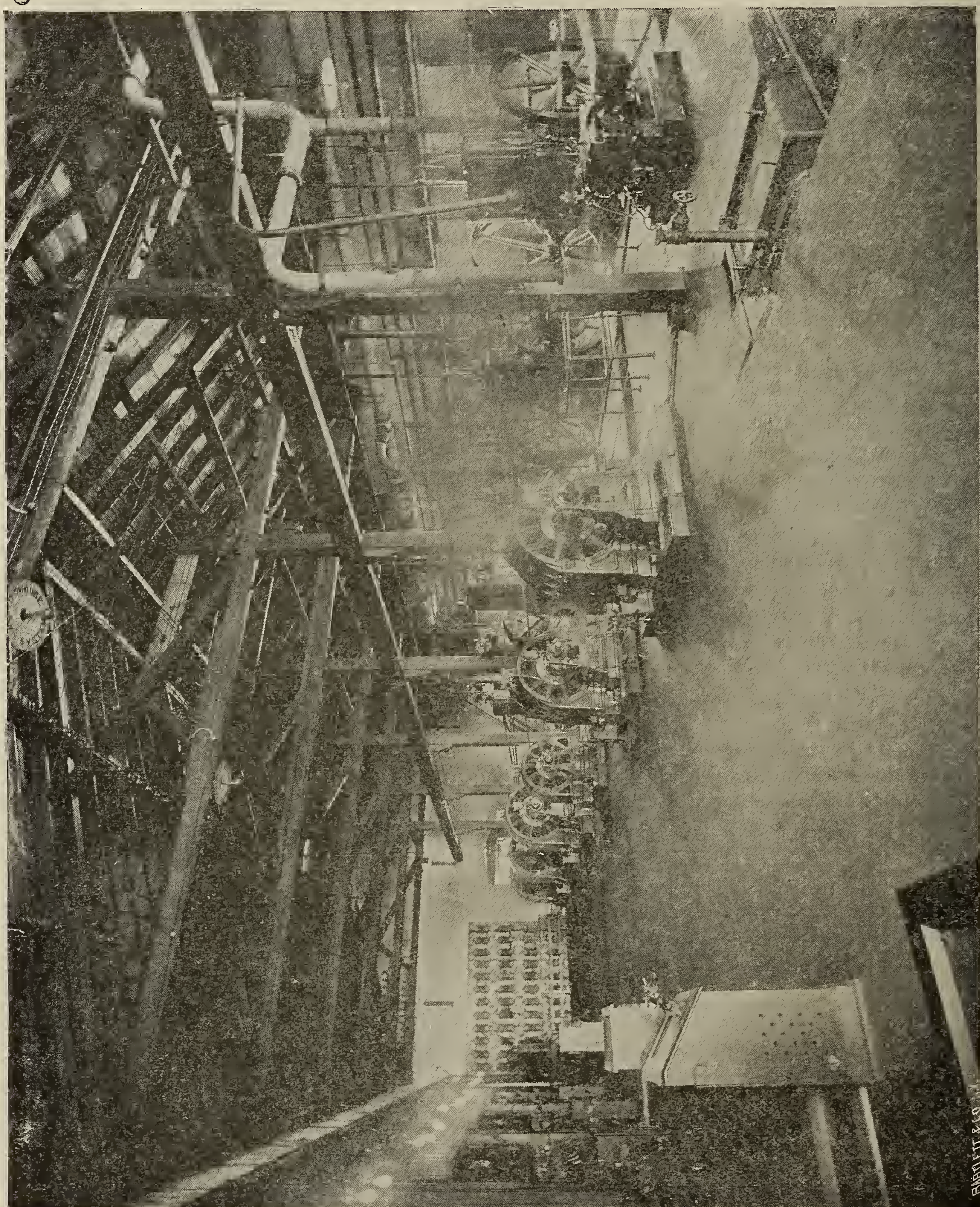
(To be continued.)

ELECTRIC ELEVATORS.

BY PERCIVAL ROBERT MOSES.

From Engineering Magazine, December, 1897.

The question of prime importance in elevator design is that of safety. Economy of operation and ease of control are large factors, but, no matter what else may have to be sacrificed, human life must be secured. Accidents may occur either from carelessness or from faulty design. The former may be guarded against, but not absolutely prevented ; for the latter there is no excuse. A system, to be absolutely safe, should include apparatus for preventing a drop, should all the ropes break at once, or if one should fail, for preventing abnormal speed due to excessive load or other cause ; for holding the car stationary on the removal of power, or under any possible conditions of overload ; for absolutely arresting the motion of the hoisting machine, and for removal of power when the car approaches the limits of travel ; for immediate removal of power from the hoisting machine in emergency, if the cables slacken or in case of temporary cessation of supply ; for receiving and stopping the car and the counterweight, should all the other devices fail to operate ; for prevention of operation until hoistway doors are actually closed. The last condition is rarely fulfilled, the automatic house machine being alone in its compliance. Speed is of sufficient importance in the majority of cases to offset the results of possible carelessness on the part of the operator. In addition to the apparatus above mentioned, the cables for hoisting, the safety clutch for gripping the rails, the sheaves, bearing, and, in fact, all vital parts, should be of a strength far in excess of average actual requirements. This strength costs little, and is of great importance. Easy, reliable control and economical operation are in a degree opposed, if the fixed charges are included in the latter. An ideally-controlled elevator would be capable of starting the car from rest with uniformly and rapidly accelerated velocity and minimum waste of power ; of running the car at varying speeds, and of arresting motion, easily for ordinary stops, and immediately for emergencies. It would be noiseless, simple, and absolutely reliable in its action, and in case of accident or carelessness of operator, should automatically stop the car. It would be so designed and constructed as to preclude accident, no matter what the operator might attempt to do. These conditions are hard to realize completely in one system, but they have been partly fulfilled by several. Two general methods of control are recognized. The first allows of varying the speed from the car ; the second does not, except for starting and stopping. The object of the first method is obtained in two ways—by a pilot motor operating to vary resistance in the main circuit, as in the Sprague system, with an inverse variation of the motor field strength ; and the variable voltage, or Leonard, control, where each elevator motor has a separate generator, and the speed of the car changes in accordance with the varying electric pressure of the generator. This pressure is determined by a resistance in series with the small field current, and is adjusted from the car. Both methods meet most of the conditions imposed, and the question of choice for all speeds of less than 350 feet per minute is one of comparative economy. The Leonard system is employed only for worm-gear machines, and could not be operated with the present make of screw and multiple-sheave machine. The variable voltage system allows of an ideal start and stop, whether from the standpoint of economy or from that of comfort; on the other hand, from the point of total economy in operation, the rheostat control is advisable because of the necessarily continuous operation, and the first cost of a separate generator for each machine. The proportion of time during which a car is in actual motion varies with the class of travel, but even in ordinary office-buildings it rarely exceeds five-eighths, and generally falls below one-half of the total operating period. In addition, each generator must be of capacity sufficient for the maximum starting load, and consequently runs at low efficiency. In this connection, the following data from seventeen elevators, taken at random from more than a hundred tests, is of interest: The speed varied from 60 to 450 feet per minute, the maximum capacities from 1,500 pounds to 3,000; the maximum live load was 1,600 pounds, the minimum 150 pounds, and the average only 593 pounds. A test on a tall office-building showed the average load to be less than one-seventh of the maximum, and the figures on another, where the elevators were apparently worked to their fullest capacity, showed it to be less than one-fifth. In general, the average live load varies from one-fifth to one-eighth of the maximum. As far as statistics show, the variable voltage system is less economical and simple than the ordinary rheostat control when applied to worm-gear machines; in smoothness of starting and operation it is superior. For low-speed machines, or for buildings where variable speed is not essential, a solenoid control answers all purposes, and its operation may be controlled directly by electricity from the car, or the shipper rope and wheel may be employed to close switches on the machine and operate the brake.



Alternating Current Station and Switchboard.

(To be continued.)

WIRING FOR LIGHT AND POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

(Continued.)

The wiring of buildings is the ultimate end of a street subway system. The current is generated in a central station, distributed either as an alternate or continuous eurrent through the streets in conduits specially prepared and then connected to the wiring circuits of any house, hall or public building.

The entire city is completely enclosed by a network of underground wires, each insulated from the other and proportioned in size so that the proper pressure and current is delivered at the door of every consumer's house.

The control and care of a subway system is in itself a duty of a most important character.

There is a likelihood of several kinds of trouble developing. Each must be discovered and treated in a manner sufficient to remove either itself or the cause as speedily as possible. There is every means observed on the part of central station managers to take the most jealous care of their subways. It is in the perfection of these and their freedom from faults that the profits of the plant mainly lie.

The wiring of a building can therefore be regarded as the final outcome of an elaborate equipment composed of

(1) A central station plant.
(2) A subway or distributing system.

The main points to be considered in the construction and maintenance of an electric-light system, with special refereuce to the lines either inside or out, are

Freedom from grounds.
Freedom from short circuits.

A series of less important troubles are constantly developing, which will be the cause of further difficulties if not immediately attended to, such as

Poor connections.
Bad joints.

Poor Connections.—The origin of this fault is either hurry or carelessness.

Fire may frequently be started by either of the above causes; their elimination, therefore, is an enforced necessity.

A wire loosely placed under a screw will generate heat and possibly set fire to something in the neighborhood. In addition the looseness of contact will mean resistance in circuit with the line and cause a decided drop. The evil results in this case are practically similar to those developed in the second case, due to bad joints. They are risks from fire or loss of pressure.

How a Building Is Wired.—When a structure of any description is placed in a contractor's hands to wire, it is necessary for him to decide upon several things.

These may be brought to the reader's notice as follows:

(1) The kind of wiring (either 2 or 3 wire).
(2) The percentage of drop.
(3) The centre of distribution.

The nature of the wiring will depend to a great extent upon the kind of current entering the building—whether it is continuous or alternating. Usually buildings that use alternating current are wired with the ordinary two-wire system. The two factors affecting the size of wire or amount of copper used are the percentage of drop and the centre of distribution.

To wire a building successfully the pressure must be retained throughout as high as possible. A network of wires must therefore be used that will effect this result, and it becomes necessary in retaining this object to select a proper centre of distribution.

A centre of distribution in a wiring system is a point from which all wires supplying the electric light direct are connected. The wires used in any building, according to their function, may be classified under the heading of

Mains.
Feeders.
Branches.

A building of given size would have a pair or pairs of main wires run up half, quarter, or one-third way, and then from this point feeders would run above and below, acting as subsidiary mains, and supplying the branches connecting to the lights on the upper and lower floors. This centre, from which all lines stream, is called in compliance with its intended object—the centre of distribution.

The wiring of a house as regards its mains, feeders or branches, may be all proportioned by a simple rule whose excellence has been tested in numerous cases. The pliancy of this rule is due to the fact that it takes into consideration the distance in feet, amperes and circular mils.

$$\frac{2 \times \text{distance in feet} \times \text{amperes} \times 12}{\text{volts drop}} = \text{C. M.}$$

where C. M. = circular mils.

The appl.cation of this rule may be illustrated by the following example:

Distance of run = 1,000 feet,
Amperes = 50 "
Volts drop = 10 "

$$\text{Size of wire in C. M.} = \frac{2 \times 1{,}000 \times 50 \times 12}{10}$$

= 120,000
= No. 00 B. & S. guage.

The size of any copper conductor may be found provided the volts lost, the number of lamps and the length of the run in feet is known; an excellent rule for arriving at the size of wire is to remember that a No. 10 wire B. & S. has about 10.400 C. M. cross section, and each wire three sizes above or below doubles or halves in cross section. For instance, a

No. 13	B. & S.	approx.	5,200 C. M.
10	"	"	10,400 "
7	"	"	20,800, etc.

This will enable a rapid mental calculation to be made of the size of wire from the circular mils obtained.

Twice No. 10 is No. 7, and four times No. 10 is No. 4, etc. In the last case the C. M. arrived at were 120,000. A size of wire about 12 times as large as a No. 10 would have 120,000 C. M. We therefore consider

2 × No. 10 = No. 7
4 × 10 = 4
8 × 10 = 1
10 × 10 = 00

The main fact to consider is, that when a wire doubles in circular mils it decreases three numbers in size.

A No. 10 wire is 10,400 C. M.; a wire twice its circular mils would be 20,800 C. M., but pass in number from No. 10 three sizes, or become No. 7.

The intervening gaps may be filled in in thirds in the following table:

Approx.	166,400	No. 000 =	167,805	C. M.
"	83,200	1 =	83,694	"
"	41,600	4 =	41,743	"
"	20,800	7 =	20,817	"
"	10,400	10 =	10,382	"
"	5,200	13 =	5,178	"

THE INTERNATIONAL HEALTH EXPOSITION will open in a blaze of glory at the Grand Central Palace, 4th avenue and 44th street, April 25th. Luther Stieringer, the exploiting electrical engineer, has the electrical effects in his charge, and B. E. Greene, the well-known newspaper man, secretary of the Exhibition, is looking after the exhibits. A big, promising show is expected. The officers of the Exhibition are Montgomery Maze, treasurer; B. E. Greene, secretary; Chas. F. Wingate, supervising director, and Luther Stieringer, consulting engineer. The International Health Exposition has received the co-operation of the Household Economic Association. In conjunction with the Exhibition there will be a Trained Nurses' Educational Exhibit, under the management of Miss Mary E. Wadley, assisted by Miss Anna Schenk.

THE ELECTRICAL EXPOSITION,

Madison Square Garden, May, 1898.

Do you intend to add to the brilliancy of the occasion by decorating your exhibit with incandescent lamps? If so, we have the regular decorative (miniature) lamps and receptacles for rental.

Shall you not want an electric sign, so that he who runs may read—and he who reads may run—to your exhibit? If so, we have them for rental.

How about an attractive illuminated device for your exhibit? Just about now The American Eagle and Shield is a good thing for all of us to keep in view. We have them and other devices, patriotic and otherwise, for rental.

Edison Decorative and Miniature Lamp Department,
General Electric Co, Harrison, N. J.

MONTAUK MULTIPHASE CABLES.

In another column will be found an open letter to the Montauk Multiphase Cable Company from the Gamewell Auxiliary Fire Alarm Co. We wish to call the especial attention of our readers to this letter.

The Montauk Multiphase Cable Co. have originated and developed a new line of cables which when installed for any or all kinds of interior electric service give to property owners and to insurance companies an ad itional protection against loss by fire always sought for, but heretofore unknown.

This system gives to wires the power to discover dangerous heat or flame and automatically to notify at any point or points desired that such heat or flame is in existence, and this upon its inception.

The great merit and pronounced value of these cables is from the fact that they are not required to be especially installed for this purpose, but, on the contrary, are used in buildings for all of the interior electric work which is at the present time required; therefore, every fractional part of every wire or cable hereafter installed under the Montauk Cable System is continuously thermostatic and results in giving protection from loss by fire, although installed for purposes of an entirely different nature.

The property-holder is not only benefited by gaining additional protection for life and property, but the insurance companies have an additional guarantee against loss through the use by the public of this system; therefore the value of the indorsement and adoption of the Montauk Multiphase Company's System of interior, automatic, thermostatic, electric cables by the Gamewell Fire Alarm Company and its auxiliary companies for their specificuse will be readily understood and appreciated when it is taken into considerationthat the Gamewell Co. is the parent of the present extensive fire-alarm system which is in use in over 700 of the largest cities of the United States and have furnished more than ninety per cent. of all the fire-alarm apparatus used in the United States and Canada.

It is from their experience of fifty years or more of endeavoring to give the most reliable and quickest poslbie notification of fire in existence that makes such endorsement of the greatest possible value, for if this company are not experts and capable judges in such matters, there can be none in the United States.

We therefore note with satisfaction these main points brought out in the above-mentioned letter to the Montauk Company, namely, The statement that this cable has received full consideration by the Gamewell people; they have come to the conclusion that an automatic protection can be safely given in connection with their fire-alarm system where no other device has ever been relied upon; in other words, they are willing to rely upon the burning of this cable to close the circuit and thus automatically call out the forces of the fire department through their auxiliary system.

Joseph W. Stover, President.
Geo. F, Milliken, General Manager.
H. F. Bender, Treasurer.
Albert H. Cross, Superintendent.

GAMEWELL AUXILIARY FIRE-ALARM COMPANY,

Executive Office, 19 Barclay Street.

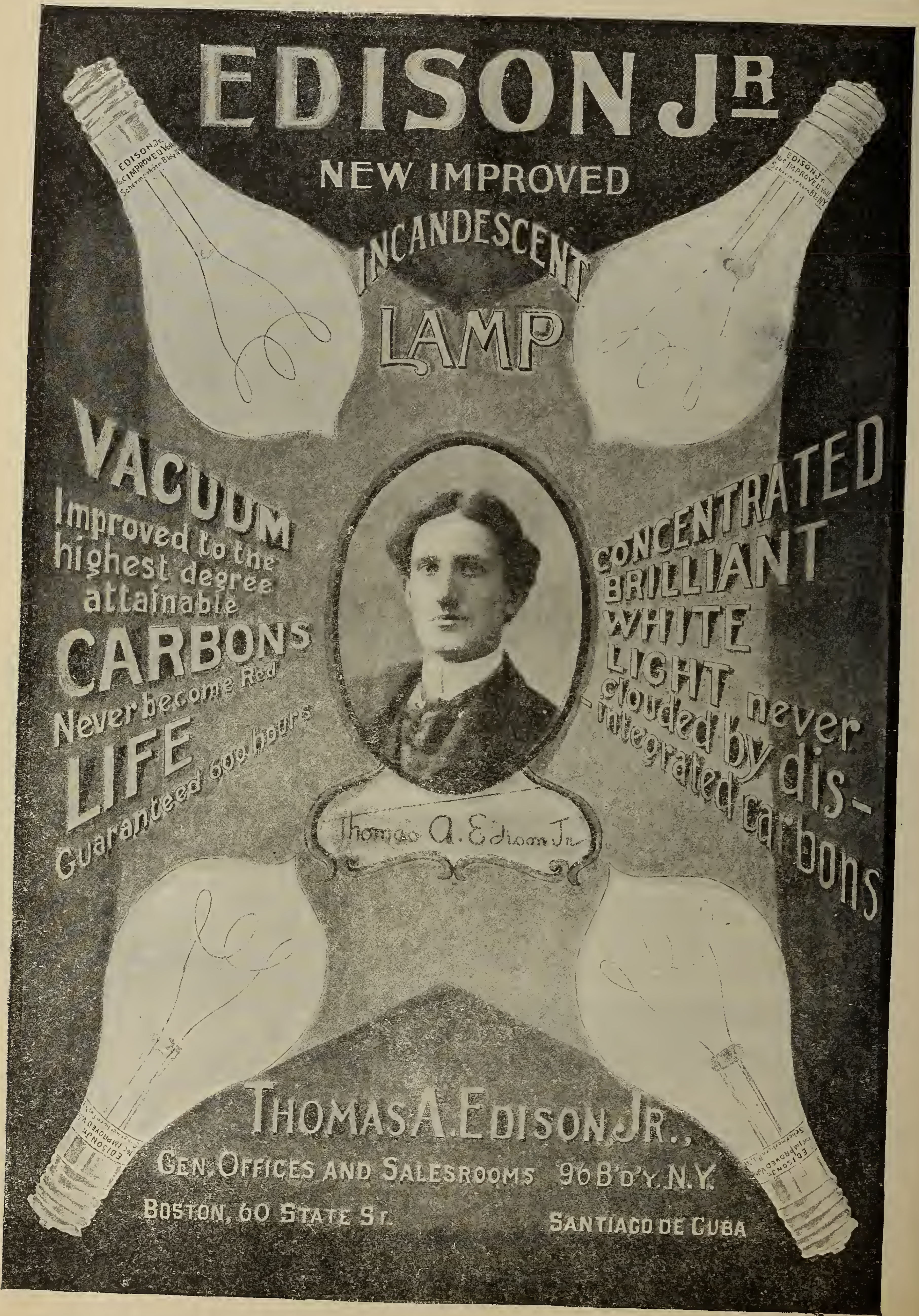
New York, March 30, 1898.

Montauk Multiphase Cable Co.,
100 Broadway, New York City.

Gentlemen—Herewith we send you formal acceptance of your proposal for furnishing us with your "multiphase electric cables."

After full consideration we have come to the conclusion that we will find, through the use of your cable, something long known to be desirable but hitherto impracticable, viz.: a device which we can safely use for the purpose of combining thermostatic fire-alarms with our auxiliary system of connection with public fire-alarm telegraphs.

Yours truly,
(Signed) Jos. W. Stover, President.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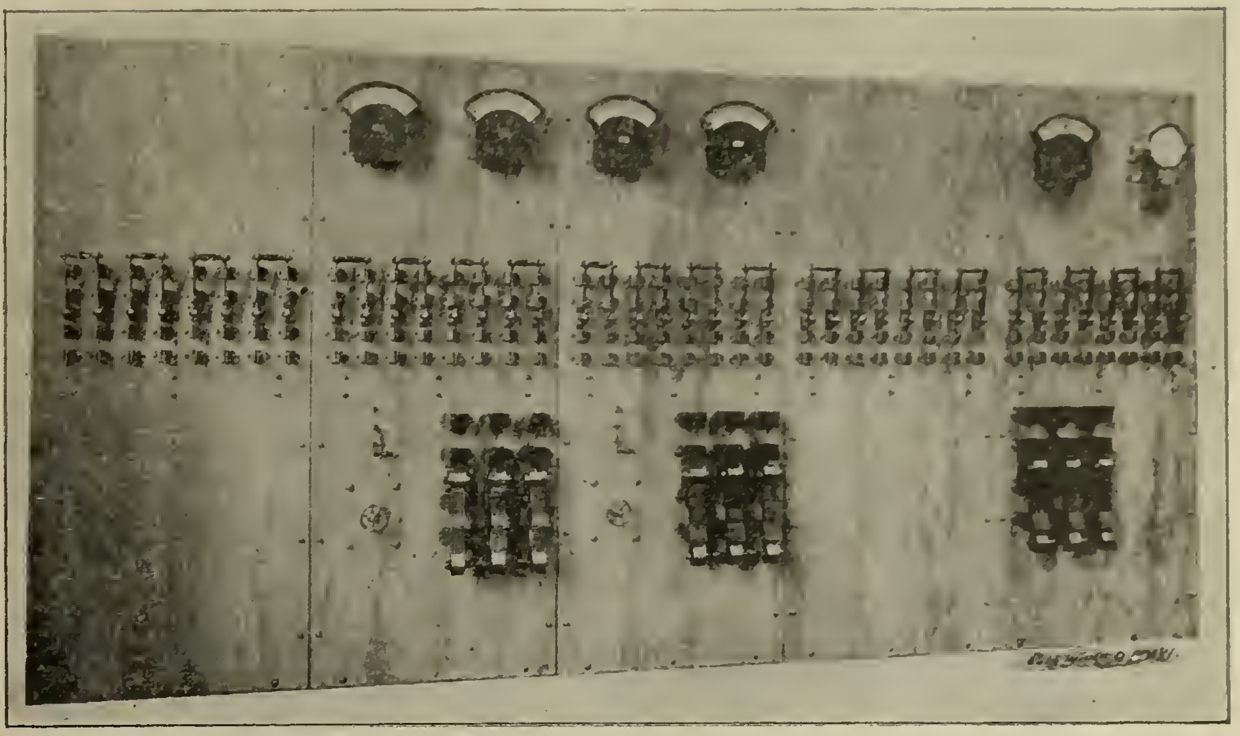
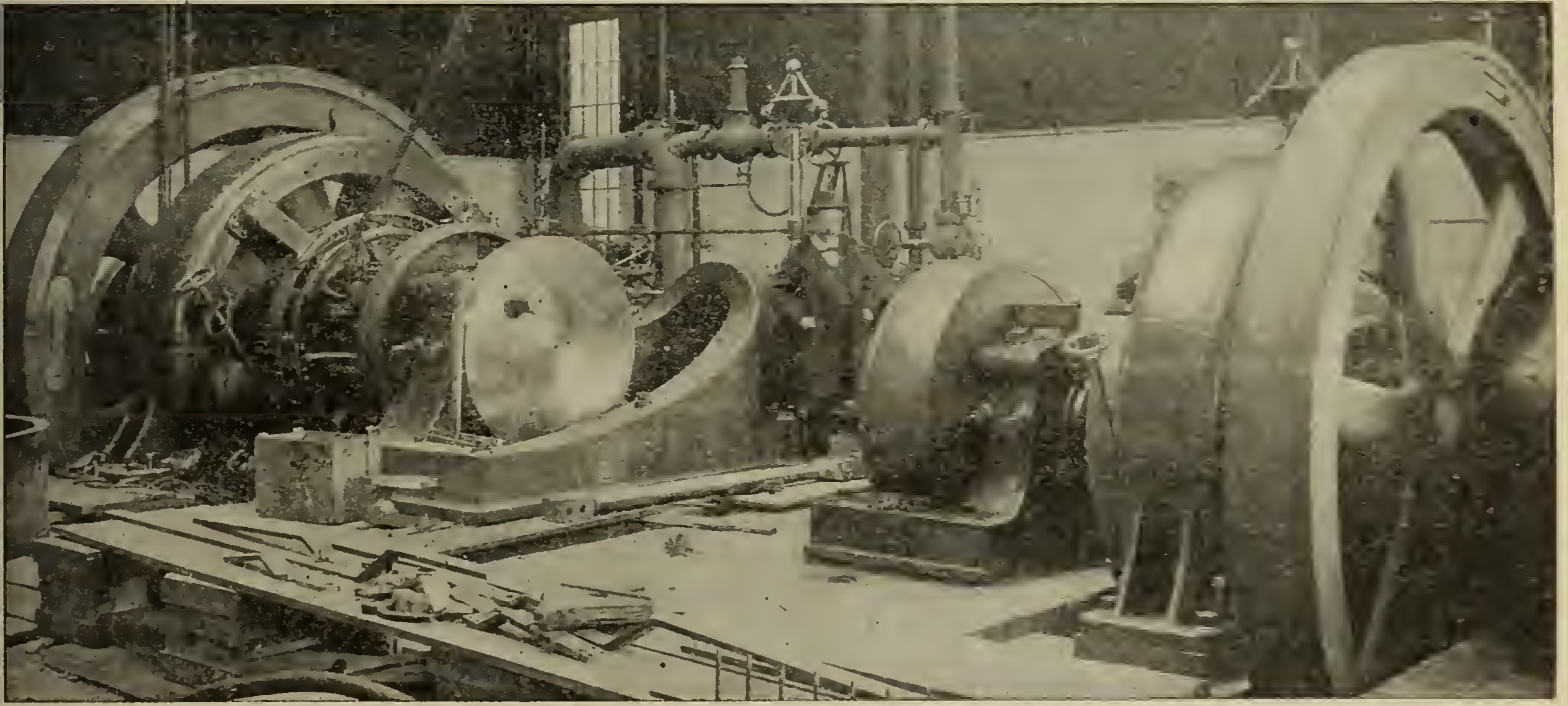
The Electrical Age.

Vol. XXI—No. 17 NEW YORK, APRIL 23, 1898 Whole No. 571



Front of new Switchboard for Government Printing Office, Washington, D. C. Crocker-Wheeler Electric Company,



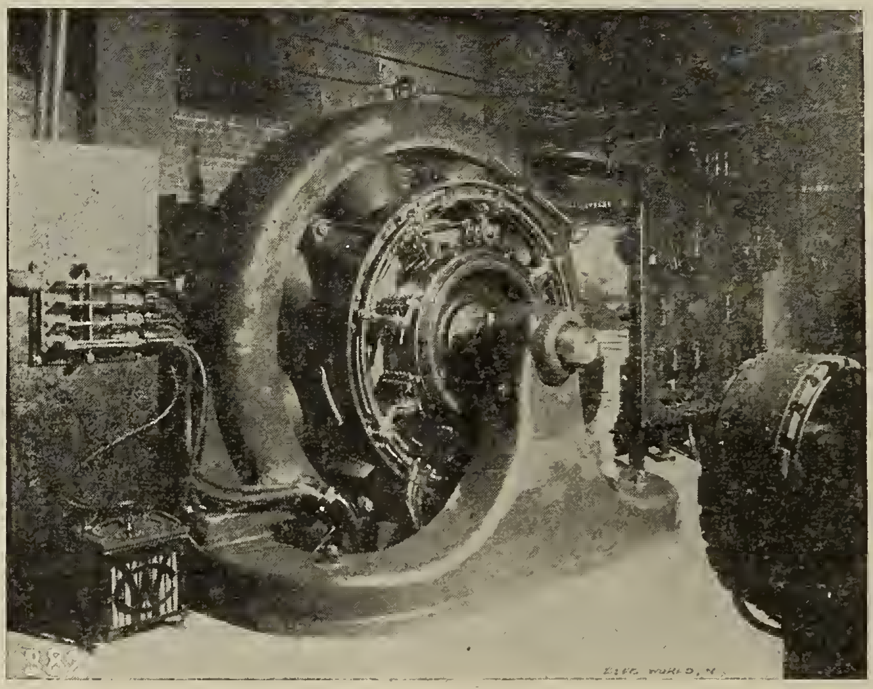
Dynamos and Engines in Power House of the Government Printing Office, Washington, D. C. Crocker-Wheeler Electric Company.

A WASHINGTON PLANT.

Since Dr. John Hopkinson, of England, announced in a paper read before the Royal Society of London the true principles upon which a design of the magnetic circuits could be based, investigations have been continued in this and other lines which have led to the construction of highly efficient motors and generators. It seems that but one man in Germany, named Froelich and an American, Prof. Rowland, of Johns Hopkins University, were acquainted with the principle of magnetic design. But unfortunately their interpretation of these principles gave to the scientific world so complex a series of formulæ, containing such constants and variables as to prevent their extended use for practical purposes. The reconstruction of this department of the science was carefully attended to by Dr. John Hopkinson who, formulated the law that the total number of lines of force produced in a circuit of magnetizable material depends directly upon the magneto-motive force and inversely upon those constituents contained under the head of reluctance. The perfection of magnetic and electrical design owes its finishing touches as much to Hopkinson for the practical results obtained as to Edison, Siemens or Kapp. In the illustrations appended to this article the principles of electrical engineering have been carefully followed out.

The Astoria Hotel, of 34th street, New York, has operating in its basement an enormous blower run by a ninety horse power Crocker-Wheeler motor. This machine, of course, runs at a constant load, and the care or attention which it receives after having been started is practically nothing. It runs cool, is efficient, and will probably perform its functions for years to come without any further expense.

At the Government Printing Office the Crocker-Wheeler Electric Company have installed a plant, which, as represented, sends current throughout the building for light and power. In this building all printed documents relating to the National Government and Consular Reports are prepared for distribution. The switchboard of this plant operates twenty distinct circuits, which control the various floors and subdivisions of power. Slow-speed multipolar dynamos have been installed and, in addition, to drive the dynamos, a steam plant, which, in conjunction with the electrical equipment, has required little or no attention from the first day of its operation. The massive frame, slow speed, sparklessness and high efficiency of these generators have earned for them a lasting reputation in the Capitol.



Special 90 H.-P. size 170 Motor, Direct-Connected to Blower at Astoria Hotel. Crocker-Wheeler Electric Company.

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from page 217.)

These experiments mark the discovery of electro-magnetism, and began one of the most important eras in electrical discovery, the work which has been participated in by many eminent authorities. Among the many advances may be mentioned the experiments of Henry on the relative effects of different windings on the strength of an electro-magnet. He deduced the fact that the magnetizing action might be increased either by increasing the number of windings, the current remaining the same, or by increasing the current, the winding remaining the same. He pointed out the application of this to intensity and quantity arrangements of the battery, and also the importance of the intensity winding for the transmission of magnetizing power to a distance, as in telegraphy. The increased effect due to increasing the number of windings on the coil of a galvanoscope had been previously pointed out by Schweigger, and the discovery is embodied in Schweigger's galvanoscope.

In 1821 Faraday began his researches and many important discoveries were made by him. The main guiding idea in Faraday's work was the possibility of obtaining electricity from magnetism and in general the discovery of the inter-relation between the two. In this connection Arago's discovery of the rotation of a copper disk by the rotation of a magnet above it is of great importance, because, among other things, Faraday set himself to explain this. The result was the discovery of the commutatorless dynamo, or Faraday disk. In view of modern developments, probably the most important of Faraday's discoveries was that of the production of a current in a circuit when a current is either established or varied in strength in an adjacent circuit. This was followed by the discovery that relative motion of two circuits, one of which carried a current, produced a current in the other, and that the motion of a magnet in the neighborhood of a circuit produced a current in the circuit. Another important discovery by Faraday was that of the quantitative laws which govern electrolytic decomposition, thus giving us our electro-chemical equivalents.

At this time Lenz was led by experiment to the discovery of his celebrated law of induction, namely, that the current produced always in turn produces forces tending to oppose the change. For example, if a current be induced in a coil by bringing a magnet towards it the mutual action between the magnet and the current is to oppose the magnet's approach. This is important when looked at from the point of view of the conservation of enerrgy or as an argument against perpetual motion. Lenz's law is, of course, when the actions are properly understood, a consequence of Newton's third law of motion.

Discoveries similar to those of Faraday as to induced currents were made almost simultaneously by Henry in this country. We have in the discoveries of Faraday and Henry the fundamental information required for nearly the whole of our recent developments in dynamo-electric generators and electric motors, but it was reserved for the next generation to develop them. This development we owe in no small degree to the splendid exposition of Faraday's discoveries and their consequences contained in Maxwell's book on electricity and magnetism.

Going back for a moment to 1822 we have to notice another important discovery, namely, the thermoelectric couple by Seebeck. There followed almost immediately the important experiment of Cumming, who showed that the thermoelectric order of the metals is not the same at all temperatures.

The next important discovery in thermoelectricity was that of Peltier, of the heat generated at the junction of two metals when a current is forced across it against the e. m. f. of the junction. In later years we have the classic researches of Thomson (Kelvin), who added thermoelectric convection and the specific heat of electricity and gave the thermoelectric diagram method of representing results. This method was afterwards used and extended by Tait, who added a good deal to our knowledge of thermoelectric data. Among the large number of others who have worked in this field we may mention Becquerel, Magnus, Matthieson, Leroux and Avenarius. Thermoelectric batteries of considerable power have been made by Clamond and others.

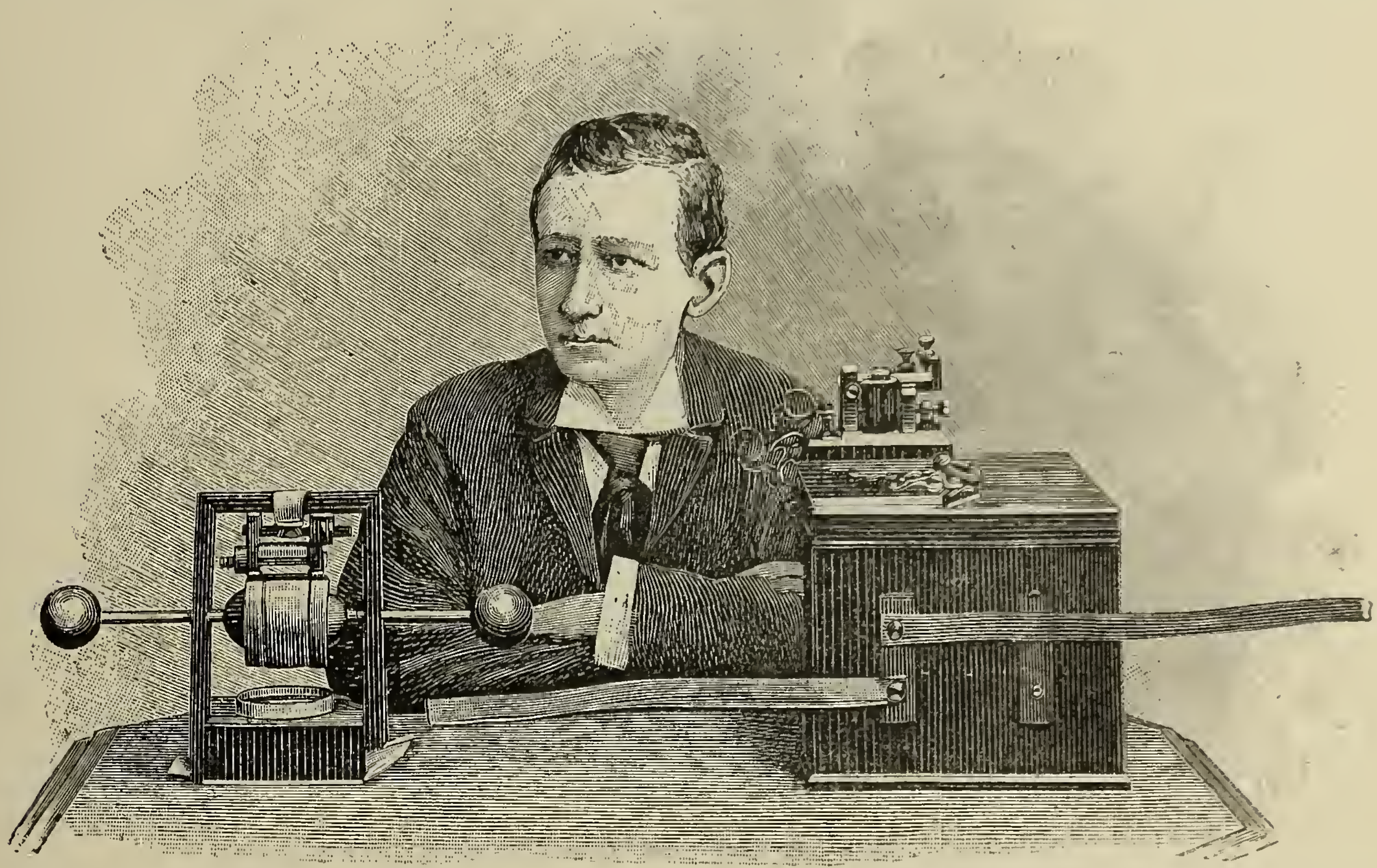
(To be continued.)

W. J. CLARKE ON WIRELESS TELEGRAPHY.

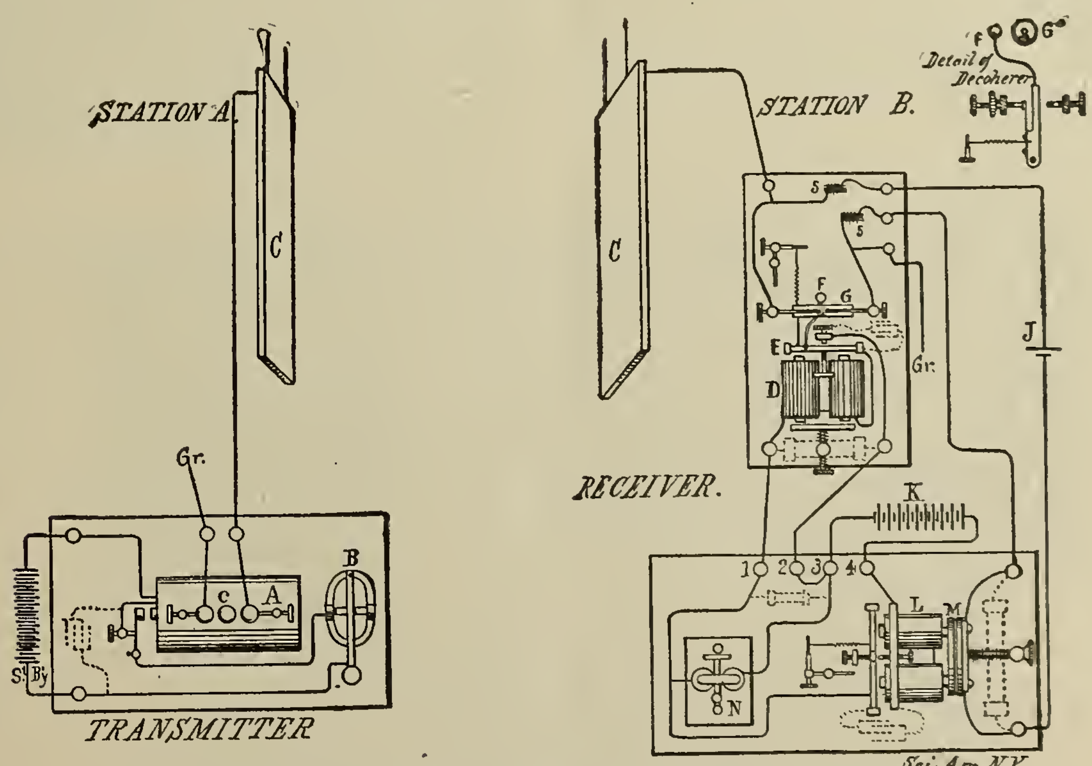
BEFORE THE NEW YORK ELECTRICAL SOCIETY.

Mr. President and Gentlemen:—In commencing this evening I will first of all describe to you the work of my predecessors in the line of wireless telegraphy before telling you what I have myself accomplished during the last few months. Here we have a portrait of Guiglielmo Marconi, who claims to be the inventor of wireless telegraphy. He is a young Italian, now a resident of London, England, and he certainly deserves credit for having accomplished a great deal in this direction, although he has made use of methods and principles which were well known for many years. We will now show you Marconi and his instrument. The transmitter is shown on the right of the picture, and the receiver upon the left. You will notice that all of the apparatus in the receiver is enclosed in an iron box, with the exception of the telegraph sounder. This is done for the purpose of showing that the electric waves will penetrate a mass of solid iron. You now have before you an enlarged diagram of connections showing the method used by Marconi in transmitting signals.

Here in the upper part of the diagram is the primary of an induction coil, which is operated by means of a small storage battery, and in the circuit of which is a Morse key. The secondary of this coil is connected, as you will see, to these two brass balls, which are about an inch and a half in diameter, and placed at a distance of about an inch and a half from these two large brass balls, which are about four inches in diameter; these latter balls are separated from each other by about one-thirtieth of an inch, and their inner hemispheres are enclosed within this heavy rubber tube, d, which is filled with a superior quality of vaseline oil. When the Morse key in the primary of the induction coil is closed, sparks pass across



Wireless Telegraphy Outfit of William Marconi.



Connections showing use of plates with Transmitter and Receiver.

between all of these balls, and in doing so it will be seen that they have to pass through the bath of oil. These sparks produce electrical oscillations of high frequency, which, in turn, send out electrical waves into space. These waves travel along until they reach the receiving apparatus, which is shown here in the lower part of the picture.

The most essential part of the receiver consists of this small glass tube, d, about an inch and a half in length and one-thirtieth of an inch internal diameter. This tube is fitted with two plugs of silver tightly fitting, and separated in the centre of the tube by about one-thirtieth of an inch, the intervening space being partly filled with a mixture of nickel and silver filings. Two platinum wires are soldered to the outer ends of these silver plugs, and pass out through the ends of the tube, the glass being sealed down upon them, so that the air cannot possibly enter the tube, and the filings are thereby preserved from undue corrosion. Attached to each of the platinum wires leading out of the tube is what Marconi calls a wing, which is a metallic plate, W, about a half inch wide, and of such a length as to cause the receiver to be in what we might call "tune" with the transmitter. A small choking coil is attached to the outer end of each of the wings, and the whole is then placed in circuit with this one cell of battery and high resistance telegraph relay, whose contact operates this telegraph sounder, by means of this local battery.

Now when the filings in the glass tube are lying in their normal state they present a resistance to the passage of the current varying from 10,000 to 20,000 ohms, but the moment that the key is pressed at the transmitting station and the sparks pass across the balls, the filings immediately cohere, and their resistance decreases to from seven to twenty-five ohms. This great decrease in resistance is, as you will see, sufficient to cause the current of the one cell of battery to pass through the circuit in sufficient quantity to operate the magnets of the relay, and so operate the sounder. It is found, however, that once the filings in the tube have responded to the waves from the transmitter, they remain in the same condition until such time as the tube has been struck a smart tap, when the filings immediately de-cohere, and the tube returns again to its high resistance. Now it is manifestly evident that, in order to transmit Morse signals, we must have some means of tapping the tube automatically. For this purpose Marconi makes use of this little vibrating arrangement attached to the sounder, the magnets of which are of very high resistance.

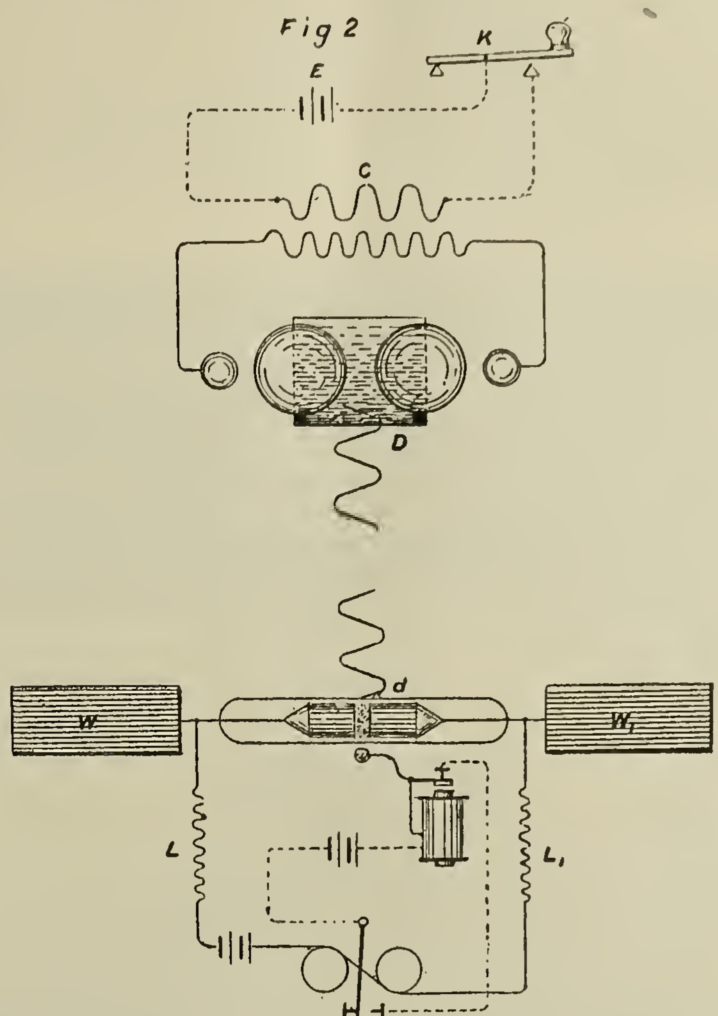
Now suppose that the key of the transmitting station is closed, the filings cohere, the relay pulls up its armature, closes the sounder circuit, and at the same instant sets the vibrator attached to the sounder in motion. The tapping of the vibrator against the tube tends to de-cohere the filings and raise the resistance, but everything is so adjusted that the waves from the distant station are just sufficiently powerful to keep the filings cohering, until such time as the key of the transmitter is raised, when the tapping of the vibrator instantly de-coheres the filings, the resistance goes up, the relay releases its armature, and the sounder and vibrator circuit is opened. In this way you will see that it is quite possible to transmit Morse signals, but, although Mr. Marconi has accomplished wonderful results with this piece of apparatus, which he has very ingeniously devised, it is not that class of apparatus which is suited to the American market, on account of the fact that it requires very sensitive adjustment and very careful management.

William Marconi.

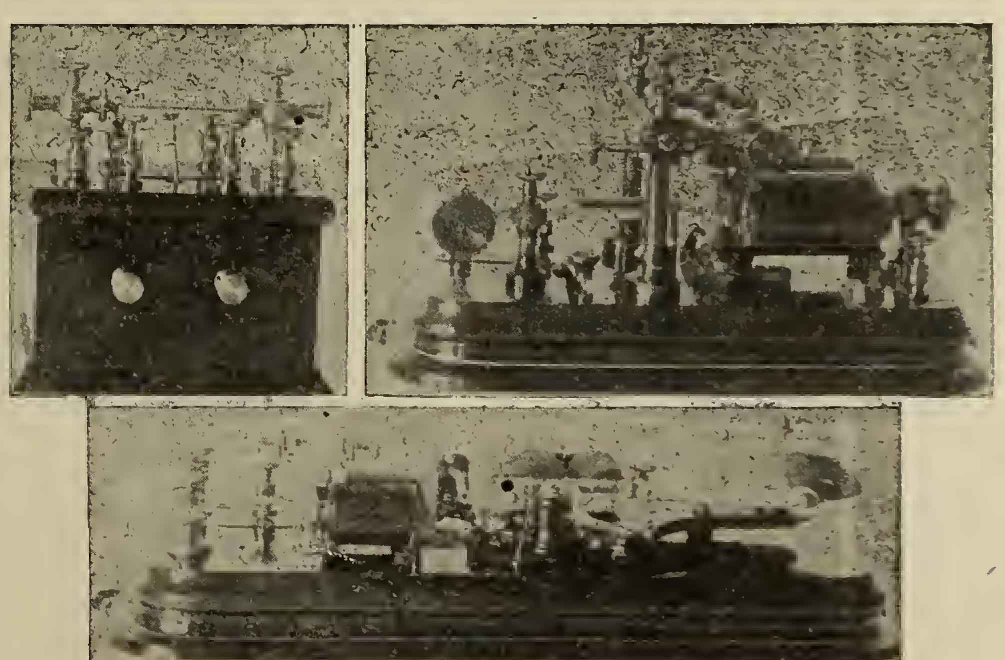
I will now describe to you some of my own improvements which I have been successful in making in this class of apparatus. I have designed two distinct sets, each consisting of transmitting and receiving devices. One set is capable of transmitting intelligible Morse signals, and the other is used where a cheaper class of apparatus is desired, and where it is only necessary to ring a vibrating bell or operate some similar piece of apparatus at the receiving station. The transmitter is the same in both cases, and consists, as you will see in the picture, of an induction coil specially wound, so as to give the most suitable kind of secondary spark. This coil is mounted upon a mahogany base, together with a specially arranged vibrating device and high-class Morse key, the condenser of the coil being so connected as to kill the spark at the key contact, as well as at the contact of the vibrator. On the upper part of the coil, you will see, are mounted two brass balls, which are one and a half inches in diameter, and arranged so that the distance between them can be adjusted within reasonable limits. When the coil is connected to a suitable battery and the key pressed, sparks will pass between these two balls, and electric waves will be sent out into space.

I find that the greater the distance between the balls the better the effect, provided, of course, that the sparks pass quite freely. I have discarded the use of oil altogether, except in very large transmitters for long-distance work. The transmitter illustrated here, with one-and-a half-inch balls, is capable of transmitting to reasonable distances, and is all that is required for the purpose of demonstration. The receiver consists of two separate instruments, the de-cohering apparatus mounted upon one base, and a special relay and sounder, together with suitable switches and connections, mounted upon another base. Here we have the de-cohering apparatus. The coherer consists of a glass tube about two inches in length fitted with two brass plugs, arranged with ring and screw adjustments to each, so that the distances between the plugs in the tube and their pressure upon the filings can be readily adjusted at will. The magnets of the de-coherer are specially wound, so as to overcome the effect on the tube of too much self-induction. Every desirable adjustment is provided for, so that not only can we adjust the distance between the magnets and the vibrating armature, but also the tension of the spring on the front of the armature, and the distance through which the armature vibrates.

In this way we are able to so adjust the coherer that the vibrating armature will strike the tube with just the proper strength of blow, so that the filings will not decohere except on the instant that the key is raised at the transmitting station, and, on the other hand, the plugs in the tubes are so adjusted that the filings will immediately cohere when the electrical waves strike the tube, on the key of the transmitter being pressed. The relay in this case, which you will see in the next picture, is wound to a very high resistance, and is placed in series with the glass tube and one cell of dry battery. Its armature is made as light as possible, so as to respond to the most feeble current, and its local contacts are so arranged as to operate the telegraph sounder, and the de-cohering apparatus in multiple, using about twelve cells of dry battery. Here we have the de-cohering apparatus used in the cheaper set of instruments; it is not provided with as many adjustments as the more expensive sets, but these are not found to be necessary where it is only required to operate a sig-



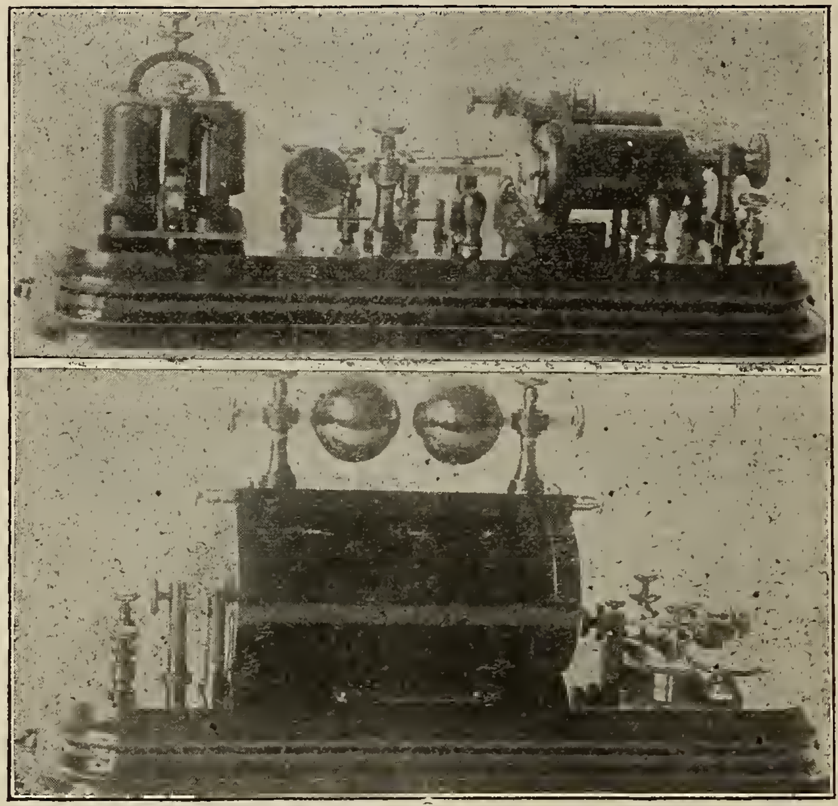
Diagrammatic View of Key, Coil, Transmitter, Coherer, Relay and Decoherer.



Mr. W. J. Clarke's Apparatus for Wireless Telegraphy.

nal similar to a vibrating bell. The relay used in this set, as you will see, is also of a smaller pattern, and is not provided with any means of adjusting the distance between the armature and the magnet cores, these adjustments having to be made by means of the screws at the back and front of the armature. The relay in this case is mounted on the same base with the electric bell or buzzer which it is intended to operate, and the whole outfit gives excellent results for signalling of this kind.

I wish to say here that I have found it necessary to have a special form of dry battery made for this purpose, it being so constructed as not to deteriorate for a very long time, but at the same time it is only intended to be used with apparatus of this kind, where a very small amount of current is required. I will now give one of our diagrams showing all the connections of our best apparatus.



Latest Outfit for Wireless Telegraphy of Mr. W. J. Clarke.

The connections and arrangements of the transmitter which you see upon your left at station A, are so apparent that it will not be necessary for me to describe them further than to call your attention to the manner in which the condenser is connected, so as to include the Morse key, as well as the vibrating contacts. You will notice in this transmitter three brass balls, C, mounted upon the top of the coil; these balls are about ¾ of an inch in diameter, but, as previously explained, we are now using only two balls of 1½ inches in diameter, and I think we obtain considerably better results. One terminal of the transmitter is, as you will see, connected to the ground and the other to plate C, which should be placed as high in the air as possible, and very carefully insulated together with the wire leading to it from the coil. Now coming to the transmitter at station B, we will commence at battery J, and trace the circuit upwards to the binding-post of the de-cohering apparatus. From this post it passes through the choking coil S, and across to one of the plugs in the glass tube; from the other side of the tube it goes down to the other choking coil, and thence runs direct to one of the binding posts of the high resistance relay L, after passing through the magnets of which it returns to the battery J. You will further see that one terminal of the glass tube is connected to the ground and the other to plate C, which is placed opposite to and parallel to plate C of the transmitter. Now it is evident, that if the resistance of the filings in the tube decreases to any considerable extent, the current from the battery J will pass through the magnets of the relay L and energize them. The magnets will now pull up the relay armature and close the local contact, and in order that you may see clearly what then occurs, we will trace out the circuit of local battery K. Beginning on the right the wire leads to binding-post 4 of the receiver; thence to the front contact of the relay across the contact to the armature; from the armature over to the sounder N, and from the sounder to post No. 3, and thence back to the battery, the magnets D of the de-cohering apparatus being placed in multiple with the sounder N, through the binding-posts 1 and 2 of the receiver. In this way you will understand that when the armature of relay L is pulled up, the sounder N gives the down click, and the de-cohering apparatus D begins to vibrate rapidly, the hammer F striking the glass tube with just that kind of blow required to de-cohere the filings the instant the waves cease coming from the distant station, and the moment the filings de-cohere the circuit of the relay L is opened, the armature drops away, the sounder N gives its up click, and the de-cohering apparatus D ceases to vibrate.

In this next picture we have a diagram of the receiver C, used for operating an electric vibrating bell or some similar signalling device. The only difference between this outfit and the one we have just described lies in the facts before stated, that the relay R is not provided with as many adjustments, and is not of such large size, and that the de-cohering apparatus is of a cheaper grade, and also not provided with as many adjustments. This outfit will readily operate the vibrating bell P as often as the key of the transmitter is pressed. It is, however, sometimes found that the bell will continue ringing for an instant after the key of the transmitter has been raised, but for bell signalling this makes little difference, while for Morse signalling it would cause serious trouble, and consequently, the high-class outfit is absolutely necessary where it is required to transmit Morse signals. For those who wish to experiment with the simple coherer, we supply one made up as shown in this next picture, provided with the same adjustments for the plugs in the glass tube as in the more expensive apparatus, and also with two binding-posts for connection through the choking coils, and two other bindings for connection to wings, or to the ground, and air-plate.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables.) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, APRIL 23, 1898.

CONTENTS.

DEATH BY HIGH PRESSURES.

A study of anatomy reveals the fact that high potential discharges attack not only the nervous system but the muscular tissues. A discussion has been aroused between certain physicists as to the true cause of death by electricity. Mr. A. W. Headley, in the London "Electrical Review," discusses the matter as follows: "Death as the result of electricity must occur in one of two ways. First, by mechanical lesions of vital structures, or, second, by arrest of organic functions essential to life, that is to say, by arrest of respiration, heart action, or nutrative exchanges. It is in persons killed by lightning that the first-named mechanical or disruptive effects are usually seen. Industrial currents kill in the second way, but even here the difference is rather quantitative than qualitative. * * * It is self-evident that disintegration of vital parts must cause death. Approaching the second class of cases, where death occurs by arrest of organic functions essential to life, the question broadens out, and it becomes necessary to enquire which of such functions is struck first. Where does death begin? What is the mechanism of death by electricity? At this point physiologists are no longer in accord."

A discussion of this nature is certainly best carried on by medical experts and not those engaged in the development of industrial arts. Yet it is possible for us to generalize and thereby lay down the causes of death as they seem to exist to us. In order to affect the vital centres, sufficient pressure is required to send a current of from one to two amperes through the human body, and it has been determined by a series of gruesome experiments beginning with Kemmler and others that consisted of secondary observations where death by accident had occurred that two thousand volts with fairly good connection will certainly cause death. In other words, we can come to the conclusion that it requires a certain amount of power to kill a man, which could be estimated by the product of two thousand volts into two amperes, namely, four kilo watts.

If the supply of current is great enough in any given case and the pressure exceeds one thousand volts, a shock may and may not cause instant death, whereas there is almost absolute certainty of death resulting from twice the pressure. If a given current is required which can only be obtained by a certain minimum pressure, then there are two classes of effects to be examined into. First, those resulting from the high pressure itself; second, the electro-chemical effects due to two amperes surging through the veins and arteries. One physician believes that dynamic apoplexy, as he calls it, caused by the rupture of innumerable capillaries in the brain, produces death; others that the respiration is prevented, and still others that believe the heart becomes paralyzed. As to the value of all this, we can only say that methods of resuscitation may be improved upon when the causes of death by high pressures are better known.

Mr. Headley's article shows a thorough acquaintance with the subject from a physiological standpoint, but if extermination can be traced to the effects of a given amount of power, then co-operation between the electrical engineer and medical investigator may lead more rapidly to definite and valuable conclusions.

LIQUIFIED AIR AND ELECTRICITY.

The Holland submarine boat has excited much interest in this country and abroad through its remarkable feats at each successive trial. It is acknowledged by naval experts to represent a form of defense which may ultimately be adopted by all civilized nations and prove of the utmost value in the protection of coasts and waterways. At present its equipment consists of a storage battery plant, gas engine, dynamo and gas tanks, in addition to receivers carrying compressed air for propelling torpedos. It seems that the stay of this vessel under water is limited, and the present difficulties experienced in its operation are caused by the varied complexities of its machinery. By installing tanks of liquified air and using this for purposes of propulsion, breathing and the projection of torpedos, many of these difficulties will disappear and a most valued addition made to the navy of the United States.

It seems as though the machinery on board could be greatly simplified through the use of liquid air and much space saved which is occupied at present by dynamo, gas engine, storage battery, tanks of compressed air, etc. To those on board, when submerged, at least this satisfaction would remain, that as long as there was power for machinery there would be air to breathe, and this in itself would relieve those that sailed in it of one of their greatest anxieties.

THE GREAT ADVANTAGE offered by the Merchants' Association to business men out of town when buying tickets to New York, pay one way and get a receipt from the ticket agent, for which the association will secure a return ticket for one-third (1-3) fare. This great inducement for business men to visit New York and see the Electric Show in May and make big purchases, saving carfare, is done at a great sacrifice by the members of the Merchants' Association. For all information, address Merchants' Association, New York Life Building, Broadway and Leonard street. The public is invited.

THE WOODBURY ENGINE direct-connected to C. W. generator 250 H. P., in the Pulitzer Building, has been running night and day for three months without any changes. Installed by Burnham & Granger, 136 Liberty street. This is the first one of three engines to be installed by them.

ELECTRIC ELEVATORS.

(Continued from page 220.)

House elevators have an automatic control, which includes the following features : push button, or buttons, on each floor to bring the car to the landing ; automatic locks, to prevent opening of the door except when the car is about level with the floor ; door switches, stopping the car if door is opened ; and a device preventing the operation or calling of the elevator by more than one person at a time. This control works with complete safety and satisfaction, with the various parts strongly and mechanically made. Small spring-and-trigger attachments are to be avoided, positive action, controlled electrically or mechanically, being substituted. Stopping the car is an important part of the control, and is accomplished by removal of power, brake and short-circuiting for heavy loads, and by the first and either of the other two for light loads. The difficulties are apparent ; a car must be brought to rest within a few feet under widely-differing conditions of speed and load, and this involves as well the stoppage of the hoisting machine, the counterweight, and the sheaves. For this reason with heavy loads a device compelling the car to do work in stopping is almost a necessity for safe and easy operation. For very high-speed machines still another device is used, which allows the brake-band to touch the pulley just before starting, causing the car to perform direct mechanical work, in addition to the electrical work caused by short-circuiting.

The use of a brake depends largely on the construction of the worm-gear. If this is of such a nature as to allow a loaded car to reverse its motion, a brake is a necessity for holding the elevator in position. If the gear will reverse only when actuated by the motor, the brake becomes an emergency stop, and short-circuiting, combined with the friction of the worm, is relied upon for ordinary occasions. This latter method involves the use of a worm-gear with a more acute angle of contact, entailing increased friction and decreased efficiency, and requires a larger current for the down-start and running. It has, however, an added element of safety.

Correct counterbalancing has an important bearing on the successful operation of the car. Efficiency and ease of running are in a degree opposed. Theoretically, that system will be under the best control which has the least inertia ; hence, the use of a counterweight tends to reduce the certainty of control, and this result increases with the speed. Practice has shown, however, that, so long as the car exerts one-quarter to one-half more downward force than the counterweight, no trouble need be feared. With the drum machine and a speed of 350 feet a minute or less, two counterweights may be employed, the car counterweight exerting two-thirds as much force as the car ununloaded, and the drum counterweight, the ropes of which wind on the drum in an opposite direction to the car ropes, exerting a force equal to that due to the unbalanced weight of the car and to the average load. Where lights or motors are to be supplied from the generators that supply the elevators, the question of economical operation gives precedence to steadiness of pressure, and it may prove advisable to have the counterweight balance one-half of the maximum load. In high buildings a varying counterweight must also be employed to allow for the change in the force exerted by the ropes, as the car moves up and down the shaft, and for the decrease in load in the upper portion of the building. This variable counterweight is a heavy chain, attached at one end to the bottom of the car, and at the other to the counterweight, or to an anchorage in the hoistway. With high-speed service the car should descend by its own weight, and should never be overbalanced. A system involving the opposite principle—i. e., a counterweight exerting a force greater than the car fully loaded—is in use, and should be condemned. The inertia of the system is nearly doubled, and, in case of accident and failure of safeties, the ropes are sure to break with the car at the top, dropping it the whole height of the building. With reduction of inertia in view, the counterweight for high-speed cars moves at only one-half or one-third the velocity of the car, the weight being increased in proportion. This reduces the total inertia of the system, and, in addition, decreases the cost of the counterweight guides and ropes.

The proper speed for a given building is one which will enable a trip up or down to be made in half a minute without stops. This figure will be modified to a certain extent by local conditions, but is a rough approximation. Apparently the speed should depend on the number of passengers to be carried, but this varying condition must be met by the size of the car, as there are certain periods of the day when the tenants all move, and high speed is of no advantage. Express elevators to the upper half or third of a tall building have been used with doubtful success. Crowding-out of lower-floor tenants is almost prevented, but a number of annoying features have arisen, such as restriction of ease of inter-communication, mistakes in cars, etc. In addition, during all but the "rush" hours, two cars are fulfilling the duty of one. Velocity of service is increased by floor calls and indicators showing the position of the cars. Variable speed is a necessity where the cars are required to run at certain distances apart, or where elevators are run from a lighting plant.

For high buildings, with elevators running from 350 to 700 feet per minute, the increase in the inertia of the system and in the probable and possible strains due to sudden stoppage must be met by increased cable strength, fixed and absolute limits of travel, an underbalanced car with a counterweight moving at one-half or one-third its speed, etc. These conditions are filled only by the hydraulic and screw electric machines. The worm-gear drum machine is unfitted for such work, as it has an endless character of movement, and can not have double or triple ropes on the drum, on account of the size of drum necessary and the impossibility of equalizing their work at the machine.

Continuation of Wiring for Light and Power.

The column obtained on the basis considered and the real value of the circular mils shows that the nearest size to this approximation will be satisfactory.

The development of a wiring system may be easily considered after the sizes of wire have been obtained.

Drop in Mains.—The drop in mains usually allowed is about five per cent., and in feeders and branches two per cent. The loss in the subways leading from the station to the door may be as much as ten per cent., and provided the pressure is kept constant no evil results follow. Variations in pressure in the subway, however well the place may be wired, will cause ruin and damage to the lamps. Either their pressure will fall very low or become too high and derease their life.

Testing.—A ground or a short circuit are two common faults in newly wired buildings. Wires imbedded in moist plaster will show a very low insulation resistance. The insulation test will bring to light the true condition of the building. This is reckoned by the underwriters at a minimum of three megohms (3,000,000 ohms). A Wheatstone bridge is employed for the purpose of localizing trouble. A short circuit will not only blow fuses continually, but show an exceedingly low resistance with the bridge. It may be in a chandelier, caused by crossed wires, or it might be due to defective cut-outs, etc. The blown fuse usually indicates the position of the fault. Grounds are shown by the great and in some cases abnormal decrease in the insulation of the wire. A wire of the bridge connected to a gaspipe and another to a main quickly determines the value of the insulation. When the building is free from grounds, short circuits and poor connections, and shows a proper and reasonable perfection, current may be applied to its lamp circuits without further delay.

QUESTIONS FOR REVIEW.

(1) What are the elements of an electric-light system?

(2) What precautions must be taken in laying wires?

(3) In wiring how may trouble be avoided?

(4) What are the principles to be followed in running lines? How is the size of wire calculated?

MEASUREMENT OF CANDLE-POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measurements of candle-power a great difficulty has been met with which, although partially overcome, still leaves the final settlement of it in doubt; that is, the use of a standard of light. A gas jet gives sixteen candle-power, an incandescent lamp sixteen, and possibly some oil lamps; but should either be adopted as a standard it is very difficult to keep track of the deterioration in light and feel secure, in using it, that no great error is made. In other words, we have no absolute standard of light, and therefore our methods, though perfect, have not a very accurate foundation. The use of a fixed standard is necessary. In order that a test can be made which will amount to more than an experienced guess, a good reliable standard which will not change very quickly is most desirable. The standards at present in use vary somewhat in their nature. The English candle has been looked upon as best for a long time, but opinions have been slowly changing. The use of other standards has become general, and the following sources of light for photometric tests tried with varying results:

STANDARDS OF LIGHT.

Carcel lamp,
British standard candle,
German standard candle,
Amyl-acetate lamp,
Pentane lamp.

The above are but a few of those that have been tried. One method that appeals to the electrical engineer is the heating of a strip of platinum to a given temperature by a known current, or the light emanating from a crater in an arc lamp. The paper entitled "Standards of Light," read before the American Institute of Electrical Engineers, May 20, 1896, is very complete, and treats this difficult problem in a masterly manner.

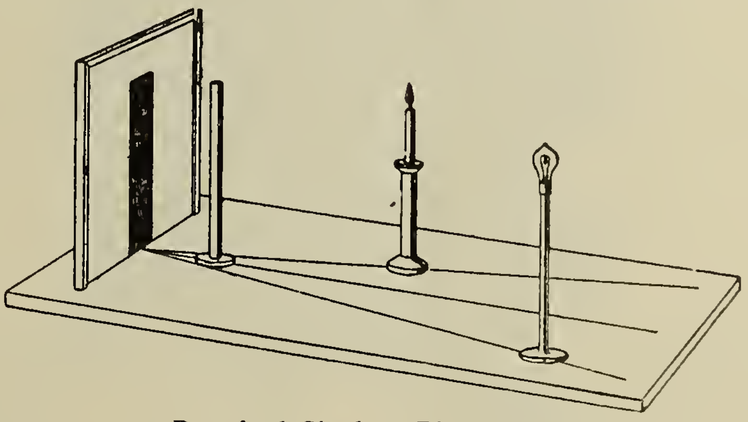
The standard that cannot be depended upon is the English candle; in fact, any source of light subject to such fluctuations and burning with such unsteadiness.

The standard must be of definite chemical composition as well as the medium around it. When a light has been produced that shows but slight variations, the problem of measuring light will be resolved down to a firm basis and become in every sense of the word a science.

In lamp factories a filament carefully made is selected and its candle-power, measured with all possible accuracy, used as a standard for the rest. A dark room is very essential for lamp tests. In any factory making illuminants, or apparatus for such, a photometer room is used constantly. It is simply a room shut off from all daylight. A scale is within; at one end the standard is placed, at the other the light to be measured. Either one is now kept stationary. The screen between with grease spot is used, as in the simplest photometer, for determining the equivalence of the intensity of light on each side. Rumford's photometer employed a screen and made use of the shadows thrown by the standard and other light as a means of comparison.

A stick mounted before a screen will throw two shadows, one due to the standard, the other caused by the unknown light; when both shadows are alike, the respective distances are compared. If the standard is one foot away and the other three feet, provided the shadows thrown are equal, the second is nine times as strong as the first, or nine candle-power.

Daylight is the light all scientists and inventors are striving to obtain. Their object is to produce light without heat, and thus illuminate city and home in the most perfect manner.



Rumford Shadow Photometer.

QUESTIONS FOR REVIEW.

(1) What is a standard of light?

(2) How many and what are the standards in use?

(3) By what reliable means may light be measured?

(4) What is a photometer?

INSULATION AND CONDUCTION.

(Continued from page 212.)

In the formulæ, the valency was introduced. This term has no definite meaning, as the valency varies with the compound. Consider the writer's chart of the elements (Fig. 3), a modification of those of Meyer, Newlands and others. On one side are seen the metals of the arts. Above them in vertical rows are marked the figures 1, 2, 3, 4, etc. These figures indicate the number of chemical linkages which as a general rule the elements under the figures tend to take up. But there is no very definite rule.

Among the univalent metals some unite with bivalent atoms, as does copper, and in general all that can be said is, that a certain valency holds generally and not in general. Consequently, when we find that by taking a group of metals having very closely the same values of Young's modulus, as, for instance, gold, silver and aluminium, their conductivities are, within the limits of errors of observation, proportional to the velocity of sound ÷ valency; and that in any of the group of metals having the same valency the conductivity is directly proportional to the velocity of sound, within experimental errors, we are to a certain extent justified in making a choice of valencies when this is needed. Fortunately, however, this only occurs in two cases:

1st, we must suppose copper to have twice the valency of silver, which we might, a priori, have granted, for, though they are in the same group, yet copper has markedly through all its salts twice the valency that silver has. 2nd, that thallium has twice the valency of aluminium, a supposition which has no other justification than the fact that, since the formula holds in other cases where the valency are known, we have a certain right to use the formula to find the valency.

being the period of the heat wave. If this be proven by experiment we would have this relation: The electric conductivities are in the same ratio as the velocities of very short sound waves, being thus analogous to Maxwell's law for the velocity of light in insulators, in that the velocity varies with the periodicity.

We have seen above that the electric resistivity varies directly as the valency. Also it has been indicated that there is some evidence to show that the polymerization or plex varies as the valency Therefore we are led to assume that increase of resistance accompanies polymerization or the linking together of the atoms into groups.

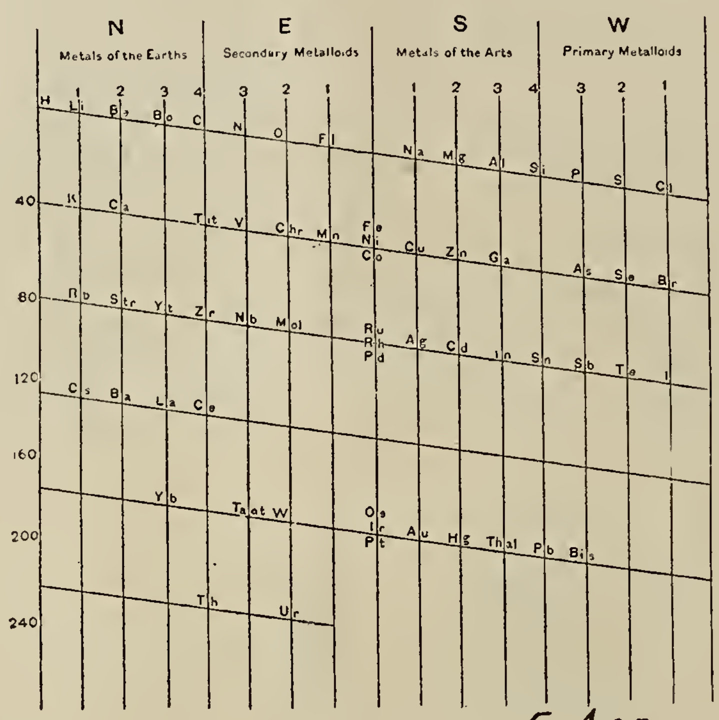


FIG. 3.

Now it is well known, especially from facts in organic chemistry, that similar atoms or molecules can combine together to form what are called polymerized substances. For instance, three molecules of $C_2 H_2$ acetylene can form one molecule of benzol, $C_6 H_6$. In general, we find that these polymerized compounds are more crystalline and have higher melting points than the original substance. Also we note that the number of atoms in such a polymer is generally a multiple of the valency of the atom. Carbon, for instance, seems to prefer to go in groups of four.

Considering now the table of elements, we see that as we pass along from row to row, and as the valency increases, the substances get more crystalline and in many ways evince a linking together.

1st. As mentioned, they are crystalline.

2nd. Their specific heats get abnormally low, this indicating that they are polymerized, or plexed.

3d. They are capable of existing in allotropic forms.

4th. Their vapor densities show that several atoms are jointed together into one molecule, and hence they are almost certainly polymerized as solids, since the general tendency of heat is to disassociate. Consequently, there is some evidence for the theory that metalloids differ only from metals in that they have a greater tendency to polymerize from their higher valencies, which are probably in some way dependent upon the shapes of the atoms, and are so more crystalline, etc.

We might therefore look for some evidence of polymerization among the metals. This is readily found, as before, from the variation of the specific heat from its theoretical value. If this linkage were but loose, it is evident that it might affect the specific heat but little, and yet have a marked effect on other phenomena. For instance, we might suppose that it would affect long sound waves less than short ones.*

We might therefore consider that when the period of a sound wave coincides with that of the molecules, it is a heat wave; the period of the amplitude of the sound wave

We see that this might hinder the transmission in various ways, since the groups would not vibrate so quickly as the single atoms, and there would be fewer of them per unit cross-section. Anything, therefore, which tends to give molecular complexity tends to give high resistance; hence we see why alloys are generally higher in resistance than the average of their components.

The resistance increases with density and molecular complexity and inversely with the elasticity. Consequently, whether a resistance increases or decreases with temperature will depend upon whether the molecular union is weakened at a less or greater rate than the elasticity falls off.

In getting a concept of this we may consider a conductor as analogous to a government department, the different atoms or officials being bound together into groups by valency bonds, the analogue to which is evidently "red tape." The rate at which a given impulse is handed on will evidently depend inversely upon the amount of red tape and the density, or stupidity, of the individual official. The two causes are often confused.

We must, therefore, for solid insulation, get substances which are strongly linked together, of great density, and of small modulus of elasticity. The first is the property which varies most, since density and elasticity vary between comparatively narrow limits.

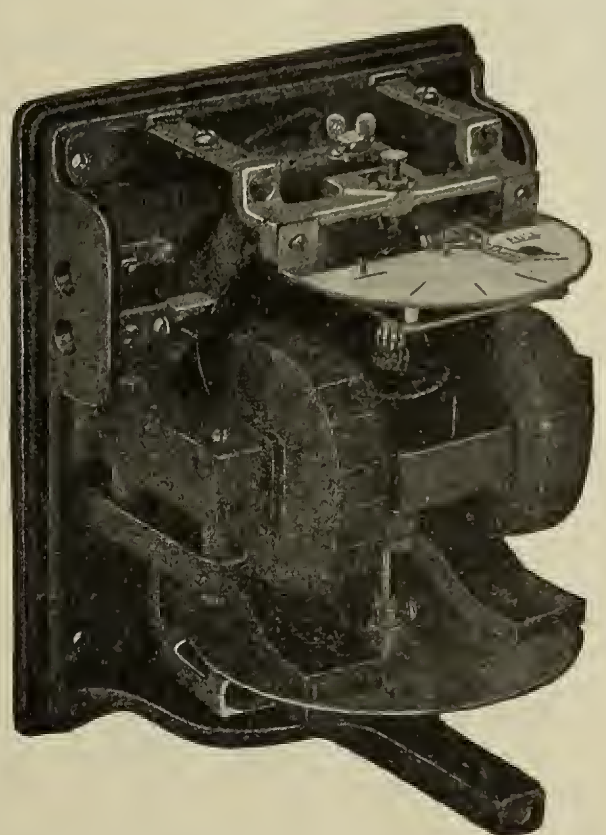
(To be continued.)

* The writer ventures to suggest that the velocity of very short waves of sound in copper may be found somewhat less than half of that given now for audible tones, while that of lead may be reduced to but one-eighth of its value as given at present.

THE THOMSON RECORDING STORAGE BATTERY METER.

The increasing application of storage batteries, consequent on their perfection, to electric light and railway station use, as well as to street cars, motor carriages, electric launches, etc., where a portable source of power s requisite, has led the General Electric Company to develop a special type of meter, which will show at a glance the amount of energy available in the battery. The Thomson Recording Storage Battery Meter resembles, in general appearance, the standard Thomson Recording Watt-Meter, and is, in fact, a development from it, the mechanism being almost exactly similar. The accuracy and durability characteristic of the standard type have both been maintained, while additional precaution is provided against injury from shock or vibration. The meter is provided with a single indicating needle moving over a horizontal semi-circular dial.

The essential requirement for a storage battery meter is that the armature shall rotate in either direction and give equally accurate readings in both. In this meter



Thomson Recording Storage Battery Motor.

this requisite is fully preserved. The energy put into the cells is, therefore, added to the reading of the meter, while the energy withdrawn is subtracted, but to compensate for the loss in the cells the meter runs more slowly when charging. The reading of the meter represents not the amount of energy put into the battery, but the amount available, and when the needle points to zero on the dial it shows that the battery is completely discharged.

For motor carriage, street car and electric launch service a meter of this character is a most necessary adjunct. Indeed, any of these vehicles of transportation not equipped with a device to warn the operator of the amount of current available to carry him forward on his journey or to bring him back to his starting point would be incomplete. Without it he is absolutely ignorant of the power upon which he can depend, and would run serious risk of finding himself at a stand-stall far from home with no means of getting either forward or backward without recourse to some mechanical method.

The durability and efficient operation of storage cells being maintained by re-charging them before they are exhausted, the only method of learning of their exact condition is by a meter of this character. The cells being recharged at the right time, the general result is a much higher battery economy.

These meters are manufactured with any desired percentage difference between charging and discharging rates, and in all of the standard sizes in which two-wire Thomson Recording Watt Meters are built. Since, however, this percentage varies in almost every case, the General Electric Company manufactures them only to order. One size, that reading to 50 amperes, however, may be considered as standard, and will be more promptly furnished than any other.

A GREAT DEAL OF PUBLIC INTEREST attaches to the work which Mr. Edison has been doing for some few years past in magnetic ore separation, and the general curiosity on the subject will be satisfied at the approaching exhibition, where Mr. Edison will actually exhibit a model built for him by Mr. Sigmund Bergmann, which illustrates admirably the fundamental principle of the process. This model will be kept running by a small motor, and the iron will be continuously separated from the crushed rock in full view. Mr. W. S. Mallory, the manager of Mr. Edison's mining works, is sending to the exhibition samples of crushed rock in its various stages, as well as samples of the separated ore and of the briquettes which are sent to the furnace. He is supplementing this by some four or five-ton masses of rock, which Mr. Edison takes bodily out of the hillside by means of huge excavators, and the magnetic condition of these ponderous masses will be shown and tested by magnets. Around the exhibit will be placed photographs illustrative of the scenes at the mines themselves, and the whole will constitute one of the most instructive demonstrations possible. This valuable exhibit will be placed along one side of the concert hall of the Garden, in company with a number of very interesting special features, which have already been arranged for.

THE SPRAGUE AUTOMATIC HOUSE ELEVATORS are being received with a great deal of favor, and many wealthy men of New York city and elsewhere are placing them in their houses. The machine in its construction embodies a number of highly ingenious features in its method of control, which is entirely automatic. By means of its devices, the machine may be operated from any floor, or from the car itself. By merely pushing a button from any floor, the car is brought to that particular floor without any further manipulation of the controlling apparatus, and when a door is opened it is impossible to operate the machine from any other point, or until the car has reached its destination, and the landing door finally closed. While the car is in operation, it is impossible to operate any of the buttons aside from the one initially connected, and there is also a mechanical locking device at each door preventing its operation except when the car is at corresponding landing. The simplicity and absolute safety of this machine is the great reason for its success.

MADISON SQUARE GARDEN.

ELECTRICAL MODEL-MAKING COMPETITION FOR AMATEURS

At the request of the management of the Electrical Exhibition, the special committee named below has organized an Amateur Electrical Model-Making Competition with the object of promoting general interest in electrical handicrafts, and of recognizing the work done in that branch of industrial study by individuals or by institutions.

The rules for this competition, the classes, and the awards, are set forth below:

1. The title of the contest to be as above.

2. The objects entered shall be on view throughout the Exhibition, but shall be adjudged by experts the first week.

3. All objects shall be entered under the name of the amateur, student, or students, or instructor.

4. All individual exhibitors, or collective exhibitors, shall make a written statement as to the work being their own, and shall send in also a certificate of good faith signed by clergymen, schoolmasters, justice of the peace, editor, or well-known citizen.

5. The exhibits shall be grouped in a space set aside for them, and shall be fully labeled. Prize awards shall be added as soon as possible to the labels.

6. None of the exhibits shall have been made for sale, or during hours of work in shop, for wages.

7. The judges shall consist of a committee of five, two from the Auxiliary Committee, two from the New York Electrical Society, and a fifth selected by the Exhibition Management, agreeable to the four. The judges to select their own chairman, who shall report the awards made.

8. The objects shall be sent in or delivered by hand, addressed to the Manager of the Electrical Exhibition, Madison Square Garden, not later than the Monday (April 25) preceding the opening of the Exhibition, and labeled "Amateur Electrical Model-Making Competition."

9. Exhibits shall as far possible be operative.

10. The judges need not award the full amount of any prize if the exhibits do not come up to their standard.

11. No exhibit shall be removed during the continuance of the Exhibition.

12. No competitor in this contest shall be admitted who is over 21 years of age, or who is already manufacturing such articles as a means of livelihood. This does not apply to the group of teachers in Class F.

13. The prizes shall be awarded and declared as soon as possible after the opening of the Exhibition, and an evening shall be set apart for presentation of the prizes.

14. There shall be Six Classes of Exhibit, with bronze medals, and a sum not to exceed $50, for each class.

15. The classes are to be as follows:

Class A. Working model, or actual machine of a dynamo-electric or electro-dynamic type, made by one or more boys under 21, so far as designing, lathe work, assembling and finishing is concerned.

Class B. Instrument of precision, made by amateur or student, such as galvanometers, resistance bridges, electrometers, etc.

Class C. Practical application of electricity to communication, the assembling and finishing to have been the work of a single exhibitor (telephones, sounders, etc.).

Class D. Ingenious application of electrical appliances to domestic, etc., uses, by an amateur under 18; none of the parts of the apparatus to be necessarily of home manufacture.

Class E. Design, or working drawing, of an electrical appliance or installation, made within the past twelvemonth by a student of a recognized chartered institution and bearing the instructor's certificate as to its bona fides.

Class F. Design or instrument made by a teacher, below the grade of college professor, for illustrating some electrical law.

Prof. Morris Loeb,
New York University.
Dr. W. E. Geyer,
Stevens' Institute of Technology, Hoboken, N. J.
Dr. C. A. Doremus,
College of the City of New York.
T. C. Martin,
Chairman Auxiliary and Educational Committee.

NEW YORK NOTES.

CRAGE & TENCH, of Buffalo, have secured the contract for building the Lima & Honeoye Falls Electric Railroad. The contract also includes the wiring of the streets of both villages for electric lights, and the construction of the power-house. A large force of men will be put to work on the job next week.

THE EDISON MANUFACTURING CO. have removed from 110 East 93d street to larger and more commodious quarters in St. James Building, Broadway and 96th street.

LOUIS B. HETTY, dealer in electrical supplies, San Francisco, Cal., is in town.

A. W. TUCKER, the popular representative of the Western Electric Co. of Chicago, Ill., was in town, last week, taking orders for fall trade.

HENRY C. THOMSON, Genl. Manager of Electric Gas Lighting Co. of Boston, Mass, was in town this week.

THE BRADFORD BELTING CO. of Cincinnati, Ohio, Manufacturers and Importers, and Jobbers of Electrical Supplies, R. F. Johnson, Eastern representative, office, 15 Cortlandt street, N. Y. They have just secured the order to equip the extension of the People's Light & Power Co., Jersey City plant with a duplicate of the order they filled for this plant in 1897. The largest belt in the world was placed here by the Bradford Co., measuring 165 feet long, 80 inches wide, three hides thick.

The Electrical Age.

VOL. XXI—No. 18 NEW YORK, APRIL 30, 1898 WHOLE No. 572

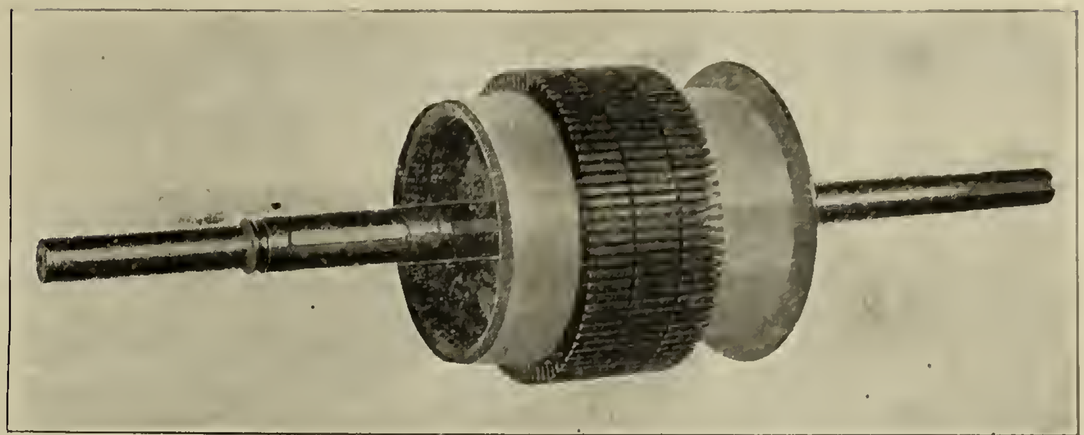


Fig. 1—Iron Core of G. E Armature.

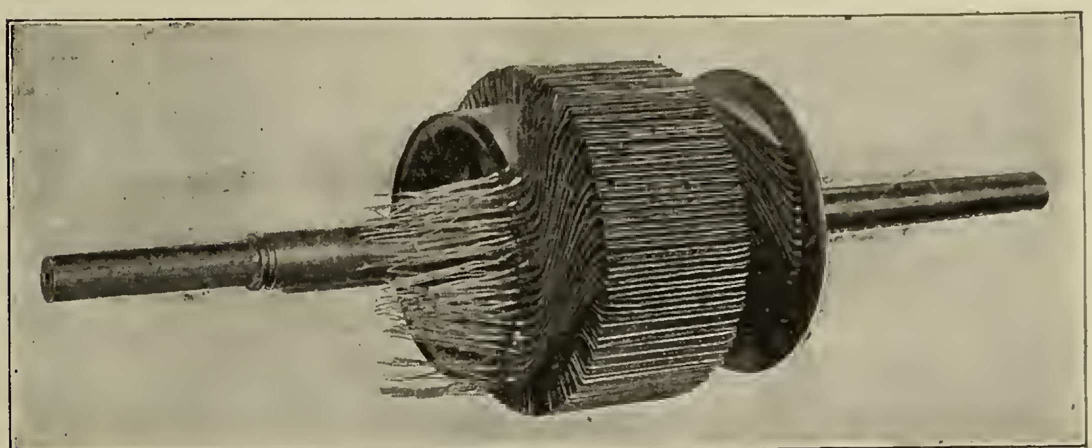


Fig. 2—Method of Applying Coils on G. E. Armature.

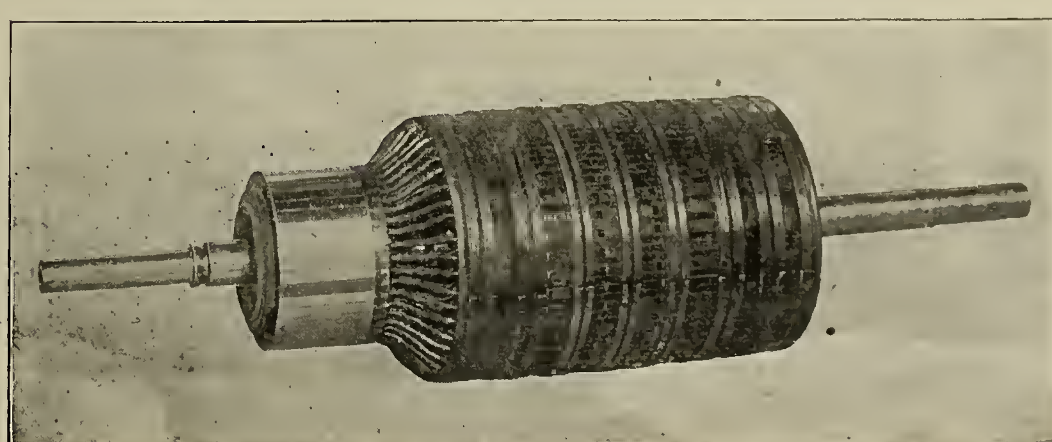


Fig. 3—Complete G. E. Armature.

ARMATURE CONSTRUCTION.

In the construction of the armatures of all direct-current generators and motors built by the General Electric Co., special care is taken in the production of as perfect and durable a part as possible without sacrificing any detail essential to efficiency and perfect operation. New ideas have been incorporated, and old and tried features retained; the wire, iron and copper must reach a certain standard of excellence or be rejected; each step in construction is carefully inspected, and the completed armature is subjected to a test many times more severe than the severest conditions which would be met with in actual service. Nothing is left to chance.

In the armatures of the new type of slow and moderate speed direct-current generators and motors these characteristic features are strikingly apparent. The completed armature is a slotted body of barrel shape so built that no part is susceptible to movement or vibration. There are no sharp bends to the wires over sharp metallic edges, and each coil is so laid on the core that the outer periphery of the core itself affords it complete protection from mechanical injury.

The spider castings holding the slotted sheet-iron laminations, are extended into cylindrical flanges at both ends. The coils previously shaped on a form are laid in the slots, and the ends lie along these flanges at each end of the spider instead of being bent down sharply toward the shaft. The coils are formed and insulated before assembling on the core in order that, before application in their final position, they may undergo a careful test, and no coil is used that does not emerge from this with insulation intact. The insulation used is similar to that employed in the G. E. railway motors, and in the operation of these has given ample proof of its excellent qualities. It is tough, impervious to moisture and practically indestructible, except under abnormal overload, while it affords high resistance to puncture, rendering injury from lightning extremely improbable. The insulated coils are laid in place in insulated slots in the core and are simply pressed home. The advantage of this method, compared with that employed on an armature with the wire wound directly upon it, is obvious.

The cylindrical winding has many positive advantages. A very large radiating surface is provided for the conductors, and this, combined with special air-ducts for the passage of currents of air through the core from the interior outwards, tends to keep the armature cool; the length of wire is reduced to a minimum and consequently the losses due to armature resistance are also reduced, while the efficiency of the machine is greatly increased. The complete coil being formed separately and then applied, any one or more coils may readily be removed and replaced.

The coils are firmly secured in the slots on the cylindrical extensions so that no part can move or vibrate. Indeed, rigidity is one of the most important advantages of the cylindrical winding, since, without motion of the parts, neither injury nor deterioration of the insulation is likely to occur. The ends of the coils are curved down to the commutator, and the connections are so arranged that open circuiting is impossible. The illustrations show the three different steps in the construction of a General Electric slow and moderate speed generator armature from the completed core to the completed armature. Fig. 2 shows the method of applying the coil to the core.

A GIANT ELECTRIC TRAVELLING CRANE.

Since the unexcelled advantages resulting from the introduction and use of electricity in the arts and industries have been recognized, the use of heavy machinery for special purposes belongs no longer to the field of novelty, but to that of plain, every-day, up-to-date engineering. The Crocker-Wheeler Electric Company's works at Ampere, N. J., make use in their assembling department of a huge electric travelling crane, capable of lifting many hundreds of tons. At the iron works of Messrs. Post & McCord, Brooklyn, N. Y., a ten-ton derrick crane, run by a one-size ten C. W. single reduction motor on hoists and one-size three C. W. on trolley travel has been successfully installed and is at present in operation.

The convenience and economy resulting from the use of these innovations has been prominently advertised by the delighted owners thereof, which adds considerably to the gratification of those entrusted with the installment of such plants.

The Crocker-Wheeler Electric Company have made a great success of their derrick travelling cranes, etc., the number in use having increased very largely in the past year. Their own plant at Ampere is well equipped and will prove to be of great interest to manufacturers and the trade desiring further pointers.

10-Ton Derrick Crane at Iron Works of Messrs. Post & McCord, Brooklyn, N, Y. One size 10 C.-W. Single-Reduction Motor on Hoist and one size 3 C.-W. Motor on Trolley Travel.

NEW YORK ELECTRICAL SOCIETY.

In consequence of the illness of Prof. Sydney H. Short, and the fact that so many of the Society are engaged in active work on the Electrical Exhibition, it has been decided to give Prof. Short's lecture on "The Outlook of Heavy Electric Traction," during the Exhibition.

At the Electrical Exhibition there will be various demonstrations of scientific phenomena and principles by means of models and apparatus, which will be in more or less continuous operation. As the society has been entrusted with a great deal of the work of this kind it would like to secure from among its members the help of volunteers to take charge of various features from time to time; the duty will not be heavy, but will be made as light as possible

The first applications will be selected, preference being given, as far as possible, in case there be a large number of applicants, to students of educational institutions. The assignment to duty will be in the hands of a committee of the Society and the Exhibition Company, and the work of such members will be publicly recognized.

EXHIBIT OF HEBREW TECHNICAL INSTITUTE.

For some time past the Hebrew Technical Institute has made a great success of its instruction in the technical branches of electricity, as distinguished from the mere teaching in a manual or trade school. Evidence of the ability of the students under Mr. Ker will be given at the Exhibition, where opportunity is being afforded for an excellent display of the electrical engineering skill of the boys. Not only will a number of instruments be entered for the model-making competition, but these will be supplemented by other instruments and apparatus built by them to illustrate principles and phenomena. There will also be a complete small plant in operation lighting a small house. A collection of blue prints and photgraphs will also be included.

THE COMING TELEGRAPH TOURNAMENT AT THE ELECTRICAL SHOW.

TO TAKE PLACE MAY 13 AND 14.

The judges held a meeting at the Astor House on April 13th, among those present being Fred Catlin, T. J. Smith, J. B. Taltavall, H. W. Pope, George H. Guy, A. E. Sink, E. A. Leslie, W. D. Weaver, P. T. Brady, P. B. Delany, S. F. Austin, T. R. Taltavall and William Maver, Jr.

The meeting was called to order by Mr. Catlin, who was elected chairman. J. B. Taltavall was elected secretary. After some discussion it was decided that the conditions to govern the judges in their decisions as printed in the circular which has been widely circulated, sufficiently covered the ground.

An executive committee was then appointed to take care of all matters embraced in the duties of the judges.

The executive committee, consisting of Fred Catlin, A. E. Sink, T. J. Smith, P. B. Delany and J. B. Taltavall, held a meeting immediately after the judges adjourned. Mr. T. J. Smith was appointed a committee to arrange for suitable phonographic records, and Mr. P. B. Delany to provide apparatus for chemical or other records not phonographic.

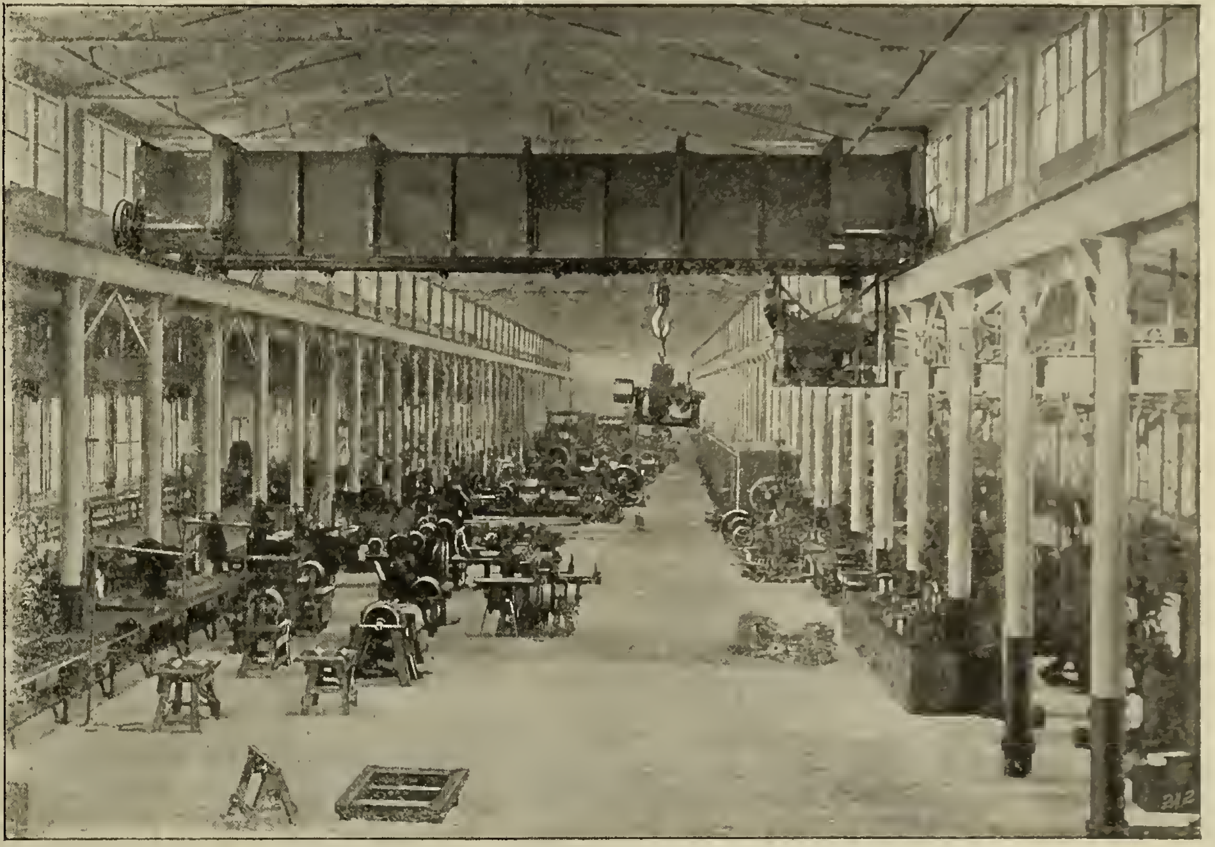
The executive committee then adjourned, to meet on April 21st.

Mr. A. E. Marr, of the Associated Press, an exceptionally good code operator, has been added to the list of judges.

The Smith-Premier Typewriter Company state that those living at a distance who desire to use their machine in the contests need not bring their typewriters with them to New York. Mr. W. H. Durphy, the New York manager of the company, is prepared to furnish all comers with typewriters. Mr. Fred E. Burnell, of New York, proposes to enter one or two events in the tournament, more with the idea of demonstrating the fact that telegraphers' paralysis is a curable disease, and giving telegraphers a practical demonstration of his complete cure by electricity itself.

Friday evening, May 13th, and Saturday afternoon and evening, May 14th, are the dates on which the tournament will take place.

THE WALKER CO., H. McL. Harding, Eastern manager, have moved to more desirable quarters in the Commercial Cable Building, 20 Broad street, N. Y.



Section of Assembling Department, Crocker-Wheeler Works.

INSULATION AND CONDUCTION.

(Continued from page 234.)

3. Conductivity in fluids.—The nature of the manner in which electricity is conducted in electrolytes has been very thoroughly worked out by Clausius, Arrhenius, Hittorff, Kohlrausch, Nernst Ostwald and others, and the work of these physicists has led to the linking together of results in a way which is simply marvellous. As the results can be obtained from works on physical chemistry. a very brief resumé is given.

The atoms of a solid are held together by the force of cohesion and driven apart by the hitting of the atoms on each other, due to the fact that they are in vibration, possessing kinetic energy proportional to the temperature. The molecule may also be pulled apart by the cohesive attractions of its atoms for other atoms. Whether a substance is a solid or a gas depends upon whether the fraction—

$$\frac{\text{Cohesive force of atoms for one another} + \text{external force}}{\text{Kinetic repulsion} + \text{cohesive attraction for other atoms},}$$

is greater or less than unity. We can thus turn a substance into a gas in two ways, i. e., by increasing the kinetic energy of the atom by heating it, or by bringing it in contact with other atoms, when, if the sum of the terms in the denominator is greater than the numerator, it will dissolve.

We have to distinguish two kinds of linkages in solids, the cohesive force of the atoms for one another in uniting to form a molecule, and the attraction of the molecules for each other. The former generally is stronger than the latter; consequently we may have a substance which on being put into contact with a solvent will have its molecules pulled apart from one another but not its atoms. In the presence of another solvent, however, the second term may be sufficiently great to pull apart not only the molecules but also the atoms of the molecules. The substance is then said to be not only dissolved but disassociated. But dissolved substances give an osmotic suction per sq. cm. which is equal numerically to the kinetic pressure which the substance would have if it were turned into a gas at the same temperature and volume as the solution. A number of proofs of more or less validity have been given for this, but it seems to the writer to follow at once from the obvious fact that if we take a solid and heat it and dissolve it, the kinetic repulsion must always equal the cohesive attraction plus the vapor pressure when equilibrium is reached.

This phenomenon of osmosis has been generally treated of as due to pressure and the dissolved substance to exercise a pressure equal to that which it would have if turned into a gas at the same temperature and volume. The writer (in the "Elec. Review, London, Nov. 27, 1891,) pointed out, as above, that the results were better explained by supposing that the solvent took up the cohesion of the solute, and that this got rid of the great difficulty of the disassociation theory, i. e., that solution was generally accompanied by heating. Recently this theory has been put forward by other well-known physicists. Prof. Poynting ("Phil. Mag.," Oct., 1896) has treated the subject mathematically, and whilst the mathematical reasoning cannot be considered conclusive, as Prof. Poynting himself states, yet, as he puts it, it shows "that it is not necessary to ascribe osmotic pressure to disassociation, but rather to association, or some kind of combination of salt and solvent." I have ventured therefore, in view of this fact, to do what I would not have done otherwise, i. e., to substitute my own conception of a suction for that of a pressure, otherwise making no change.

paper will dissolve in some high resistance oils, forming a conducting solution.

C. Conductivity in Gases.—There is much evidence to show that conduction in gases is electrolytic, more especially J. J. Thomson's beautiful work on this subject. Also the fact that in air or CO_2, carbon is deposited on the negative pole, sometimes to the thickness of more than an inch in enclosed arc lamps, according to Marks, while in hydrogen or hydro-carbons in many instances the carbon is deposited on the positive carbon, would seem to favor this view. Also in its favor is Prof. Elihu Thomson's observation of the formation of copper "trees" in incandescent lamps with coppered filament joints. Against this is Schuster's observation that the metallic lines in the spectrum have a fairly high velocity, and also the general appearances of the arc, which looks as if something were going in one direction down its centre and something else back on the outside. Also there is one other phenomenon which looks as if it were convective. This is the fact that if we take a solid carbon and bring it nearer to a similar carbon while the current is passing, the resistance first decreases and then increases. This was I believe first pointed out by Mrs. Ayrton in her admirable paper on the

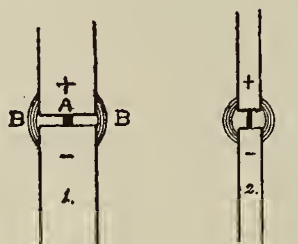


Fig. 4.

Fig. 5.

EL.AGE.

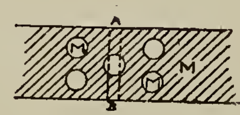


Fig. 6

In this way by measuring the osmotic suction we can tell whether a salt is disassociated or not; and it is found that only those salts which are disassociated can conduct electricity. The molecules split up generally into two parts, one charged with posititive, the other with negative electricity. These charged parts or ions when placed in an electro-static field move with a velocity proportional to the slope of potential and to the specific ability of each ion to move among the crowd of molecules of the solvent. Consequently the faster an ion can get along through the crowd of other molecules, i. e., the faster it can diffuse, the faster will the electricity be carried, and the greater the amount carried per second for a given slope of potential; also the greater the quantity of electricity carried per ion the greater the current. The total quantity carried will be the sum of that carried by each ion, so that by adding the velocity of the ions we get the total velocity with which the electricity is moving.

The conductivity of a solution is thus dependent upon the following:

1. How powerful the attraction of the molecules of the solvent is for the ions of the solute, for on this depends how much of the solute is disassociated, i. e., how many ions are set free to carry the current.

2. How fast the ions move.

3. What the valency of the ions is.

In designing insulations, the first is the important point. For from it we see that two good insulators mixed do not necessarily make a good insulator. A solid may dissolve in one substance and be an insulator in solution, but in another solvent may conduct quite well.

This is what makes the chief difference between fluid insulators, for practically all the fluids which are not simple elements, like mercury, have very high ohmic resistance, and all have practically about the same dielectric strength. The ohmic resistance of pure water is, according to Kohlrausch and Heydweiller, about one meghom per cubic centimetre, consequently on account of its non-inflammability and great specific heat, its great heat of vaporization and low boiling point, it would be a very valuable insulator for some types of apparatus were it not for the fact that it dissolves almost everything in slight

subject. The reason of it has not I believe been given; it seems to be due to a necessity for circulation in the arc. If we have two carbons as in Fig. 4, at 1, the centre part of the current seems to flow all right, but the part B cannot flow unless the + carbon is very hot, and this is only cured by either increasing the current so as to heat the whole carbon up or by reducing the cross-section, as at 2 in Fig. 4. Whether a carbon is cored or not has nothing to do with this increase of resistance on the distance being shortened, as all that coring does is to diminish the cross-section of the carbon, and I have repeatedly found by actual test that the difficulty is entirely obviated by using carbons of × or — cross-section, provided the greatest thickness at any point of the cross-section is less than that of the cored. The phenomenon is evidently analogous to the jumping back of the discharge in a Geissler tube when the electrodes are brought too close together. The theory of this was given by J. J. Thomson, and it was by applying this that I got over the difficulty with the carbons. A true arc can be run from a much lower voltage in open air than is generally supposed when the section of the carbon at any point is not more than $\frac{1}{10}$ cm. thick. On the whole, the evidence seems to be in favor of the belief that both convective and electrolytic discharges take place in air. The whole subject is very fully treated in J. J. Thomson's "Recent Researches in Electricity and Magnetism." There can be, in my opinion, very little doubt but that when a true electrolytic discharge takes place, as it does in a hot flame, the conductivity is proportional to the velocity of sound in the gas, though so far I am not aware that any experiments have been made on the subject. It is possible that in certain cases the elasticity itself may be a function of the slope in the electrostatic field. As the vacuum increases up to a certain point, the dielectric strength increases, and this point depends somewhat on the electrodes and voltages, and has led to the amusing result, that on the average every two years the discovery is announced that a vacuum is a good conductor. Above this, the discharge appears to get more and more convective, and a fact may be stated which I have not seen mentioned, i. e., that the largest quantity of X-rays is ticles back to the cathode is blocked up as much as possible. An experimental tube made by Mr. Meadowcroft for the writer last spring, in which there is a small tube running from the back of the anode to the back of the cathode which can be blocked up by tilting it, shows this very nicely.

As regards the electrolytic discharge, this can only take place when the gas is disassociated by heat or by a strong slope of potential. To the convective discharge the same remarks apply as to the convective discharge in gases. At ordinary pressures the only gases which allow a discharge to pass easily are helium, argon and possibly that unknown gas whose spectrum we see in the light of the Aurora Borealis. Helium, as shown by Ramsey, behaves at ordinary pressure much as air at low pressure, and a spark will jump through it for about thirty times the distance it will through air at the same pressure, when the pressure of both approximates that of the atmosphere.

Having got rid of the theory which was necessary in order to give opportunity to condense later, and which has led me to wonder if it were ever possible to find the pleasing mean between the conciseness of the Carpenter and the discursiveness of the Walrus, we shall take up the practical part of the subject.

(To be continued.)

HISTORICAL TABLEAUX AT ELECTRICAL SHOW

A series of eight illustrative and historical wax tableaux (designed to mark some of the successive stages of electrical development), prepared by Dr. Park Benjamin, Prof. F. B. Crocker and Mr. T. C. Martin, executed and arranged by the Eden Musee Company, will be a feature in the Concert Hall.

The series will include the First Recognition of an Electric Effect, when the Syrian woman, centuries before our era, wonderingly perceived light objects flying to her amber spindle; the Mariner's Compass, ascribed to the Chinese and Italians, but probably to be credited to the Finns, in the 11th century; the Earth a Great Magnet—William Gilbert explaining the Terella to Queen Elizabeth, 1600; the First Conductors or Circuits; Stephen Gray, a Charter-house pensioner in London (1720) experimenting on the Conduction of Electricity; the Leyden Jar, showing the bottling of electricity and the terrible shock to Dean Von Kleist, Canon of the Cathedral in Cumin, in Pomerania, 1746; the Identity of Lightning and Electricity—when Benjamin Franklin drew down the lightning from the skies, 1752; the Beginnings of the Modern Primary Battery or Voltaic Cell, with Galvani's famous frog experiment, 1791; and the Beginnings of Modern Dynamo-Electric Machinery, showing Michael Faraday's famous experiment, 1831.

These tableaux are accompanied by a selection from Dr. Park Benjamin's celebrated library of early philosophical, technical and electrical books, each illustrating some feature or stage of electrical evolutions.

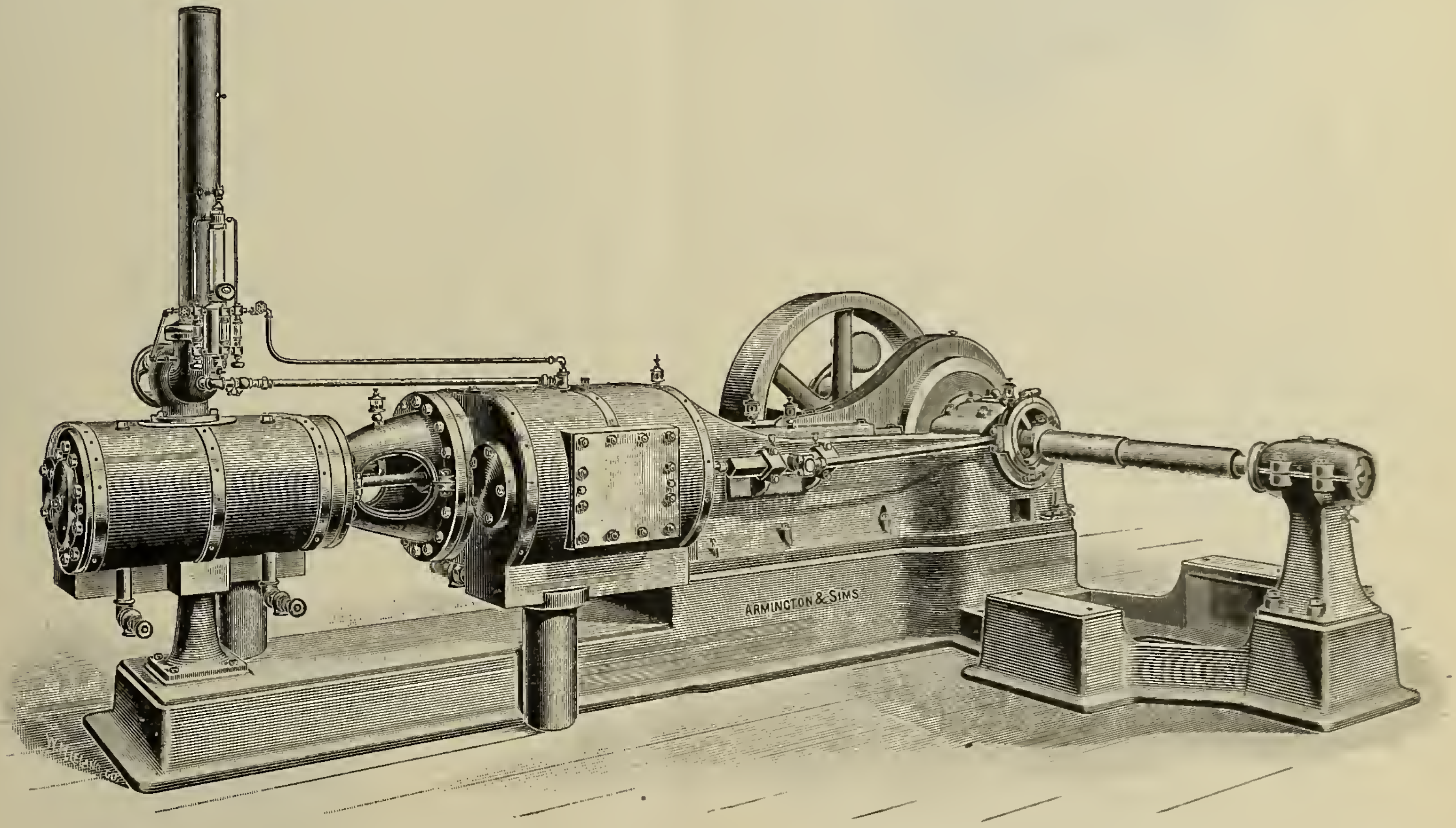
Mr. Chas Chamberlain has been placed in charge of the Press Bureau of the Electrical Exposition.

HIGH-SPEED ENGINES FOR ELECTRIC LIGHTING.

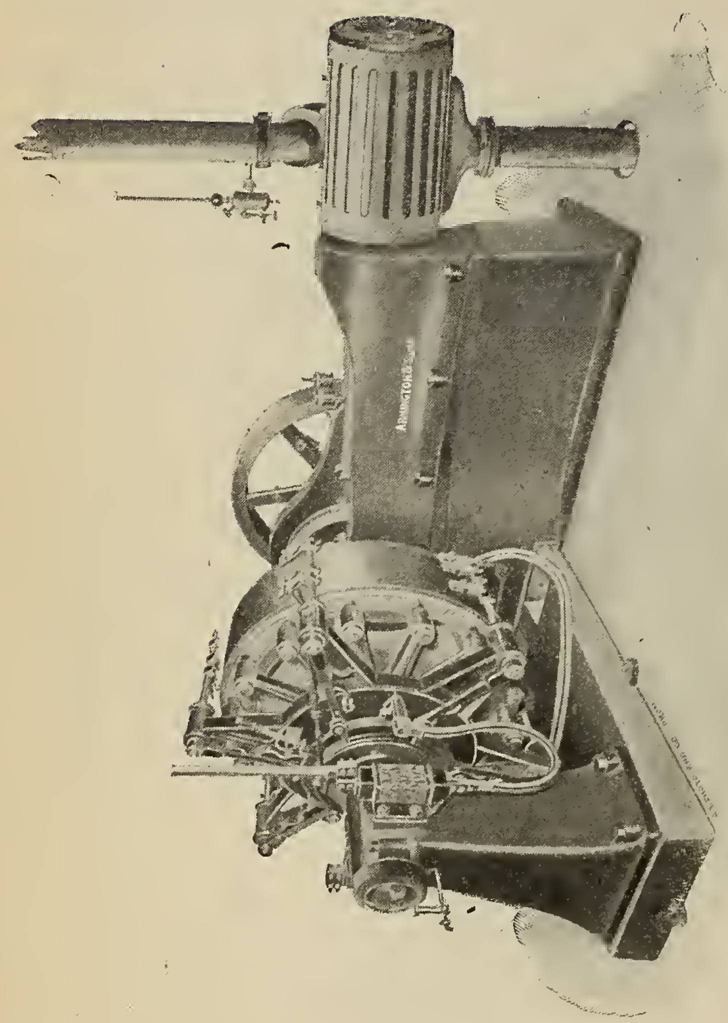
The development of electric lighting has exercised a wonderful influence over the design and construction of steam engines. The valve gear with its modern improvements, the governor with its all but human intelligence, and the strength and lightness of the engine as a whole shows conclusively that it can well perform its function in driving the dynamo uniformly and economically for electric lighting.

The Armington and Sims high-speed engine represents a combination of improvements which make its reputation the highest and its serviceability widely known. Such improvements as the self-adjusting cylindrical or piston valve, the Ritz inertia governor and certain oiling devices are included among the list. For electric railway service, which is of the severest character, engines of giant mould have been built, which meet great external variations without the least tremor. The operating parts of the Armington and Sims engine may be readily inspected without inconvenience, and all parts apt to wear are capable of further and immediate adjustment. The above illustrations relate to direct-connected plants, either for shipboard or land service. Dynamos of 150 K. W. capacity or less are provided with engines having an extended shaft, outbored bearing and an extended sub-base. For dynamos larger than 150 K. W., engines direct-connected to the same are built with separate cast-iron base-blocks for dynamo instead of extended sub-base.

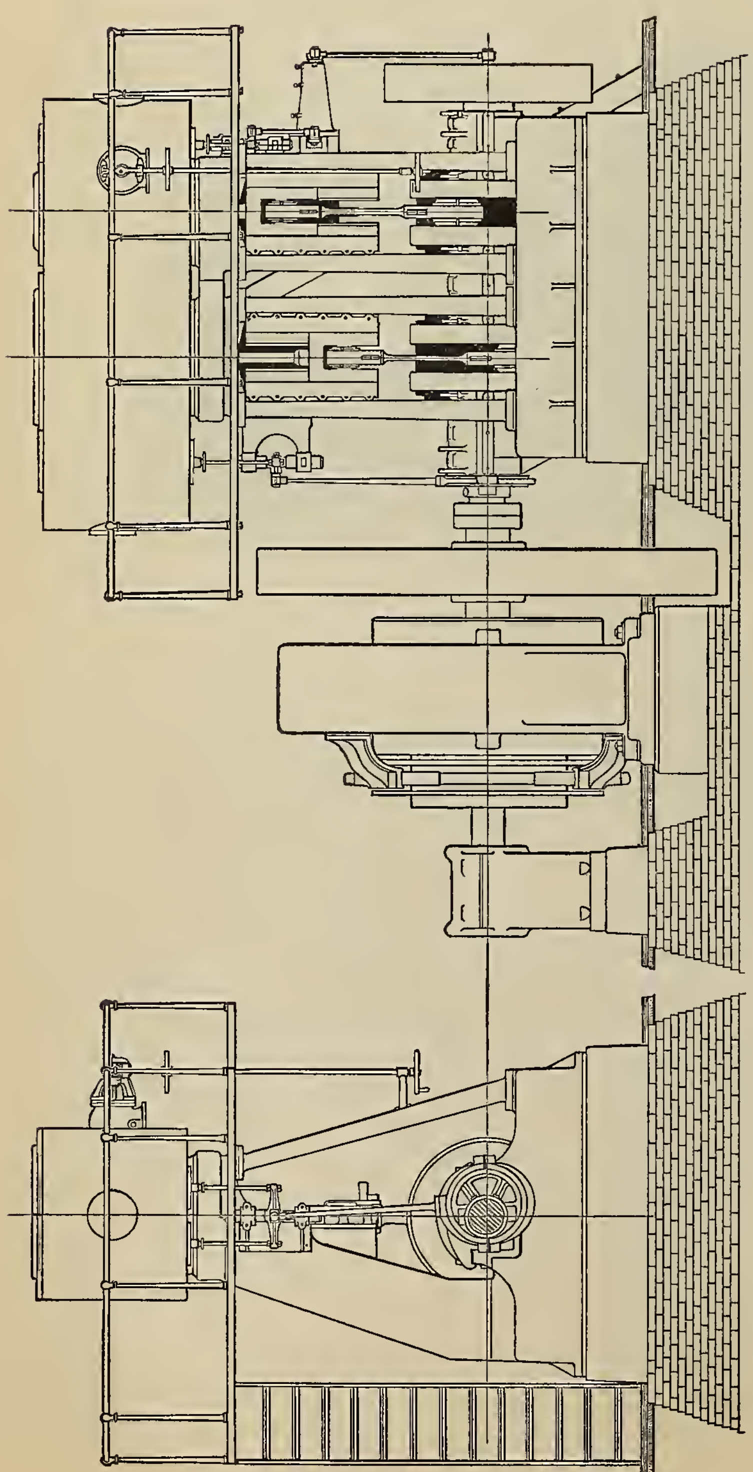
The Armington and Sims engines are so constructed that connection may be made to two dynamos at the same time, each end of the shaft driving a generator. "In this arrangement the governor is mounted upon a slotted



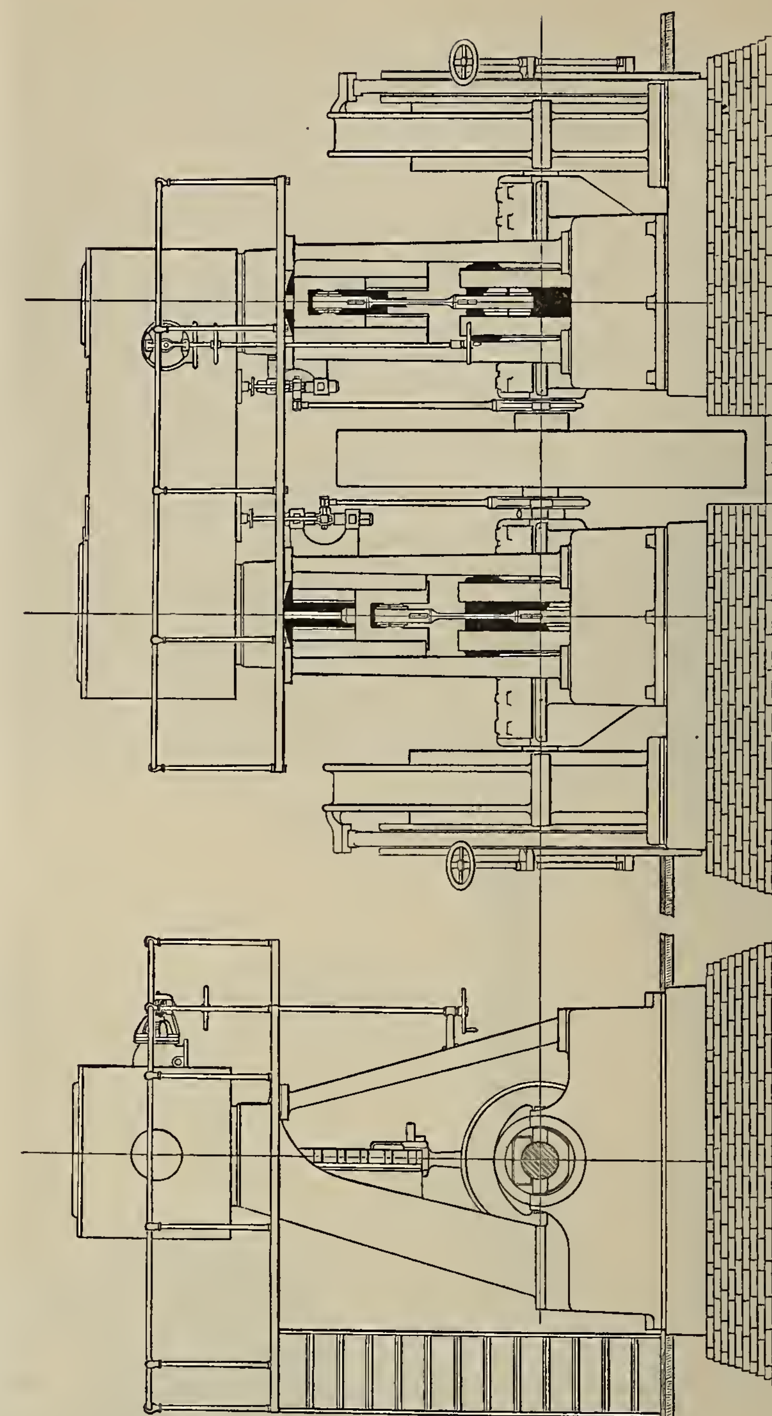
250 H.-P. Tandem Compound Engine, Direct-Connected Type.



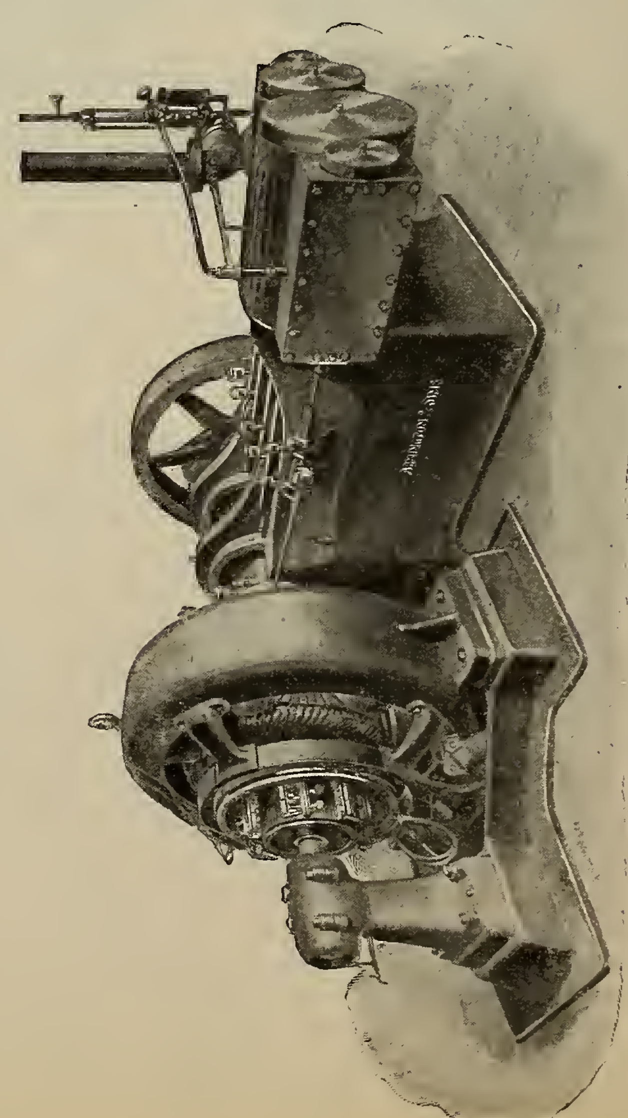
160 H.-P. Simple Horizontal E gine, Direct-Connected to 100 K.-W. Dynamo



750 H.-P. Cross Compound Vertical Engine, Direct-Connected to 500 K.-W. Dynamo.



750 H.-P. Cross Compound Vertical Engine Direct-Connected to Two 250 K.-W. Dynamo.



120 H.-P. Cross Compound Engine Direct-Connected to 75 K.-W. Dynamo.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - $2.50
One Copy, six months, - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.
NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, APRIL 30, 1898.

CONTENTS.

PROPERTIES OF CELLULOSE.

The investigations of science frequently bring to light new properties in old substances. Regarded from a general standpoint, cellulose bids fair in the future to find its application as part of the equipment of war vessels and as a means that cannot be despised of insulating high potentials. In the "Yale Scientific Monthly," of November, 1897, Mr. E. L. Freeland, in an article entitled "A New Form of Cellulose," explains its use as a means of preventing the sinking of cruisers whose armor would be penetrated by shot. For this purpose cocoa-cellulose, as well as the pith of cornstalks, has been used. Corn pith is obtained from grist mills as a sort of by-product, being exceedingly cheap in consequence and readily obtained. Cellulose used for purely electrical purposes exists, according to Reginald A. Fessenden, in an article on "Insulation and Conduction," read before the American Institute of Electrical Engineers, in two states, that is to say, the pure cellulose.

A condenser made of this material and with pure parraffine, according to Fessenden, will stand two hundred and fifty volts per thousandth of an inch when the dielectric is less than one one-hundredth of an inch, and at a higher rate for greater thicknesses when the effect of small defects is not serious. There is a suggestion contained within the limits of this argument which might find its practical application in the insulation of certain heavy wires and cables. The cheapness and comparative ease with which it can be used should appeal very strongly to the practical engineer, to such an extent, we hope, that they will follow the recommendations of Mr. Fessenden and find out where it can be applied or used to the greatest advantage.

THE ENCHANTED ARMOR OF SCIENCE.

The belief of the most luminous minds of this period is to the effect that war in its most violent phases has become merely the antagonism of two nations armed with scientifically constructed means of onslaught and defence. In other words, the armor with which science clothes the military and naval forces of a nation places it upon the list of powers according to the protection it affords.

The "Spectator," of London, publishes the following note, which clearly shows the trend of modern thought in that country and will certainly be regarded with pleasure by those appreciating a short and concise eulogy of our own abilities: "American naval officers have in them qualities which Spanish naval officers have not, and for which mere courage, however gallant, is no sufficient substitute, and we think that when the two fleets clash in earnest the American flag will not be the one to be struck. The fight may be a stubborn one, but it will be a fight between a brave man with his weapons only and a brave man also with weapons, but clad in an enchanted armor of scientific knowledge. The American will have fifty devices where the Spaniard has five."

The use of the Fiske Range Finder has added greatly to the strength of war-ships by supplying them with a device for accurately determining the distance between one vessel and another and the proper angle at which a gun must be pointed in order to land its shot. The use of torpedo boats, sub-marine mines, etc., has greatly aided those interested in the modern art of destruction. These appliances will in the future exercise a great moral influence on the aspirations of those that desire war, and if for no other reason than this, the work of improving coast defences and constructing devices of an electrical or mechanical nature for attack and defence should go on uninterruptedly.

STEEL.

Steel is not cast into crank shafts, gear wheels, locomotive driving centres and any number of castings which need strength. It is used a great deal in electrical castings where high magnetic permeability is needed. A steel casting has about twice the magnetic permeability that an iron casting has. Therefore steel castings weigh about half as much as iron castings of the same magnetic permeability. The chief objection to steel castings is that they cost about three times as much as iron castings. But in these days of progress, weight is being noted as much as price, and steel castings are being used very extensively in all classes of machinery where iron castings of the same strength would be too cumbersome. The above statement was made by Robert D. Reynolds and clearly indicates the position the manufacturing world is occupying in regard to the use of steel.

The present perfection attained by manufacturers of electrical machinery can be attributed, first, to their increased knowledge of the design and construction of dynamo electric machinery, and, secondly, to the advantages offered by the use of a highly permeable and easily moulded material.

THE TELEPHONE AT THE EXPOSITION.

The New York Telephone Company will make an exhibit illustrative of the operation of the telephone system of this city. There will be shown specimens of the latest styles of telephone apparatus and silence booths for the equipment of public and private telephone stations. Pretty nearly everybody is more or less directly interested in the telephone service nowadays, though few know just how it works. The New York Telephone Company's exhibit will give visitors to the show a very fair idea of just how the serviee does work, as part of the exhibit will be a switchboard in actual operation, which will serve stations at various points in the Exposition Building. Trunk lines will run from the Exposition switchboard to one of the main exchanges, so that the stations in the Exposition may not only be connected directly to each other, but also to any station in the city or in any part of the country reached by the telephone systems of the New York, the New York and New Jersey and the American Telephone and Telegraph Company.

In short, this part of the exhibit will be a working specimen of the Private Branch Exchange System which has been so largely adopted by big business houses of all classes since its introduction by the New York Telephone Company a year or two ago.

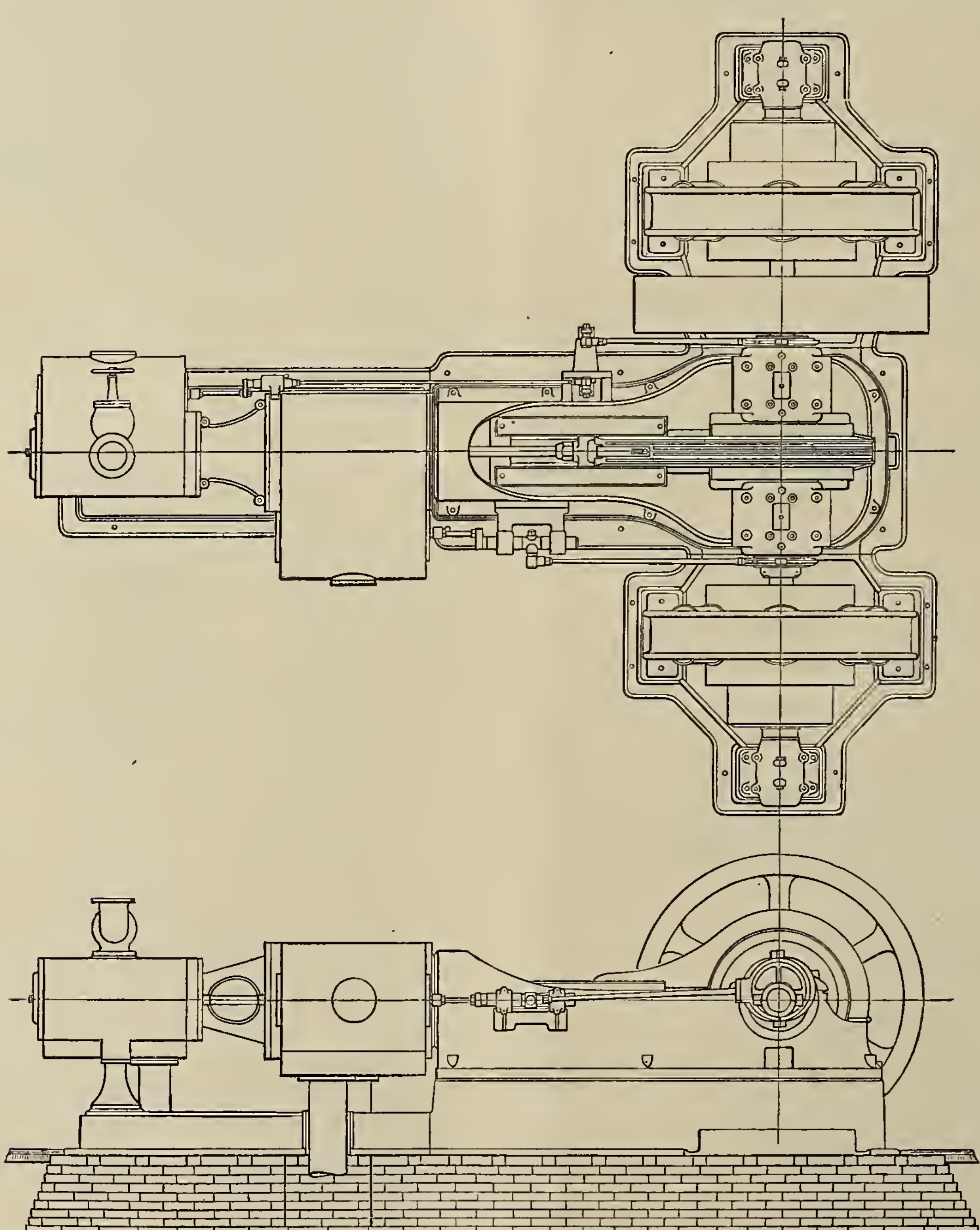
Arrangements are also making for a separate telephone feature, which will be the transmission of music from various New York theatres and out-of-town points every evening during the month of the Exposition. The Exposition Company, the American Telephone and Telegraph Company and the New York Telephone Company are working jointly in the production of this attraction, which is sure to be popular with the general public.

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from page 226.)

In 1827 the celebrated law giving the relation between e. m. f. resistance and current was published by Ohm in a paper on the mathematical theory of the galvanic circuit. The theory has been sometimes criticised, but there seems to be absolute certainty that the law is almost exact, and it has proved of the greatest importance in the further development of the subject of electric measurements.

The subject had, about the middle of the century, reached a stage in which it was possible to develop almost completely the mathematical theory as we now have it. Most of the work since Faraday's time has been directed towards quantitative measurements and the furnishing of exact data to answer questions as to how much in various cases. F. E. Neumann discovered what he called the potential function (now called the coefficient of self and



200 H.-P. Tandem Compound Engine, Direct-Connected to Two 95 K.-W. Dynamos.

(Continued from page 243.)

eccentric working across the shaft and a roller bearing to reduce the friction to a minimum." About 5,100 Armington and Sims engines are in operation, the indicator cards of each one showing high efficiency and necessarily economical operation for changes of load.

Electric lighting puts an engine to a severe test, which has not in any way diminished since later and larger plants have been installed by electric railway, light and power companies. A large percentage of these are operated by Armington and Sims engines, which, serving as motive power for these plants, have proved themselves well worthy of the name they bear in every particular. The Armington and Sims Company build their engines in Providence, R. I., to which correspondence may be directed for information of a special nature.

mutual induction) of one current on another, and on itself, and succeeded in giving a theory of induction which was in accordance with the experimental laws. The laws were afterwards experimentally verified by Weber.

In 1849 the experiments of Kirchoff on the absolute value of the current induced in one circuit by another, and in the same year Edlund's experiments on self and mutual induction, are important. In 1851 Helmholtz gave a mathematical theory of this part of the subject, which he supplemented with an experimental verification.

One of the most important of the series of experiments made by Henry was on the oscillatory character of the discharge from a Leyden jar. This he discovered from the effect of the discharge on a steel needle surrounded by a coil, through which the current was made to pass. The results of these experiments were communicated to he A. A. A. S. in 1850, but he knew of the effect much arlier, certainly in 1841. Previously the anomalous beavior of the discharge of a jar when used to magetize steel needles had been noticed, but was attributed, s I believe, to some peculiarity of the steel. Henry was he first to appreciate the true reason, although he could ardly at that time be expected to see the great importnce of his discovery.

Helmholtz, in 1847, suggests that the discharge of eyden jars may be of the nature of a backward and forard movement.

There is a curious parallelism in the work of several vestigators about this time, and particularly in that of elmholtz and Thomson. In the "Philosophical Magane" for 1855 there is a paper by Professor W. Thomson Kelvin) in which the theory of the discharge of a Leyen jar is discussed and the prediction made that under ertain specified conditions the discharge must be oscillary. A number of similar papers, going back to 1848, eat of similar subjects. Henry's results do not appear have become generally known, and we find the verifition of Thomson's prediction in 1857 by Feddersen. A umber of other physicists have investigated the subject, e work of Schiller being of particular value. The recent pplications will be referred to later.

The mathematical theory of electrostatics and magetism was greatly extended about this time by Thomson nd others, and received its most complete statement at e hands of Maxwell in his papers read before the Royal ociety and in his book, published in 1873, but still the andard of reference. Very little has since been discoved which was not foreshadowed by Maxwell's theory or ontained in his equations, which have been found general ough to cover almost everything, although experiment as generally been necessary to suggest the consequences the theory.

The practical applications of eleetricity have played a ost important part in the development of the subject uring the last sixty years. Indeed, a great part of the ork of these years has had some practical application in ew. One of the first of these practical applications was at of telegraphy.

The telegraph, being one of the earliest of the practil developments, naturally had a great effect in stimulatg the advance in knowledge of electricity, and hence I ve a somewhat fuller sketch of the early history, that ace will permit for the later applications.

The discovery of Stephen Gray, in 1829, that the elecical influence could be conveyed to a distance by means an insulated wire, is probably the first of direct influce in connection with telegraphy. As a result of this scovery and the investigations which followed it, a nsiderable number of proposals were made as to the use the electrical force for the transmission of intelligence. he first of these of which I have found any record was ade in 1753 by Charles Morrison, a Scotchman, and then llowed other proposals for electrostatic telegraphs by ozolus in 1767, by Le Sage in 1774, by Lomond in 1787, Betancourt in the same year, by Reizen in 1794, by avalla in 1795, and by Ronalds in 1816.

The discovery of voltaic electricity, and most directly e discovery of Nicholson and Carlisle of electrolysis, ve rise to another group of proposals for the application this discovery to the production of telegraphy. Among ose may be mentioned that of Sommering in 1809, of oxe in 1810, and of Sharpe in 1813. In more recent ars, of course, the same application appears in the chemal telegraphs, some of which are capable of giving very tisfactory results and great speed.

The discovery which had the greatest influence on the evelopment of telegraphy was that of Oersted, suppleented by the work of Schweigger and Ampere. Ampere oposed a multiple-wire telegraph with galvanoscope incators in 1820, and a modification was constructed by itchie. A single-circuit telegraph of this character was invented by Tribaoillet, but didn't come into use. In 1832 Schilling's five-needle telegraph appeared, and he, also, used a single-needle instrument, but his early death stopped further progress. In 1833 Schilling's telegraph was developed, to some extent, by Gauss and Weber, who used it for experimental purposes. The following quotation, referring to Gauss and Weber's telegraph, from "Poggendorf's Annalen," is of considerable historical interest:

"There is, in connection with these arrangements, a great and until now in its way novel project, for which we are indebted to Professor Weber. This gentleman erected, during the past year, a double-wire line over the houses of the town (Gottingen), from the Physical Cabinet to the Observatory, and lately a continuation from the latter building to the Magnetic Observatory. Thus, an immense galvanic chain is formed, in which the galvanic current, the two multipliers at the ends being included, has to travel a distance of nearly 9,000 (Prussian) feet. The line wire is mostly of copper, of that known as 'No. 3,' of which one meter weighs eight grammes. The wire of the multipliers in the Magnetic Observatory is of copper, 'No. 14,' silvered, and of which one meter weighs 2.6 grammes. This arrangement promises to offer opportunities for a number of interesting experiments. We regard, not without admiration, how a single pair of plates, brought into contact at the farther end, instantaneously communicate a movement to the magnetic bar, which is deflected at once for over a thousand divisions of the scale." Further on in the same paper: "The ease with which the manipulator has the magnetic needle in his command, by means of the communicator, had a year ago suggested experiments of an application to telegraphic signalling, which, with whole words and even short sentences, completely succeeded. There is no doubt that it would be possible to arrange an uninterrupted telegraph communication in the same way between two places at a considerable number of miles distance from each other."

(To be continued.)

DEMONSTRATING THE USE OF SUBMARINE MINES AT THE ELECTRICAL SHOW.

Major H. J. Smith, of Pompton, N. J., one of the best known experts in the world in submarine explosives, mines, etc., has very kindly tendered his services to the Exhibition Management for the demonstration in a special tank of the manner in which harbors are protected, ships blown up, etc., and some of his ingenious apparatus has been loaned for this interesting work by Mr. C. McLaughlin, of J. H. Bunnell & Co. This will probably be one of the most attractive features af the show.

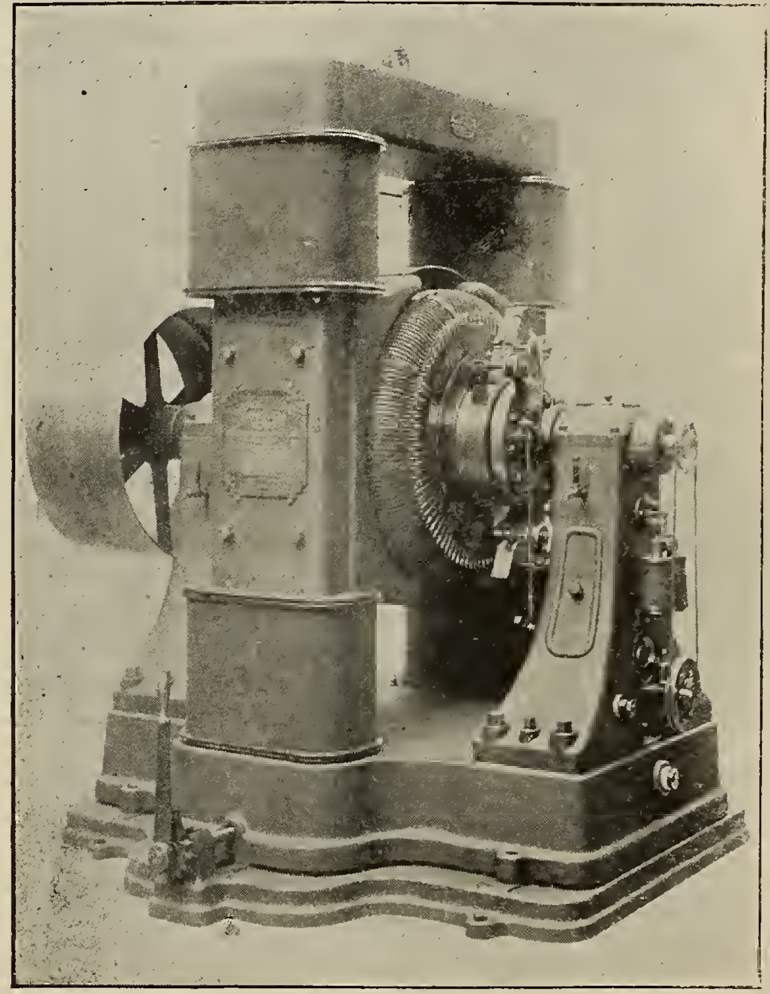
ELECTRO-MAGNETIC INDUCTION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The many phenomena brought to our notice by the action of a current are still more wonderful when the current acts upon another. It is strange that today we are just waking up to the fact that many of the effects around us are due to the presence of an invisible and extremely fine atmosphere called ether. It is not necessary to know what ether is in studying its effects, only that its presence be remembered, and its qualities, as far as they are known. In studying the principles of electro-magnetic induction we are compelled to look upon the subject as we would gravitation; that is, in each case one body is capable of affecting the other without any visible material between. But we know that one exists, as well as we know that air, or hydrogen and oxygen are realities. It is always surprising to see one body iufluence another, as, for instance, a magnet a piece of iron. Yet the old effect of the earth on a stone is constantly forgotten Familiarity with certain electrical experiments makes them lose novelty and become accepted with unconcern as the most prosaic truth to be found.

A coil of wire carrying a current becomes surrounded with magnetism. If the current changes the magnetism does likewise, and even the minutest variation is distinguishable at once. Another coil in the vicinity of the first can only be affected if these changes occur. Either the current must increase in the first coil or it must decrease; in either case, the second coil produces a current. A steady and uniform current in the first coil produces



Dynamo Producing Pulsating Current.

no lasting effect in the second. But when the current is started the second coil shows it, and when it is stopped. Each of these changes, however, mean an increase or decrease of current in the first coil, and it is in these changes that the phenomena of electro-magnetic induction occur when another coil is present.

Currents may be divided, according to their nature, into four kinds at least:

Uniform current,
Pulsating current,
Alternating current,
Interrupted current.

The coil receiving these currents will affect any neighboring coil in the same way. If it be connected to a galvanometer, the pulsations and changes can be clearly noted. The circumstances governing the intensity of this effect are deeply interesting. It is a department of science which touches upon a new field of facts—the study of action at a distance.

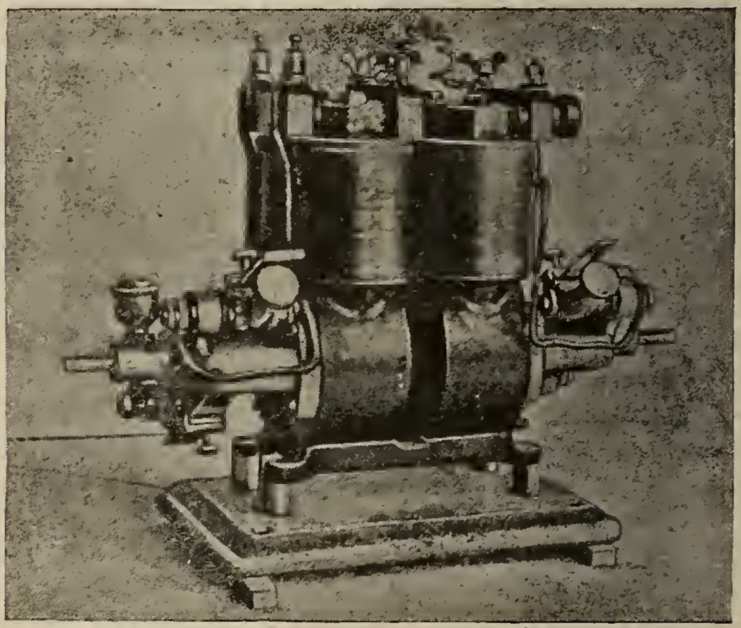
The ordinary lighting current is due to a series of pulsations, so small, however, that they appear to blend into one continuous whole. The arc-light current is a true pulsation, a rise and fall, of the current strength, but a flow which, whether weak or strong, does not change in direction. The remaining current used in commercial lighting is the alternating or sinusoidal current. It derives its name from the peculiar growth, decrease and reversal in direction. It may be observed that entirely different systems of lighting are built upon this difference between each. In the last, transforming devices are required, which have opened up a new field in the transmission and distribution of power.

The entire principle of electro-magnetic induction depends upon the mutual reaction occurring between a wire and a field of magnetism. Either may be moved in the neighborhood of the other and an electromotive force will be excited.

It is important that this fact be received as an absolute truth, which in any case can be depended upon with the same surety that gravitation, or the revolution of the earth, is relied upon.

An invincible principle like this is the mirror with which we reflect all other truths; it is the foundation—the stepping stone—without which further progress is impossible.

It may be understood from the last statement that either a wire moves in a magnetic field, or the field is moved in the neighborhood of the wire. We can also add that both may take place and still produce the effects spoken of. By moving a wire and a magnetic field so that they mutually interact, we are simply transferring the power required for that motion to the wire. The



Continuous Current Transformer.

elastic material required for the transference of this energy is the magnetic field; the strained ether. In what direction does the current flow, and how can it be increased or diminished by this means ? In other words, what limitations are there which give but a circumscribed value to the effects of all electro-magnetic relations ?

The E. M. F. developed in any case depends upon the number of lines of force cut per second. If a coil is carrying a current and thereby generating a magnetic field, another coil in its vicinity will have excited in it a potential difference of 1 volt if it is moved across the streaming lines of force so that its turns and the magnetie lines give a product of 100,000,000 per second.

Supposing the coil to have ten turns and the field proceeding from the other coil to equal 100,000 lines of force. To excite one volt the product of 100,000,000 must be sustained in a second. At present, with but one move of the coil, only 100,000 lines of force are cut. Therefore, the coil must be moved ten times in a second to generate one volt.

In developing this principle, the same basis is taken that all electro-magnetic phenomena consist merely of interactions between a magnetic field and a coil.

For commercial purposes it is necessary that we should know the exact value of the E. M. F. developed with a given number of lines of force and turns.

In all dynamos this first conclusion practically determines the size of the machine. By following this lucid le still further, the great department of alternating t machinery may be investigated. We have to deal case with a series of special devices which have, e of their peculiar nature, successfully resisted all ts to usurp them. Were it not for the ease of rmation, the life of alternating-current systems be very short.

in this fact lies its strength; it is simple and con- t and in certain cases most economical. The trans- of an alternating-current system consists of a te magnetic circuit and two coils. A ring of lam- Swedish iron with a coil on each side comprises al apparatus.

iron is called the frame of the transformer and the ils, the

Primary, and
Secondary.

Primary.—This coil is usually of finer wire than ner. It is the one which receives the current direct ne dynamo and turns it into magnetic energy. It e carefully insulated from the iron frame and the coil. In daily practice the primary receives any- from 1,000 to 2,000 volts; its function is to mag- and demagnetize the iron of the frame. For this e the coil is specially designed, because it gener- lot of heat when these rapid reversals occur. The y is made with the proper radiating surface to ad- the rapid emission of heat. It is wrapped around eral layers of insulating tape and in some cases in oil and kept there. The resistance in ohms of imary is not the only factor which prevents the t from the dynamo injuring it. There is a back motive force, called self-induction, which holds the o pressure in restraint. Its full effect is only felt he secondary is supplying its full number of lamps urrent. As an automatic valve, it is unequalled in ailing action at all times and under all circum- s. Were it not for the presence of this invisible reg- the use of transformers could only be carried on reat difficulty. When the current flows into the pri- he magnetized coil at once affects the secondary uses it to generate an E. M. F.

Secondary.—The principle elucidated now comes rect application. The coil has been magnetized instant. Another coil wrapped around the iron in ar manner to the primary is thus subjected to the ce of those lines of force the primary has just gen- If 100,000,000 of these lines of magnetic force through the coil but once in a second, and the ary consists of only one turn, the pressure devel- n it will equal one volt. The design of a trans- hangs upon this fact.

QUESTIONS FOR REVIEW.

In what medium does electro-magnetic induction

(2) By what means is a current excited in an adjacent coil?

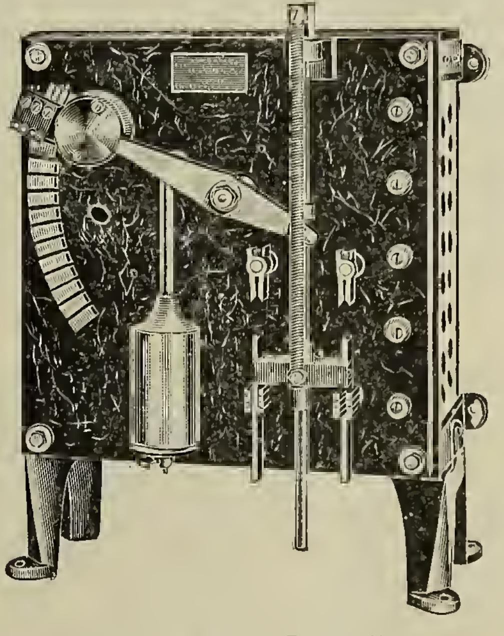
(3) How may currents be divided?

(4) Upon what does the E. M. F. developed in a coil depend?

(5) What parts are there to a transformer?

THE GRAVITY MOTOR CONTROLLER.

In offering this device to the trade, the Electrical Appliance Company, of 27 Thames street, New York, call their attention to the following salient points in its design: First, its remarkable simplicity in principle of design, small number of parts and accessibility to repair. Second, its durability, which in its working parts insures excellent wear. Special attention is called to the contacts, and the use of an exterior, non-conducting device for securing tension and the best of contact. The resistance in this arrangement will last and can be readily taken apart and replaced anywhere. The device itself



Gravity Motor Controller.

can be easily attached to belted elevators by making rod connections direct from belt-shifting wheel or wheel operated from same.

There are three methods of using this contrivance: First, for starting an elevator and motor simultaneously; second, for starting the motor in advance of elevator, but still retaining automatic cut-off feature. With this method the automatic cut-off can be used or not, according to conditions. The above is changeable in a second, so as to permit motor to run independent of elevator; for instance, where the motor operates a pump, etc., for a portion of the day. Third, the above device is used for starting and stopping the motor independent of the elevator.

The Electrical Appliance Company have in course of construction a special controller and reverse switch for direct-connected elevator. The gravity motor controllers are made in sizes varying from three to fifty horse power for controlling elevators, motors, pumps, presses, etc. The remarkable success met with so far is an assurance of a heavy trade and rapid development.

Mr. G. A. Nisbet, the general manager of the company, is a man of wide experience in the electrical business, and very popular among the trade.

ELECTRICAL CONSTRUCTION & SUPPLY CO., formerly of 120 Liberty street, are nicely settled in their new quarters, 27 Thames street, N. Y. They have a fine repair shop and assembling room; also office and salesrooms. They make the well-known Kinsman Enclosed Arc Lamp; make a specialty of construction, wire, etc.

Petoskey, Mich.—D. D. Whitten, City Clerk, may give information concerning construction of new $8,500 electric-light plant.

lectric Show, as we are going to press, is looming up into beautiful proportions. The decorations of the interior will be the most attractive the Garden has ever seen. The Edison Illuminating Company will make the Garden glow with electric light and their beautiful colonnaded exhibit will be worth the price of admission to see it. The beautiful exhibit containing the artificial vacuum tube, daylight system, under Mr. Moore's supervision, will be the attraction of visitors. A large number of exhibits were well under way, so that the Electrical Show, as it appears today, will be the greatest exhibition ever given in the Garden.

THE TELEGRAPH TOURNAMENT.

Signs are already visible of the keen spirit of rivalry which has been aroused in telegraphic circles by the announcement of the coming tournament. Already the cracks in many cities, both in the States and in Canada, are getting themselves into training. Some of the Montreal operators have written to ask whether they will have the same show as their American competitors. The reply they received assured them that they would have an open field and fair play, and they are now busy getting their contingent in racing form. In other cities, such for instance as Chicago and Philadelphia, the telegraphic fraternities are uniting to raise additional prizes to be given to the successful contestant from their city at the tournament.

The complete list of judges includes the names of—

A. S. Brown, Western Union Telegraph Co.
Francis W. Jones, Postal Telegraph Co.
A. E. Sink, Manager Western Union Telegraph Co.
Chas. Shirley, Manager Postal Telegraph Co.
Geo. H. Usher, Supt. Postal Telegraph Co.
D. B. Mitchell, Manager Race Bureau—Western Union Telegraph Co.
Minor M. Davis, Traffic Manager, Postal Tel. Co.
Gardner Irving, Manager Commercial News Dept., Western Union Telegraph Co.
S. F. Austin, Commercial Cable Co.
P. J. Tierney, Manager Central Cable Co.
F. F. Norton and S. A. Coleman, Chief Operators, Postal Telegraph Co.
E. F. Cummings, Night Manager Western Union Telegraph Co.
Edwin F. Howell, Sec. Serial Loan Association.
E. T. Baberie, Postal Tel. Co.
Chas. Thom, Chief of Quadruplex Dept. Western Union.
E. H. Cox, Manager, and E. W. H. Cogley, Asst. Supt. Associated Press.
Thos. R. Taltavall, Editor Electrical World.
E. A. Leslie, Manhattan Electric Light Co.
J. H. Bunnell, Electrical Manufacturer.
H. W. Pope, Telephone Supt.
Wm. Maver, Jr., Electrical Expert.
Robt. W. Martin, Cable Editor N. Y. Sun.
P. B. Delany, Telegraph Expert.
Edward H. Johnson and Thos. J. Smith, Electrical Manufacturer.

Judges of Press Code: Ed. H. Curlette and P. T. Brady.

All the judges are expert telegraphers. The selection has been so carefully made, and the list includes so many men in the front of the electrical as well as the telegraphic industry, that every contestant may be assured that his individual interests will be protected. Phonographic and other records of each transmission will be made, so that in the event of any dispute the work may be reproduced.

Thomas A. Edison, Jr.'s exhibit will be one of the main attractions of the Show.

Elmer R. Morris and F. A. La Roche Company were arranging their beautiful exhibits as we go to press.

The Ward Electric Supply and Construction Co., 39–41 Ann street, New York City, have received the contract for installing the wires, mains and cables for the Electrical Show, and also for some of the private exhibits.

MR. REYNOLDS, the former steward of the old Electric Club, is managing the Manhattan Hotel and Restaurant, 1281 Broadway. It has been refitted and was opened April 18th. Messrs. Holloway & Irish are putting in the electric plant, dynamos, electric fans, lights, etc. Mr. Reynolds invites the profession to call.

J. Jones & Son, 64 Cortlandt street, New York, manufacturers and supply dealers in electrical goods of all kinds, will have one of the finest exhibits at the Electric Show. It is opposite the Edison Illuminating Company exhibit, and next to Thomas A. Edison, Jr.'s, beautiful booth. The back of the exhibit will contain a rich white mahogany board with panel work, studded with novel fixtures and lighting effects; the centre is a plush oblong design containing the name of the firm formed by small incandescent lamps on a blue plush ground. This will form the back of the exhibit. A handsome marble switchboard with all appliances on one side, and panels and supplies of all kinds made by the firm will form the opposite side of the exhibit. If you miss everything else, you cannot pass this exhibit by.

Faries Manufacturing Company, No. 136 Liberty street, New York, will exhibit at the Electrical Exhibition, Madison Square Garden, a general line of their goods, such as the Universal Electric Lamp Holders and Aluminum and Steel Electric Lamp Shades; also their Fire and Water Tube Boiler Cleaners. The exhibit will be located on the 27th street side of the Garden, on the promenade.

Syracuse, N. Y.—W. K. Niver has made application for a franchise to build an electric railway.

The Electrical Age.

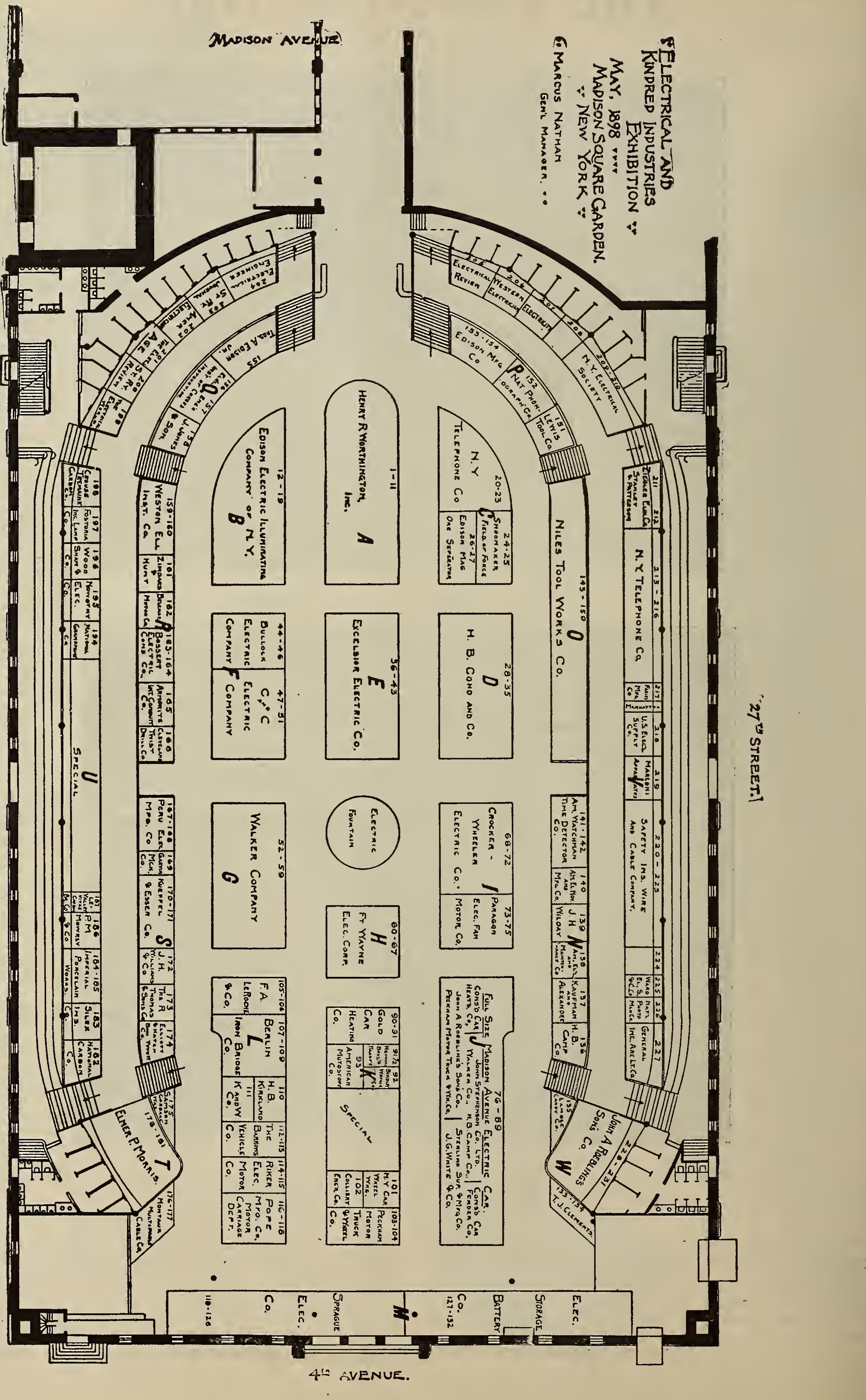
VOL. XXI—NO. 19 NEW YORK, MAY 7, 1898 WHOLE NO. 573

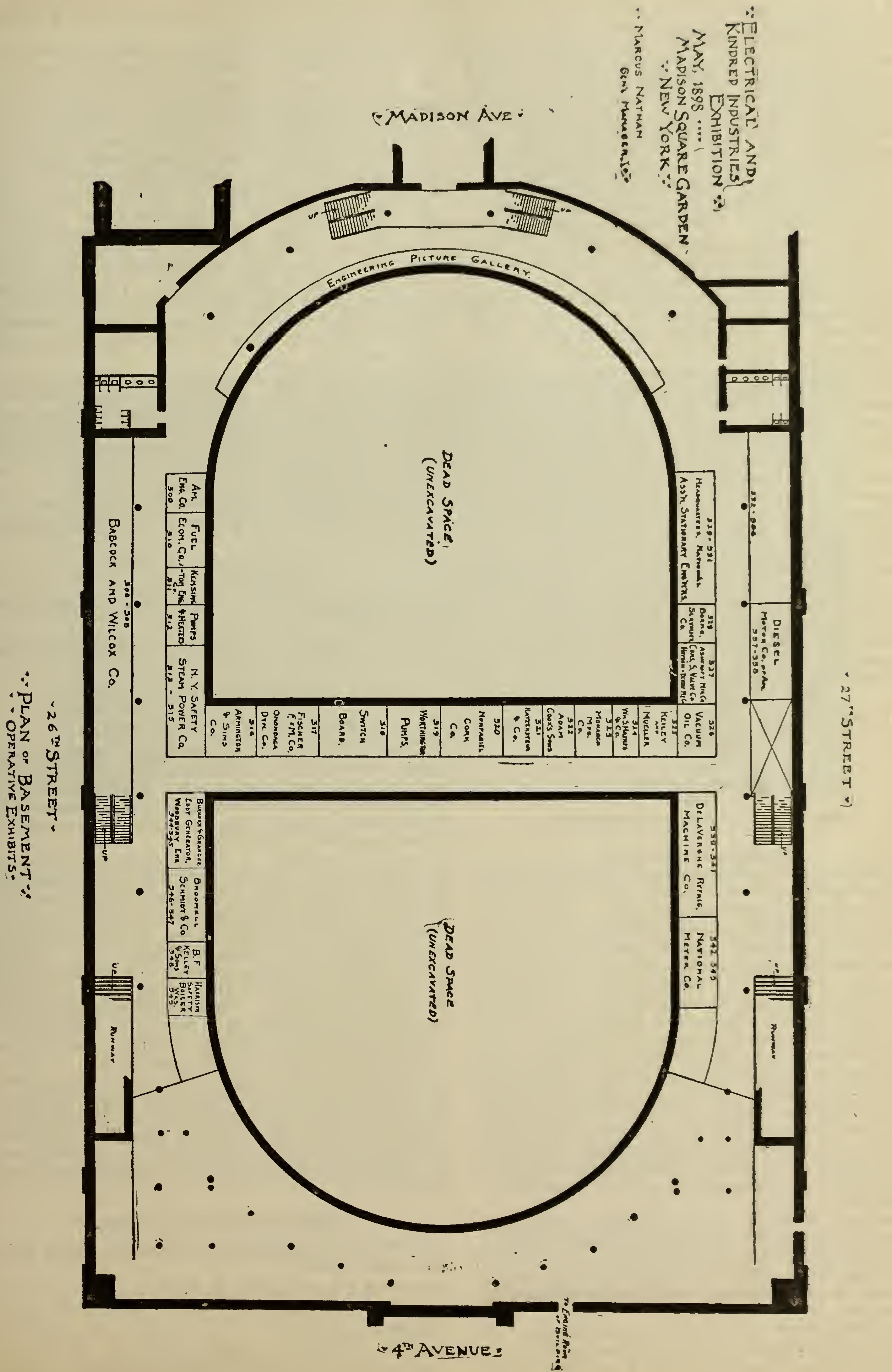
View from Madison Avenue End of Garden.

View from Fourth Avenue End of Garden.

THE FIRST NIGHT OF THE ELECTRICAL EXHIBITION.

New Yorkers are cultivating a love for scientific expositions which certainly shows a high standard of culture and an investigative spirit that could hardly be duplicated in any civilized centre on the face of the globe. The evening of the opening of the electrical exhibition presented a brilliant scene to those attending the function on that occasion. Chauncey M. Depew, New York's beloved orator, made the opening speech and spoke highly of the marvellous aptitude exhibited by Americans in the fields of scientific application. About eight thousand people listened to Dr. Depew's remarks with growing enthusiasm, which rose to a pitch of great intensity when the following letter was read from President McKinley, direct from the White House: It gives me great pleasure to open the electrical exhibition in Greater New York and to participate in this wonderful demonstration of the latest method of recording and publishing by means of electricity. I congratulate you upon the achievements of American genius. I am glad to know that the resources of the wonderful electrical art have already been so far advanced in the United States that American electrical goods are welcomed the world over. —William McKinley." Another letter, from Garrett A. Hobart, the vice-president, was recorded phonographi-


Madison Avenue
Electrical and Kindred Industries Exhibition
May, 1898
Madison Square Garden, New York
E. Marcus Nathan
Gen'l Manager.
Plan of Amphitheatre and Arena Circles
27th Street.
26th Street.
4th Avenue.
Henry R. Worthington, Inc.
Edison Electric Illuminating Company of N.Y.
Excelsior Electric Co.
H. B. Coho and Co.
Niles Tool Works Co.
N.Y. Telephone Co.
Walker Company
Electric Fountain
Crocker-Wheeler Electric Co.
Ft. Wayne Elec. Corp.
Madison Avenue Electric Car.
Sprague Elec. Co.
Battery Storage Elec. Co.
Elmer P. Morris
John A. Roebling's Sons Co.
Special


ELECTRICAL AND KINDRED INDUSTRIES EXHIBITION
MAY, 1898
MADISON SQUARE GARDEN
NEW YORK.
MARCUS NATHAN
GEN'L MANAGER
MADISON AVE
ENGINEERING PICTURE GALLERY
DEAD SPACE (UNEXCAVATED)
BABCOCK AND WILCOX CO.
DIESEL MOTOR CO. OF AM.
N.Y. SAFETY STEAM POWER CO.
SWITCH BOARD
WORTHINGTON PUMPS
VACUUM OIL CO.
DE LAVERGNE REFRIG. MACHINE CO.
NATIONAL METER CO.
DEAD SPACE (UNEXCAVATED)
RUNWAY
26TH STREET
27TH STREET
4TH AVENUE
PLAN OF BASEMENT
OPERATIVE EXHIBITS

cally from the telephone receiver and contained the following sentiments: "I respond with pleasure to the invitation of the New York Electrical Society to assist in opening the electrical exhibition held under its auspices at Madison Square Garden, and beg to express my wishes for its success as a means of promoting further advances in the great electrical and engineering arts with which our national fame is already so proudly associated. I congratulate the citizens of Greater New York that they have this opportunity of studying all that is latest and best in the science to which Franklin, even in the midst of patriotic duties and cares, gave his transcendent genius. —Garrett A. Hobart." When these messages were received they were almost instantly set up in an electric type setting machine, printed in an electrically-driven press and distributed at once to the visitors. Dr. Depew astonished his audience by the facility with which a small submarine mine situated in a fountain seventy five feet away was blown up by Hertzian waves, one of the first and greatest applications of wireless telegraphy in naval warfare. The splash occasioned by this unexpected explosion caused some disquiet to those in close proximity to the fountain at that time. Loud cheers rang out from thousands of throats when specail news was received direct from President McKinley in relation to the war. Those that wandered through the bye-ways and labyrinths of this wonderful exhibition saw many remarkable exhibits whose influence in the future upon the advancement of the human race will be most pronounced. Magnificent lighting effects could be seen on all sides, and away upstairs in the southwest corner the strange, weird light of Moore's vacuum tubes lit up a small chapel. The popularity the exhibition has thus far met with is so great that every night the great garden is crowded with curious onlookers, of which a large percentage belong to the fairer sex. Many prominent men have already visited the electrical show and pronounce it on a par with the best they have ever seen.

ALTERNATING CURRENTS AND ALTERNATORS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In the many applications of power to various industries none have so occupied the attention and interest of engineers as the use of alternating currents. Years ago the alternator was accepted as a simple device for the generation of reversing currents. Its comparative cheapness of construction and ease of operation have always placed it foremost as the basis of a power plant stretching over rough and rugged countries where attention and skill are of the lowest order. Jablochkoff invented his historic candles for alternating currents and thereby drew attention to its usefulness for arc lighting. In its varied applications we meet with many unique effects. It is striking to notice the results obtained by applying it for the production of light and power and the remarkable developments that have issued from the many attempts to produce a constant and steady light, a self-starting and independent source of power. These problems have gradually reduced the field of alternating-current work to certain constricted lines.

The labors of the past do not partake of the brilliant successes of the present. Continuous and alternating currents stand side by side as indispensable power factors, to be individually applied according to the circumstances, each with its own peculiar set of apparatus designed and perfected to perform its special work.

It is then necessary to accept the achievements of the past as but the beginning of a vast engineering revolution, the final outcome of which will be a new and infinitely more economical means of illumination and a cheaper source of power.

An alternating current is one in which the flow of electricity is constantly reversing. It rises to a high value like an ocean wave and recedes, growing again in the opposite direction in a similar manner. The growth of the current and its reversal in this peculiar manner is due to the arrangement of the lines of force when cut by a revolving conductor. In the alternator a series of poles are arranged around a common centre pointing inwards. As a conductor passes in front of them, each pole creates within the wire a wave of electromotive force. When the wire passes in front of the north pole the rise and fall of current is the reverse of what it would be in front of a south pole. These poles are always some multiple of two —either four, six or eight poles, etc. Therefore we have as many north as south poles. The conductor develops while rotating a continued succession of rapidly reversing waves of electricity, which have earned the name of alternating currents.

Frequency.—The rapidity with which these waves reverse back and forth is called their frequency. If a wire passes in front of a south pole the current rises and falls, but does not reverse in direction. If continued past a north pole the reversal does occur; it is therefore necessary for the wire to pass before two unlike poles to provide a rise and fall and a reverse rise and fall.

Period.—This constitutes a complete current wave. It is called a period. The number of periods are dependent upon the

Number of pairs of poles.
Speed of the dynamo.

To calculate the number of periods in an alternator we observe the following rule:

Number of periods = one-half of the poles $\times$ revolutions per second.

Take a dynamo having poles = 8
speed = 1,200
Periods = $4 \times 20 = 80$ per second.

Phase.—The rush of electromotive force through a wire is such that the entire electrical influence does not pervade it until an instant afterwards. The current does not instantly flow; a certain inertia, as it were, prevents it. The retarding influence may be either the resistance or the self-induction of the circuit.

While it is true that an electric current requires both pressure and amperes to properly deserve the name, it is possible to imagine, upon the closing of a circuit, the electromotive force at work almost at once, as though it were merely a static effect and the current requiring an exceedingly short interval afterward to follow it. In other words, pressure or potential arrives at a given point and affects it before current. The interval elapsing is called the difference of phase. There are two ways of regarding it—as an interval of time or as an angle of difference.

To our minds' eye the first is preferable, as it supplies a physical something within the grasp of all.

Impedance.—The retarding effects of resistance and self-induction give rise to a condition called impedance. The circuit acts as if affected by a heavy resistance; the current is restrained from flowing, and without any great consumption of energy the flow is checked. The frequency also gives rise to this condition to a greater extent than self-induction.

QUESTIONS FOR REVIEW.

(1) What is the differeuce between an alternating and a continuous current ?

(2) What is a wave of E. M. F. ?

(3) Define frequency.

(4) Define period.

(5) Define phase and impedance.

(6) Are alternators generally self-exciting ?

AN INTERESTING EXPERIMENT IN HIGH-VOLTAGE LONG-DISTANCE TRANSMISSION.

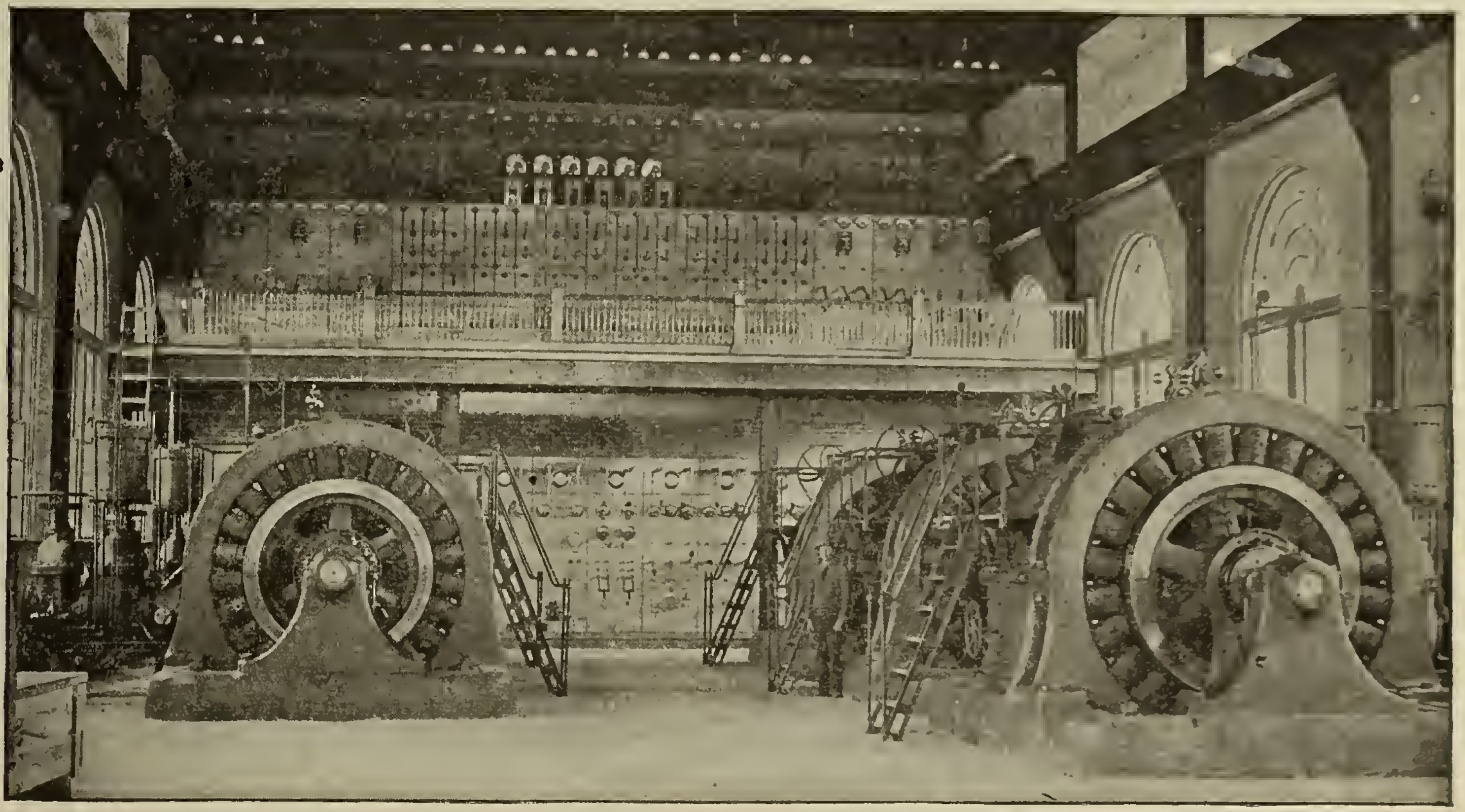
An interesting experiment in high-voltage, long-distance electric-power transmission, pregnant with influence on all transmission work was recently made at Ogden, Utah, in order to ascertain the limits within which high-voltage currents might be used commercially. The experiment was made by Mr. F. O. Blackwell, of the General Electric Company, over the lines which connected the great power-station of what was, until recently, the Pioneer Electric Company at Ogden with the distributing circuits at Salt Lake City, and consisted in connecting the Salt Lake ends of the transmission lines together and dividing the transformers at Ogden, normally used for raising the pressure of the current for transmission, into step-up for the outgoing current and step-down for the incoming. The distance from the power-station at Ogden to Salt Lake City is about 36½ miles. Making a complete circuit of the outgoing and incoming line, therefore, with Salt Lake City midway, gave a complete transmission circuit of 73 miles over three No. 1 wires. The amount of power transmitted amounted to one thousand horse-power, and the voltage at which the transmission was effected reached at times as high as 30,000 volts. The current on the return was delivered to resistance vats at the power-house, consisting of three wooden tanks.

By careful and repeated measurement with watt meters at both ends Mr. Blackwell ascertained that this power was transmitted with the loss of only nine per cent., including four per cent. loss in the two sets of transformers. The drop in pressure due to inductance was practically nil, the capacity of the line being sufficient to compensate for reactance loss.

Continuing the experiment, part of the Salt Lake City Station load was run from Ogden, with current at 24,000 volts. This was supplied to about five hundred horse-power in synchronous motors and lights for two days, under most severe climatic conditions — rain, fog and snow alternating. In addition a severe thunder-storm prevailed all through the night, the lightning-arresters discharging repeatedly. Notwithstanding the severity of the conditions under which the test was made, the motors operated without failure and the lights burned without flickering even during the times of lightning discharges. Not the slightest difficulty of any kind developed while this experiment lasted.

By the recent accomplishment of a scheme of consolidation all the electrical plants in Salt Lake City, as well as the transmission plants, supplying current from it to the outside, have been merged into the Union Light & Power Co. The companies thus consolidated were the Pioneer Electric Power Co., the Salt Lake and Ogden Gas and Electric Company, the Big Cottonwood Power Company, the Little Cottonwood Power Company, the Citizens' Electric Light Company, and certain smaller interests.

The plant of the Pioneer Electric Power Co. is one of the most important installations in the West, and the transmission one of the longest. The power-house is located a short distance from the mouth of the Ogden Canon. The power is derived from the Ogden River, the water being brought to the power-house through a wooden stave pipe and riveted steel pipe line, about 32,000 feet long.



Latest View of Interior of Generating Station of Pioneer Power Plant.

The electric plant consists of five General Electric three-phase alternators—24-pole machines running at 300 revolutions and delivering 750 K.-W. each at 2,300 volts and 60 cycles. The complete plant is designed for ten units or a total output of 10,000 H. P. The exciters are G. E. six-pole 500-volt Kilowatt dynamos, each of ample capacity to excite ten generators. Each alternator is directly connected to a Knight water-wheel of 1,200 H. P. capacity, and each exciter to one of 135 H. P.

The current is fed into the transmission lines from the step-up transformers at 16,100 volts, and delivered to the step-down transformers at 13,800 volts. They are ordinarily connected in delta, but can also be connected in Y to raise the potential to 25,000 volts whenever it is desired to run at the higher potential in order to increase the capacity of the line or the distance over which the power is to be carried. The switchboard panels on the gallery at the end of the power-house are for the outgoing feeders, and are arranged to handle potentials of 25,000 and 30,000 volts. Everything necessary to control the operation of the electric and hydraulic machinery has been carried to the switchboard panels on the same level as the generators.

Both step-up and step-down transformers are of the air-cooled type and are each of 250 K.-W. capacity. The pressure of the current for local distribution to the smaller transformers at Salt Lake City is 23,000 volts.

INSULATION AND CONDUCTION.

BY REGINALD A. FESSENDEN.

HIGH RESISTANCE INSULATION.

(Continued from page 243.)

In laboratory apparatus in many cases, for instance with electrometers and resistance boxes, we need as high ohmic resistance as it is possible to get. Here, however, we are met by the fact that the two substances most commonly used, i. e., hard rubber and glass, are among the poorest insulators known for this class of work.

Rubber is very objectionable from the fact that whilst it presents a nice bright appearance when new, it contains sulphur and is very easily oxydized, especially when exposed to light. A film of sulphuric acid is thus formed on the surface, and if the tongue be applied to a piece of rubber which has been in use for some time the taste of the acid is very strong. I have seen the top of a Wheatstone bridge, supposed to be capable of measuring accurately to one part in 5,000, in which the total length exposed to leakage, divided by the average distance between which leakage could take place and the average voltage was only .008, with the top so acid that the tongue could hardly be allowed to touch it.

As a rule, it is very hard to remedy this; rubbing the surface does no good, as the acid extends in to some distance. Rubbing with cigar ashes is advocated by some, but I should fancy it would be almost impossible to remove the last traces of alkali. The method used by the writer is to steep the rubber in warm 10 per cent. caustic soda, then in warm distilled water, frequently renewed, then drying in the dark quickly and rubbing with pure paraffin, treated as described under paraffin, then polished while warm. This does good for a time, until the paraffin takes up dust.

For rods, a good way is to treat as above and coat half an inch thick with paraffin; then run over the rod with a wooden die and cut a thread in the paraffin. Run over the thread about once a month, and good results will be obtained.

With bridges, however, it is impossible to remove the top, and the only thing which can be done is to keep them covered up from light.

Rubber has also one other disadvantage, in that it does not show dirt, and where rubber comes in contact with copper it is apt to rot.

Glass is very bad because the alkali in it has a great affinity for moisture. The alkali is slightly soluble, and hence it is the custom with analytical chemists to boil all beakers used in exact work for several days before using, so as to get the soluble alkali and silica out of them. When possible, this should be done with the glass of electrical apparatus.

Another very serious trouble is that the angle of contact between water and glass is zero, so that when a drop of water is placed in the middle of a pane of clean glass it immediately spreads all over it in a thin film. This method is used by chemists to determine when a glass is clean. Nothing much can be done with glass but to keep it dry. Sulphuric acid is generally used, but it sometimes, if allowed to get dust in it, gives off vapors which condense on the side of the apparatus. This, however, does not often happen.

Evidently we need some substance of high ohmic resistance and one which water will not wet. Boys, who has earned the thanks of electricians for his happy discovery of an almost perfectly elastic fibre, has given us also, as he himself has pointed out, such an insulator in quartz. Dip a thread of glass in water and lay it between the knob of a charged electrometer and the ground, and the leaves close almost at once, the whole fibre being covered with a film of water. Treat a quartz fibre similarly and the water slides off it, or remains in little drops each separate from its fellow, and the insulator is apparently as good as the air itself.

Quartz should therefore be used as much as possible in electrical instrument work. It can be melted in a powerful gas flame furnace, and though it can never be melted down free from small bubbles, these make no difference except in appearance. It is, however, possible to obtain glass which contains no alkali, and resembles quartz in that it is not wet by water. Such a substance is Faraday's borate of lead glass, as he himself points out. This is, however, too brittle for most work, but by an admixture with silica a glass could no doubt be made which would be perfectly satisfactory. If some glass manufacturers would take up this question and furnish us such a material for electrical instruments, the greater part of the present annoyance met with in making delicate experiments would vanish. It would not leak, would show dirt, could be readily cleaned, and would be free from one of the great disadvantages of rubber, i. e., a large coefficient of expansion, which is always making trouble by bending terminals of resistance coils, thus changing their value and sometimes opening the circuit.

It is also probable that a fine grade of porcelain would be a great benefit to the electrical profession, if coated with a good non-alkaline glaze.

For insulating the coils of resistances it is doubtful if we have any good solid material. For paraffin cannot be used, as its expansion and contraction are so great that large pressures are put upon the wire, and the resultant strains change the resistance. It might be easy enough to prevent the strain on the first solidification in a way similar to that devised by Rowland for cementing flat mirrors without buckling them, i. e., by mixing a little glycerine with the beeswax; the glycerine not dissolving in the beeswax makes it act like a viscous fluid, i. e., deform under the action of infinitesimal forces in time. The glycerine, however, finally works its way out like zinc in a resistance alloy (as first pointed out by Mr. Weston), and if a similar method were used with the coils it would still be subjected to strains on change of temperature.

Another objection which has been made in England is that paraffin absorbs moisture. It is possible that this is due to the dissimilar methods of producing American and English paraffin, as I have never had to complain of this, except, of course, when cold paraffin was placed in saturated moist air. The insulation resistance of paraffin seems, however, to be markedly increased by the treatment mentioned below. The great objection to paraffin is its tendency to collect dust. Shellac has been recommended, and since the coils are in the dark the material will oxydize but slowly, and if care be taken to use pure alcohol for a solvent, and not denaturized spirit (which sometimes contains conducting impurities), has a very high resistance when dry. Some forms of Japan lac seem to remain flexible permanently, as, for instance, the sample A (composition unknown), which is ten years old.

Oil is sometimes used for resistance coils, and this is without doubt the best method, since the great point in the use of resistance coils is to know their temperature. The writer's experience with manganin and constantin as practical laboratory standards has been unfortunate, and he has hence decided to use only standards of pure lead run into glass tubes and kept in water. The reason is that, other things being equal, the most sensitive Wheatstone bridge is that which takes the greatest current without appreciable heating, and in the ordinary form of resistance coil a very small current will heat the interior up to such a temperature as to alter the value. Moreover, if the coil is of a material not affected by such changes of temperature, it (with our present alloys) will have a larger temperature coefficient, and as the temperature of the interior of the coil is not known this introduces another uncertainty. With the oil mounting, how-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - - $2.50
One Copy, six months, - - - 1.25
Great Britain and other Countries, - - 3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

FIRST FLOOR, WORLD BUILDING.

NEW YORK.

NEW YORK, MAY 7, 1898.

CONTENTS.

Our issue of this week was delayed on account of the removal of the Printer.

TESTING OF STEEL ARMOR PLATE BY INDUCTION.

It is unnecessary to state in how many cases the principle of induction has been used, but it is certainly of importance and immediate consequence to point out how a new application may be made of it. The great fighting battle-ships of this country depend for their efficiency upon the thick belt of armor surrounding them and reaching three feet below the water-line. It is a great satisfaction to know that this armor is free from blow-holes, homogeneous, and capable of withstanding the tremendous shocks of projectiles hurled at it with the force of thousands of foot-tons per second.

A suggestion contained within this article is simply to the effect that steel armor could be tested by an induction method, which would certainly lead to the conclusion as to its availability for naval purposes.

In an article published by Prof. D. E. Hughes in the proceedings of the Physical Society of London, volume third, page one, called "The Induction Balance and Experimental Researches Therewith," a method is outlined which, if applied to metals of any given thickness, will afford a means of scientific comparison which is by nature so accurate as to rise above criticism, test or inspection of any other description. The Hughes induction balance has been utilized on a small scale for the purpose of testing counterfeit coin, but it will find its immediate use in detecting pieces of defective armor-plate in the same manner. Blow-holes in the metal and differences in the proportions of metals used in any samples tested will be immediately detected.

The simplicity of the method and the ready means of discrimination offered should lead to its immediate adoption by the naval department of the United States in examining each piece of armor-plate before it is placed into position upon the vessel's hull.

In the present war, success will depend as much upon the effectiveness of the armor employed as upon the penetrating power of the projectiles, and it would seem as if a vessel properly armored, having smaller-sized guns than its opponents, would do greater damage than if its guns were larger and its armor weaker. If the United States desires to realize its hankering wish to become the greatest naval power in the world, it will have to pay special attention to the qualities of its armor, the strength of a battle-ship lying more in this than anything else that can be considered.

The testing of armor-plate by means of a gigantic induction balance would put a quietus on all doubts as to the invincibility of the armor manufactured, within the limits of the specifications, and would add to the confidence of those entrusted with the care of one of our floating forts.

TRANSMISSION OF POWER AT HIGH POTENTIALS.

The increase in transmission lines has become very marked in the last five years. The greatest and most successful of them send alternating, two or three-phase currents over the power line. The rapid growth of polyphase transmission plants may be readily traced to the invention and commercial application of polyphase motors. The labors of Tesla, Dobrowolsky, Steinmetz and Bradley have been particularly fruitful in this respect; and to them a large percentage of the enterprise leading to the installation of great transmission plants is directly attributable.

The erection of lines carrying high potentials has opened up a broad and comprehensive field of investigation to the contracting engineer. In transmitting alternating currents, the efficiency of transmission is dependent upon the resistance of the line, the frequency and the pressure; and it is well understood by those engaged in this work that the saving in copper is not at all desirable if carried out at so great a sacrifice that the economy is thereby affected. The facility with which a high potential alternating current may be sent, received and transformed again to a commercial pressure has led to the adoption of that system in all cases where power of any consequence is to be delivered.

Marcel Deprez was among the first to attempt to obtain any practical figures relating to the efficiency, cost, etc., of transmitting electrical energy. His conclusions were well received and made a subject of study by others interested in the same field of work. Lord Kelvin framed his important law at about this time and showed the capitalist that the cost of power wasted should not exceed the interest on the invested capital spent in the construction of the power line. Many conclusions were arrived at of a valuable nature relating to power transmission that have been faithfully followed out at home and abroad by different engineers.

It is highly evident to those interested in this subject that the cost of line construction is a direct function of the pressure at which the energy is transmitted, and in reviewing the history of transmission plants it will be seen that a strong tendency exists leading to the use of higher and higher potential in transmitting any considerable quantity of power a great distance. The limit reached seems to be that greatly dependent upon the resisting power of the insulators on the lines and insulation in the transformers, and it follows as a matter of course that the perfection of either of these will result in a higher efficiency of transmission due to the use of several thousands of volts more in the line.

A study of transmission plants therefore resolves itself down to a study of insulation and its limits, which are best expressed in terms of frequency and resistance. It is a common thing to hear of pressures being sent over the line of ten thousand volts, but the time is near at hand when twenty and thirty thousand volts will not be considered extraordinary, as all future developments of this kind depend entirely upon improvements in insulation, which, in the light of Prof. Fessenden's remarks upon "Insulation and Conduction" before the American Institute of Electrical Engineers, is not a problem of the greatest difficulty. It seems as though insulation specialists were as necessary in this profession as nose, ear, throat and lung specialists are in the practice of medicine.

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ever, this is all done away with, and pure oil has a very high resistance for low voltages.

For condensers and induction coils it is not only necessary to have materials of great ohmic resistance and of great dielectric strength; they must also be perfectly pure and free from admixture. For the first two properties there is nothing so good as paraffin, when properly used, all compositions such as beeswax (cerotic acid), etc., being quite inferior in both respects. Paraffin, and what is practically the same thing, pure ozokerite, will stand, according to the tests of Mr. Chesney, which I had the pleasure of witnessing, at the rate of 500,000 volts per inch. This I have confirmed up to 60,000 volts, alternating. Most substances, such, for instance, as glass, are at once cut out from consideration from the fact that they have too much electrical absorption, and heat when subjected to a fluctuating voltage.

(To be continued.)

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 124th meeting of the Institute was held at 12 West 31st street on Wednesday evening, April 27th, Mr. H. Ward Leonard in the chair. About sixty members and guests were present. A paper on "An Economy Test of Central Stations" was presented by Prof. W. E. Goldsborough, of Lafayette, Ind.; also a paper on "A Novel Form of Thermo-Electric Battery" by C. J. Reed, of Philadelphia, which was accompanied by experiments. The discussion was participated in by Messrs. Cox, E. P. Thompson, Mailloux, Reed, Wintringham, Steinmetz, and W. M. Mordey, of London.

At a meeting of the Executive Committee in the afternoon the following Associate Members were elected:

Wyatt H. Allen, care H. F. Allen, 202 California street, San Francisco, Cal.

Wm. H. Fitzhugh, Supt. Bay City Electric Plant, Bay City, Mich.

John Breckenridge Fleming, Mill Superintendent and Cons. Engineer, Austin Mining Co., Austin, Nev.

George J. Henry, Jr., Engineer for N. Y. Branch, The Pelton Water Wheel Co., 143 Liberty street, N. Y.

N. S. Hopkins, ass't engineer, General Electric Co., Box 825, Schenectady, N. Y.

Robert Lindsay, general supt., The Cleveland Elec. Ill. Co., 717 Cuyahoga Building, Cleveland, Ohio.

Frederick A. Muschenheim, electrical engineer, Western Electric Co., 57 Bethune street; residence, 41 West 31st street, N. Y. City.

Newton L. Schloss, consulting engineer, 39 Cortlandt street; residence, Stuart House, N. Y. Citv.

Clarence M. Tolman, electrical engineer, with Edw. G. Stoiber, Silverton, Colo.

Ernest Stiles Vinten draughtsman, Walker Co., New Haven, Conn.; residence, 89 Pearl street, New Haven, Conn.

MADISON SQUARE GARDEN.

LECTRICAL SHOW opened May 2nd in a radiance of light, with blare of trumpets and the eloquence of our only Chauncey M. Depew; the telegraph; blowing up of a submarine mine by Clarke's Hertzian waves or electricity without wires at a distance of several hundred feet; Thomas A. Edison, Jr.'s, beautiful fountain, and many other interesting features that go to make this the greatest show ever held in Madison Square Garden. The night scene on the tower is grand and attracts crowds from the surrounding country.

Among the elaborate and beautiful exhibits we start on a pilgrimage at the left of the Madison Square entrance and are received by SMILES and a grasp of the hand by GLADSTONE, who are receiving guests and detailing the features contained in the exhibit of the EDISON MANUFACTURING COMPANY. They show a beautiful line of X-Ray outfits, kinetoscopes, medical apparatus of all kinds, Edison-Lalande batteries with and without fan motors; also phonographs, and the greatest of all, Edison Symphony Concert Records.

WE NEXT VISIT THE NILES TOOL WORKS, the great Cincinnati industry, with offices at 123 Liberty street, New York. Everybody is acquainted with machinery, but not everybody is acquainted with Niles tools. If you are a manufacturer you cannot afford to pass by this exhibit.

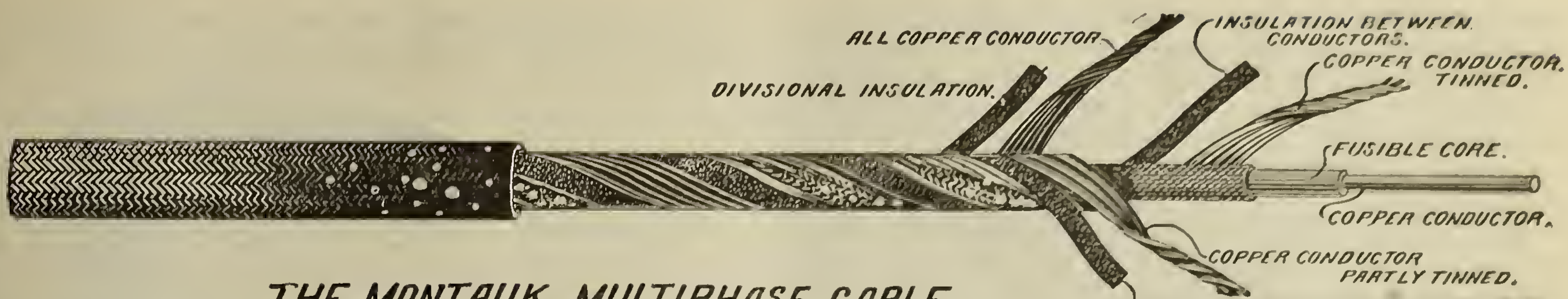
THE ADJACENT BOOTH contains watchmen's clocks, supervised by Mr. Morse, the agent, of 253 Broadway, New York.

HELLO ! is the exclamation when you strike the next booth. Why, he is engraving by electricity. Yes; it is MR. J. H. WILDEY, engraving on all kinds of metal by his patented electric engraving machine, which he sells at his offices 23 Duane street, New York.

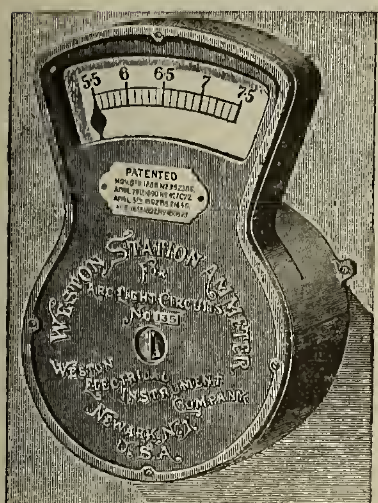
IF YOU HAVE A SWEET TOOTH you can have it satisfied by buying candy at the next stand, and you can also quench your thirst and that of your lady companion at the adjoining booth. As you are tilting your glass, enjoying your soda, without a "stick," your eyes strike the illuminated sign "CHLORIDE ACCUMULATORS" under the balcony of the Fourth avenue and 27th street end. Here is the fine exhibition of storage batteries, showing their application to boats, motors and all kinds of electrical apparatus, all under the supervision of MR. BLIZARD, their New York manager, who has offices at 20 Broad street, New York.

HEAR THE SWEET STRAINS OF WAGNER'S LOHENGRIN. Why, that comes from the organ in the SPRAGUE ELECTRIC COMPANY'S big exhibit. MR. VANDEWATER, the assistant manager of the company, is at the organ playing popular airs. He is so popular himself that he can't help it.

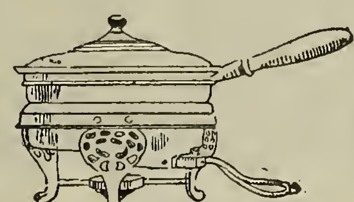
Where does all this wind come from? Why, that comes from their famous "Lundell" fan motors, found in every nook and corner of their big exhibit. It's a wonder that they were able to make a good showing of their "Lundell" power motors, as writer knows they had to refuse orders within this present week. They are



THE MONTAUK MULTIPHASE CABLE.
SHOWING FUSING EFFECT AFTER CONTACT WITH DANGEROUS HEAT OR FLAME.

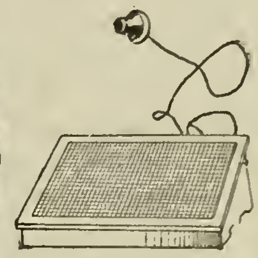


Weston Station Ammeter.

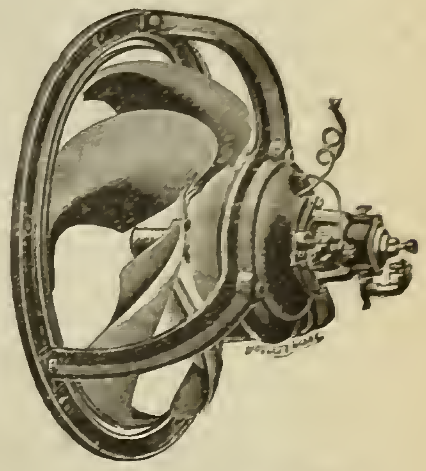


American Electric Heating Corporation Chafing Dish.

A Well Known Trade Mark.



American Electric Heating Corporation Foot Warmer.



Lundell Blower, Sprague Elec. Co.

The Riker Carriage.

working night and day to catch up with the demand. The great Sprague electric elevator and their noted "Interior Conduit" that so many have tried to imitate is attracting the admiration of thousands. It would take all our space to try to describe this exhibit.

GOOD MORNING, MR. GOULD. I hope MR. PRICE is well. These two are the genial president and secretary, respectively, supervising and practically illustrating the great advantages of the Montauk Multiphase Wires and Cables, address 100 Broadway. With one of these wires or cables running through your house, store or factory, in connection with a bell, or telephone, or telegraph, or messenger call, or window or door openers, or electric light or anything else electrical, you always have an instantaneous fire alarm, as the wire or cable is constantly thermostatic. If a fire should break out in the vicinity of this wire or cable, it gives an instant alarm, and you may have it connected with the auxiliary fire alarm system, for the call of the fire department. This is one of the greatest inventions of the age, and everybody should call at the beautiful booth of the Montauk Company and have them give you an exhibition of the operation of their thermostatic wires and cables.

After that the booth contains SAMPSON'S CORDAGE for all electrical and street railway applications.

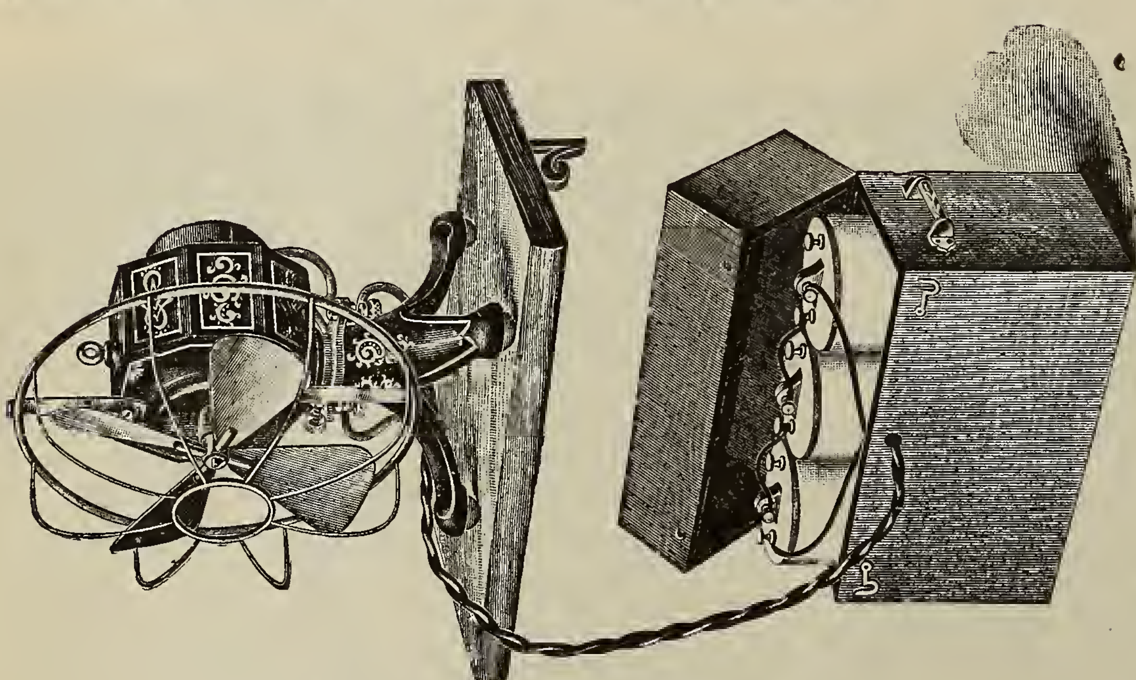
THE NEXT booth contains samples of drop forgings of J. H. WILLIAMS & COMPANY, of Brooklyn, N. Y.

KEUFFEL & ESSER COMPANY come next, the greatest manufacturers in the world of drawing materials and instruments of precision. They display a very large and assorted line of electricians' drawing instruments, surveyors' outfits for electric railway mc , Helios paper for blue printing drawings, etc., and a variety of goods that every electrician should use.

GARVIN MACHINE COMPANY, of Spring and Varick streets, New York, exhibit a large line of machine tools for manufacturing fine electrical apparatus. They are one of the busiest companies in the country today and no doubt make the finest line of tools and exhibit the greatest variety, either at the Electrical Show or at their great works, Spring and Varick streets. What you cannot find here no one else can supply you with.

PERU ELECTRICAL MANUFACTURING COMPANY, of Peru, Ill., exhibit in the next booth a big line of porcelain goods, as well as their large line of carbon goods for batteries, etc. They make a very handsome showing and are proud of it. A very elegant show case is next door, containing a full line of Cleveland twist drills.

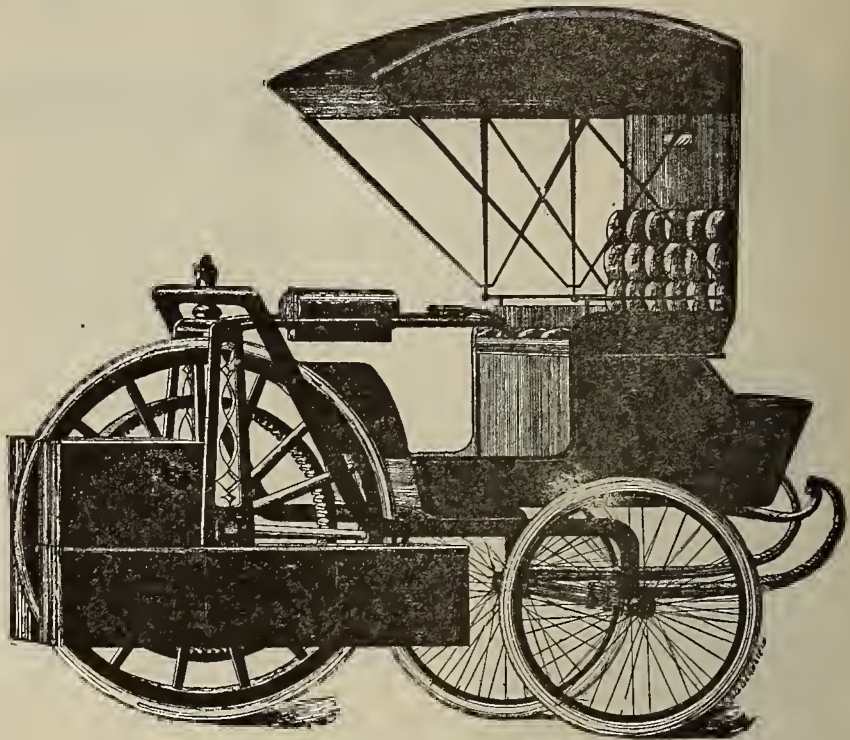
THE NEXT EXHIBIT contains the giant of the show, the only ROBERT COREY and his Armorite Conduit. This is the wood-lined iron tube conduit that has been so much talked of lately and is becoming very popular among the contractors.



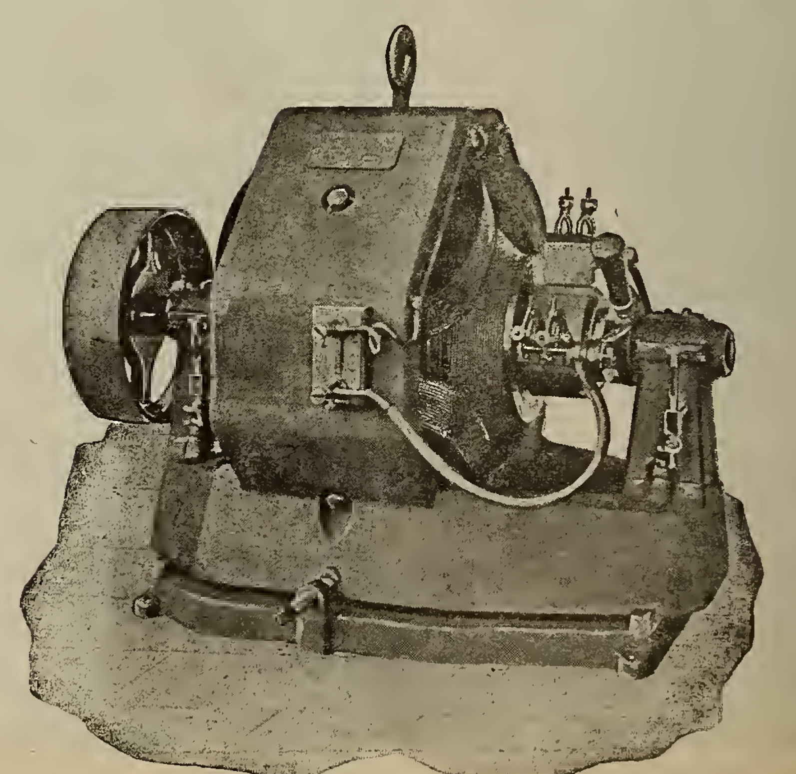
Edison Mfg. Co.'s Battery Fan Motor Outfit.

Chloride Accumulator.

W. T. BOSSERT is in the next exhibit, prepared to do battle for the Bossert Electrical Manufacturing Company,



Barrowes Electric Carriage.



Eddy Generator Run as a Motor in Coho & Co.'s Exhibit.

of Utica, N. Y., manufacturers of steel boxes or receptacles for conduit systems. To fully appreciate Mr. Bossert's exhibit, if you are a contractor, you must call and see his exhibit and get his explanation, especially of his new line.

WE NEXT VISIT ZIMDARS & HUNT, one of the main attractions of the Electrical Show. To enter this fine exhibit you open the circuit of an immense single-pole switch, ten feet long, the knife of which forms the gateway. Mr. John T. Hunt, of the company, assisted by Mr. Atkinson, the superintendent of the works, explains to your satisfaction all the details of the great variety of switchboards, panel boards, switches, automatic motor starters, etc., contained in the elaborate exhibit.

THE WESTON ELECTRICAL INSTRUMENT COMPANY occupies the next space, which is about twenty feet wide, one of the largest in the Show, with rich show cases containing a large variety of samples of their standard volt and ammeters, alternating current and watt meters, multivolt meters and everything used for power and station work; switch-board instruments of all kinds.

WHEN WE COME opposite the beautiful exhibit of the Edison Electrical Illuminating Company, Mr. J. Jones, Jr., of J. Jones & Son, will give you a hearty welcome to one of the most elaborate booths of the Show. It was shocking to see how some young men took hold of his medical batteries last night. That switchboard in the back part of J. Jones & Son's exhibit is the talk of the Show. The name of J. Jones & Son in ground glass lamps on a rich plush back ground cannot be surpassed for beauty of design and finish. Their switches, panel boards, etc., exhibited by Mr. Jones are all manufactured in their large works in Brooklyn Borough, Greater New York. They have moved into their new building, 64 Cortland Street. First floor is the salesrooms, second floor of offices, basement for shipping and upper floors for stock. For every $5 purchase you get a free ticket to the electric show.

THOMAS A. EDISON, JR.'S, exhibit comes next. Mr. Edison himself has the sympathy of all his acquaintances. By his over-zealous ambition last Tuesday night to get the great fountain in the centre of the Show in operation, in some manner he had three of his fingers on his right hand broken, a most serious and unpleasant accident at the beginning of the Exhibition. It has not marred his anxiety to make the Show a success, as can be seen in his beautiful exhibit to the right of the Madison avenue entrance. Mr. Gill, a very popular representative of Mr. Edison, Jr., is kept constantly busy explaining the virtues of Edison, Jr., lamps and more particularly the fickle people desiring Mr. Edison's personal signature.

HOW CAN WE DESCRIBE the beautiful exhibition made by the Edison Electric Illuminating Company? Those great white columns and domed cupola all brilliantly illuminated with Edison lamps. The EDISON DECORATIVE AND MINIATURE LAMP DEPARTMENT, of Harrison, N. J., must be given great credit for the beautiful manner in which they carried out the installation of the illuminating effects of this booth.

In the Madison avenue end are all kinds of electrical cooking apparatus furnished by the AMERICAN ELECTRIC HEATING CORPORATION, of Boston, Mass. In another part is shown an ice machine run by an electric motor, also a printing press, ceiling fans in operation, arc lamps, and every application of electricity.

RIGHT OPPOSITE the Madison avenue entrance is the large exhibit of the H. R. WORTHINGTON COMPANY, of New York, where are shown compressed engines run by large electric motors, and condensers of all kinds for electric light and railway power plants, and everything for the engine room.

NEXT TO THIS is the NEW YORK TELEPHONE COMPANY's booth containing long-distance telephones and telephone booths for secret telephoning. This company has an adjunct to their exhibit in one of the galleries to the left of the Madison avenue entrance, where they are receiving nightly over the telephone the music and performances of the different theatres. Wednesday night we had the pleasure of hearing from the Broadway theatre, the singing, music, speaking, and even the applause of the audience.

THE PARAGON fan motor exhibit on the main floor attracts great attention with a great pyramid of motors. One of the features of this exhibit is Mr. Williams's baby rocked in a cradle operated by one of his new Paragon power motors. The swish of air created by the pyramid of fan motors is very refreshing. It is a perfect western cyclone and will be more highly appreciated in the coming warm days of the Show. With his usual generosity, Mr. Williams has offered to keep all exhibitors cool by furnishing their booths with a fan motor free of charge.

THE FORT WAYNE ELECTRIC CORPORATION show their immense arc and incandescent generators, as well as their general line of alternating and direct-current apparatus. Their Duncan watt-meters are in great demand.

F. A. LAROCHE, of the Ideal Electric Corporation, made a big showing of their new automatic circuit breakers in operation. They are set up and connected with volt and ammeters and rheostat, so that you can see the exact reading at the time they break the circuit. They also show their various styles of dynamos, switches, etc.

THE RIKER ELECTRIC MOTOR COMPANY, of Brooklyn, attract a constant crowd of people examining the beautiful motor delivery wagon built for Altman & Company, the big dry-goods people in New York City. They also show their electric motor Victorias, all operated by Chloride Accumulators. They have a number of their Riker fan motors in operation, and Mr. Riker himself creates a halo around the booth.

THE BARROWES VEHICLE COMPANY, 302-306 West 53rd street, New York, exhibit their motor vehicles at the Show. They show the most novel line of electric motor vehicles. They operate in conjunction with the Willard storage battery, which is all suspended on a powerful pneumatic-tired single wheel in the front of the vehicle, operated like a bicycle handle from the seat of the vehicle. By having all the weight on the single wheel in front, they claim it gives greater traction and takes away all vibration in the carriage.

THE POPE MANUFACTURING COMPANY exhibit their Columbia motor carriages, operated by Chloride Accumulators. All the mechanical work on these carriages and delivery wagons are in the usual style of the Columbia wheels, finished in a very ornamental and substantial manner.

WE NOW LOOK UP into the gallery from the Pope Manufacturing Company's exhibit and spell out the name E. P. Morris. There is only one E. P. Morris in this Borough, and he is making a big show at the Garden, and his goods as well as himself must be seen to be appreciated. He has a little room partitioned off from his exhibit wherein he receives his dearest friends. I have not been made acquainted with the full contents of this room, but you can feel assured, readers, that there are some fine cigars there. These cigars are not as strong as the great Monarch paint he handles, that will insulate everything electrical, from a wire to a dynamo. He handles the noted Keystone volt and ammeters, everything needed in the electric railway line and everything in the supply line, from a push button to a dynamo.

WE COME along the gallery and find the only Prof. Ker in the Show, representing that popular educational institution, the Hebrew Technical Institute. He is showing a beautiful line of models, from a complete dynamo to an ordinary spark coil, all made by the boys in the Institute, and put on exhibition for the purpose of drawing some of the prizes.

FROM THE NEXT booth we hear the musical notes of the GRAM-A-PHONE echoing throughout the Garden.

WE HAVE already passed the Le Vallee Vitae Carbon Company. They show a full line of carbon cylinders for open circuit batteries, as well as a full line for all battery uses.

THE NOWOTNY ARC LAMP is in this gallery in an elaborate booth, and they are letting their light shine as an example for buyers to call and leave their orders.

WOOD, SHAW & COMPANY come next with a full line of the noted Partridge carbon brushes for dynamos and motors, Universal lightning arresters; and Mr. Harry Shaw himself, who lately hitched horses with Mr. Wood, have their offices at 42 Broad street.

THE CROUSE-TREMAINE CARBON COMPANY is in the next booth, manufacturers of every kind of carbon.

THE NEXT BOOTH is one well to be remembered. The Fostoria Incandescent Lamp Company have their booth fitted out in front with brilliantly illuminated Greek columns surmounted with globes all brilliantly illuminated with Fostoria lamps. The columns contain spirals of pretty colored low-volt lamps. In the back of the booth is a large board containing all styles of 220-volt lamps, a new feature of the incandescent lamp business.

WE COME NEXT. The Electrical Age booth was the first one completed at the show, and we take pride in writing it, as we distributed the first electrical paper at the Electrical Show, Monday afternoon and evening, containing accounts of the exhibition.

THE SAFETY INSULATED WIRE & CABLE COMPANY has without doubt the finest exhibition at the Show—Fort Safety they call it. You look into the mouth of one of the great disappearing guns and there the word appearing within its interior is "Safety." Then we look overhead and find the Stars and Stripes thrown to the breeze. By the ingenious idea of the Safety Company the flag-pole is made hollow, and through an opening in the pole they throw the breeze from a fan motor upon the flag. They show in the centre of the booth an exact model of Sandy Hook with a beautiful battle-ship at anchor with the channel filled with submarine mines. Every visitor receives a disappearing gun with the word "Safety" printed on the same. Messrs. Requa, Eckert, Richards, Williams, Holloway, are the representatives of the company at their beautiful booth.

STANLEY & PATTERSON, of 32 Frankfort street, New York, one of the largest supply dealers of this city, have a large booth in the gallery filled with all the most novel electrical goods, from a push-button to a complete X-ray outfit, and to complete the exhibit Messrs. Stanley & Patterson are there every evening to receive their friends. WE FOLLOW THE CROWD up the stairs over the Madison avenue entrance and enter Music Hall, filled with lay figures of all the ancient electrical dignitaries. IN THE FAR LEFT-HAND CORNER is a stairway leading up to Moore's chapel. The constant stream of people kept the writer from visiting this beautiful exhibition of vacuum-tube lighting, but the following remarks were overheard from visitors to the chapel:

We cannot conclude these remarks about the Electrical Show without reference to our friend and faithful worker, Mr. Marcus Nathan, the general manager. Everybody had a good word for him. They all praised him, from the employé to the biggest exhibitors. Similar tributes were paid to his assistants, Mr. T. Martin, Mr. Osterberg; Mr. Deronda Levy, Mr. M. Norden, Mr. Lardner and the faithful work of the trustees of the Exhibition, C. O. Baker, G. F. Porter, L. F. Requa, etc.

The Berlin Iron Bridge Co., of East Berlin, Connecticut, manufacturers of iron trusses for electric light, power, etc., and roof supports. They are light and airy and are specially insulated. You are invited to inspect the handsome structure they have in the electric show.

The Bullock Electric Mfg. Co. have lately issued a small card in which they enclose all their letters to machine builders and factory owners.

On one side of the card is diplayed a cut of one of their motors operating a 72-in. planer. The motor is of small size and is placed on top of the planer, allowing a travelling crane to pass over it. The shaft of the motor is coupled direct to the main driving shaft of the planer. The motor is shunt wound to give constant speed under varying loads, and has a capacity of 12 horse power.

On the other side of the card is a short description of the arrangement of motors on machine tools and the advantages to be derived from this mode of supplying power. The card is printed in two colors and makes a neat enclosure for letters.

American Electrical Novelty Co., 231 Broadway, N. Y. exhibit at the electrical show a fine line of automatic and push button lighters for all kinds of home uses; some are very ornamental. You must see this line of fine electrical goods when you visit the show.

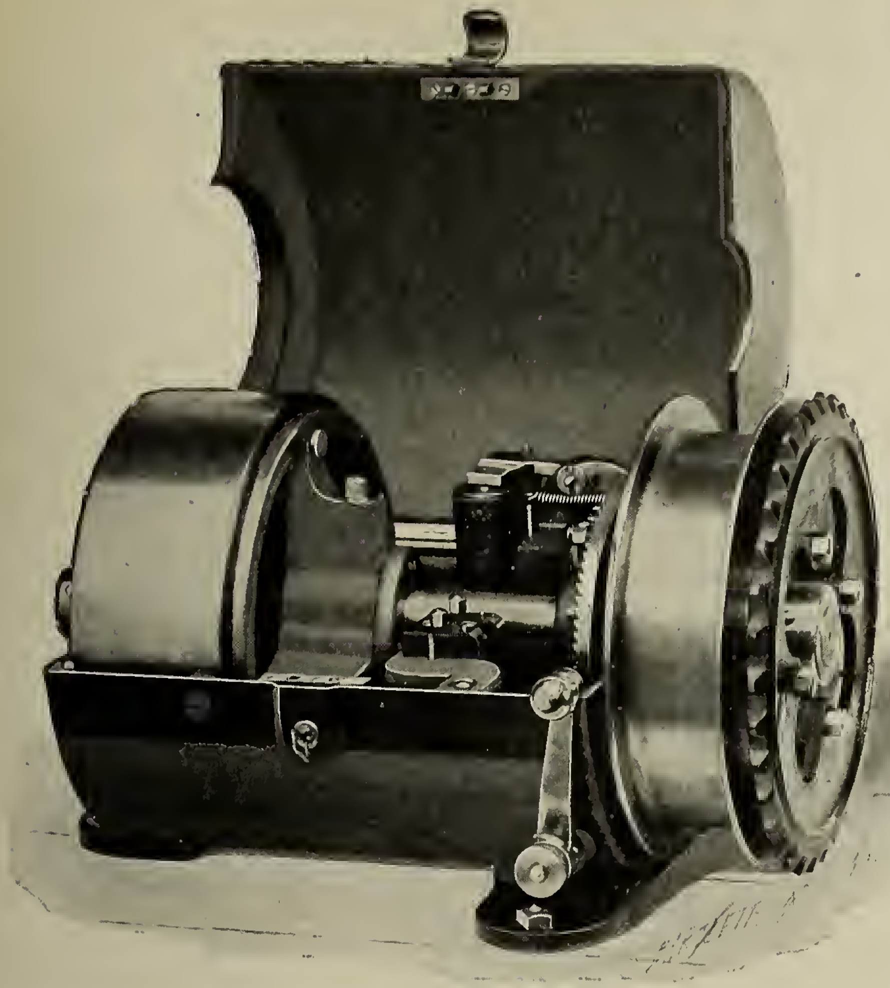
H. W. Kirkland, 120 Liberty Street, N. Y., is special agent for the Cutter Electrical Manufacturing Co., makers of the popular automatic circuit breakers for central stations and electric railways and small power circuits. They can be seen in operation at the electric show.

Otis Brothers & Company, of the Potter Building, New York, are exhibiting an improved push button device used in connection with their well known electric elevators. A small working model of the same is on view in the exhibit of H. B. Coho & Company. The device is used for operating electric elevators in private residences and other places where no operator is employed in the car. The movements of the car are controlled by buttons, inside and outside the car, the device not operating unless the doors leading to the shaft are closed. This insures absolute safety, not only to the occupants of the car but also to outsiders.

H. B. COHO & CO., 30 Cortlandt St., N. Y., manufacturers of switchboards, panel boards, expert electrical engineers and contractors for electric light and power machinery, especially the general repairing of dynamos and motors. This branch of the business was taken up by them after a number of years' experience in having this work done outside. They are selling agents for Eddy apparatus and The Warren Electric M'f'g Co. They are making big exhibition at the electric show. They exhibit a direct-connected Eddy dynamo, 15 H.P., to a Van upright gas engine, switchboards, panel boards, and American rheostats, crown brushes, Watertown engine and new-type, 6-pole Eddy dynamo, No. 3 Eddy plater, 75-K. W. Warren alternator, and two new-type Eddy ironclad motors.

The Electrical Age.

VOL. XXI—No. 20 NEW YORK, MAY 14, 1898 WHOLE NO. 574



Monarch Engine Stop.

Automatic Speed Limit.

THE MONARCH ENGINE STOP AND AUTOMATIC SPEED LIMIT.

The Monarch engine stop is one of the latest products of the engineering world, and represents a combination of an electrical and mechanical nature which prevents an engine from exceeding its normal speed. This ingenious affair does not require any attention after installation, as it operates with absolute certainty and cuts off the steam supply at first very rapidly; then with diminishing speed. In case the engine should by any accident begin to race, the engine stop will throw into action an electro-magnet which, by the motion of its armature releases a detent and allows a drum to revolve rapidly, thereby shutting off the steam supply, that is to say, the throttle valve. A sprocket wheel attached to the drum is spun around by means of a suspended weight, a cord connected to which is wound around the drum. When the drum is allowed to rotate by the descent of the weight, which is caused by a release or pawl, a sprocket chain connecting to a sprocket wheel on the throttle valve turns with it and closes it.

It is possible to set this engine stop so that it will operate at any given speed, immediately shutting off steam when the limit is reached. The speed limit represents a combination consisting of a governor which operates a contact collar which, according to the speed of the engine, will move the contact collar backward or forward, closing the circuit by pressing upon two slips of metal, threby sending current through a magnet which, by the mechanism previously described, shuts off the engine.

When the engine speeds up beyond the proper number of revolutions per minute, the governor balls are thrown out, the contact collar slid forward, current circulated through the electro-magnet and the steam throttled. It is possible by the aid of this device to stop the greatest Corliss engine in existence through the medium of an ordinary push button. The illustrations show the engine stop with ratchet catch, electro-magnet, drum and sprocket wheel. In the illustration of the speed limit is shown the governor, movable collar and contact slips. The value of these innovations are being shown to the utmost advantage at the Electrical Show in Madison Square Garden. They are being manufactured by the Monarch Manufacturing Company, 39 Courtlandt Street, New York.

ELECTRIC HEATING, LIGHTING AND VENTILATING AT THE MACKAY MAUSOLEUM AT GREENWOOD CEMETERY.

The inside of the Mackay Mausoleum is lighted by sixty 10-C. P. incandescent lights placed at the base of the dome roof and are hidden from view by a heavy marble cornice; the sixty lamps are set in a horizontal position and underneath the lamps there is a special white enameled copper reflector fitted to the base of the dome in such manner that the light is reflected to the dome which is decorated with Venetian mosaic work; by this means the whole of the interior of the mausoleum is thoroughly lighted without any shadows, there being a perfect diffusion of light, and a very pleasing effect.

The heating and ventilating of the mausoleum is accomplished by a series of plates being charged by a current of 220 volts, taking altogther 80 amperes of current, installed in four series of 20 amperes each, so that any desired temperature can be obtained according to the requirements of the owner. There is in connection with this electric heater a nine-inch air duct carried to the outside of vault so as to obtain a current of fresh air, which, in passing over the heated plates, gives a current of pure warm air to the interior of the mausoleum, which in turn passes out at the top of dome, thereby completing the system of perfect ventilation for the interior.

The heating apparatus is sunk in the centre of the mosaic floor and covered by a handsome bronze grill work perfectly flush with the floor.

The lighting and heating is controlled at the panel and distributing board set flush in one of the black Belgium marble panels inside the mausoleum, which is enclosed in a handsome bronze frame and marble door.

The whole of the above work was designed and installed by Zimdars & Hunt, 127 Fifth avenue, New York city.

INSULATION AND CONDUCTION.

BY REGINALD A. FESSENDEN.

(Continued from page 260.)

We must have an electrically homogeneous dielectric, i. e., one of the same specific inductive capacity all through. This is for two reasons. First, because, if we have a dielectric A between two charged conductors, the introduction of a dielectric of greater specific inductive capacity even if of infinite dielectric strength and ohmic resistance, will cause A to break down. To take a numerical case,—suppose we have two plates, 1 cm. apart, and attached to the terminals of a 10,000 volt A. C. dynamo. (Fig. 5.) Suppose the dielectric, air, to support 50 per cent. more than this pressure. Introduce two plates of glass of K = 8, each ¼ cm. in thickness. Since the voltage divides itself up inversely to the capacitance, we will now have 8,889 volts between C and D. This being at a rate of 17,778 volts per cm., and as it only supports 15,000, we will get a spark between C and D at every reversal of the voltage, which will quickly heat the glass and make it conduct. The full potential of 10,000 will then be between C and D, and a regular arc will form.

Thus we see that the introduction of a good insulator will, in all cases where an intermittent or alternating voltage is used, have the paradoxical effect of weakening the insulation, unless the whole space is filled up with the material. This weakening is not generally apparent at once, as the spark takes some time to eat its way back, and this explains why many induction coils only last for a few years of operation.

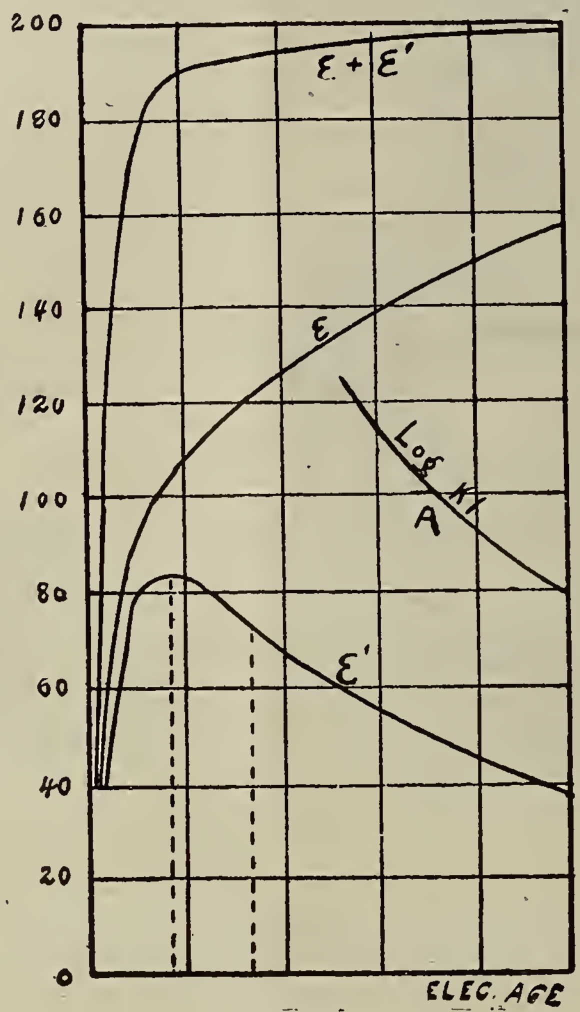


Fig. 9.

Another cause is that treated of by Poisson, Clausius and Maxwell.* This is, that layers of dielectrics of different capacities and resistances show electrical absorption, and this theory has been proven experimentally by Muraoka, who showed that by taking two fluids, neither of which showed absorption, a layer of one on top of the other did do so. Maxwell treated the general case. It has, however, been treated in a more specialized way by in "La Lumiere Elec.," 1891. In this paper are brought out the following points:

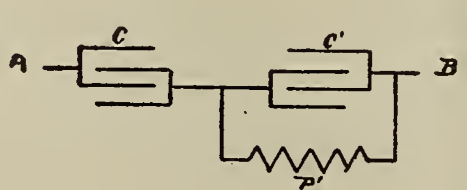
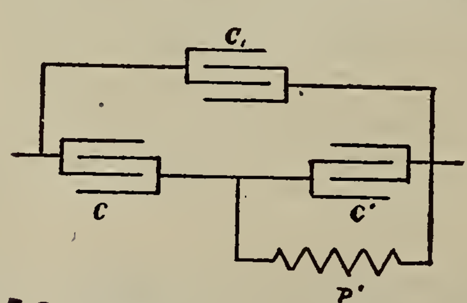


Fig. 7.



ELEC. AGE

Fig.

1. A dielectric, as in Fig. 6, containing conducting particles of water, for instance, may be considered as an arrangement of condensers and resistances in series and shunt with each other. Two cases, shown in Figs. 7 and 8, are worked out, and Fig. 9 gives the curve of charge in the cases of Fig. 7; E is the voltage on the condenser part and E^1 that on the condenser and resistance.

2. A condenser can show large residual charge, though its true ohmic resistance is infinite.

3. With dielectrics showing absorption, there will be found some discharge time at which the amount of dis-

iarge will be constant at all temperatures.

4. Why in some tests insulation seems to be lower ith higher voltages.

5. Why the presence of conducting particles increases pparent capacity.

6. That to get true ohmic resistance of most dielecics, voltage must be kept on for a long time, even for ys.

7. Why Siemens' method of taking the rate of loss of arge by electrometer does not give correct results.

8. That specific inductive capacity of such dielectrics n only be determined by rapidly alternating currents. his possibly explains an effect noticed by the writer any years ago, i. e., that an A. C. static wattmeter imersed in water did not give anything like the torque it ould have if the true value of K for water were 80.

9. The importance of getting out the last traces of iter in gutta percha and paper when used for cables.

As mentioned, this author considered a simple case of axwell's general theory and proved the above results by iking actual measurements on condensers and resistces connected up so as to correspond to a sime case of a dielectric of high resistance with concting particles in it. This paper should be read all electricians, especially those concerned with ble work. I would like to speak of this subject ore in detail, but for lack of time will only add that ost of the conclusions in that paper have been confirmed me, and that some which had been arrived at indepenntly were seen to be in perfect agreement.

It is this absorption and the consequent losses which ike glass useless as an insulator against high A. C. ltages. In some experiments made by Messrs. Stanley d Chesney, which were shown to me, the glass plates the condenser when on an A. C. voltage (though thick ough to have stood ten times the D. C. voltage) after a v moments got hot, sparks could be seen passing in.e the glass, and the plates finally broke down. Glass not homogeneous, as it is made up of a number of subinces, some much better conductors than others, and of ferent capacities and all stirred together, but not ssolved. This is shown by the care which has to be ed in getting glass homogeneous enough for optical rposes, it even having, as has been told me by Mr. ashear, to be kept perfectly horizontal when annealing, the heavier parts tend so much to sink down to the ttom, even when the glass is only plastic, that the only y to do is to keep the levels of different density rallel to the surface of the disk so that their effect on light will be as equal as possible for all rays. Otherse one side of the lens would be of heavy glass and the ier light, while at present it is so arranged that one face dense and the other light.

Mica is much less objectionable, especially if its cracks filled up and it is well dried. Paraffin when properly eated makes very good condensers. The old method of ing together pieces of paraffin paper and tin-foil and en pressing them, left much air and moisture inside. iis produced large electrical absorption and gave large pacity. Messrs. Hutin and La Blanche were the first discover that good condensers could be made by heatg such condensers till the moisture and air were exlled. Their results† showed that the specific inductive pacity of this more homogeneous dielectric could be reced from 8 to 2.5. I have myself found it come down low as 2. They then found that the same results could obtained by heating the paper before making up the ndenser. Since then this method of forming connsers by heating them to expel moisture, air and acid s been used quite generally, with some modifications d improvements resulting in a shortening of the process.

It may be said as a general rule that the capacity all substances showing absorption may be reduced by s treatment, if the heating be kept up long enough. great many oils, for instance, are given high capacities, but I have found that in many cases this can be greatly reduced by this method, and that the slight remaining excess of K over that called for by Maxwell's theory can be almost entirely removed by removing the free fatty acids, mucins, etc. Oils tested by me were olive, castor, linseed and cottonseed. All these have very high insulation resistance and low specific capacity when so treated and purified, but they soon lose this again when exposed to air.

It is evident, therefore, that the anomalous results obtained by Hopkinson and others were due, in some cases at least, to impure material, and such results must be considered as forming a strong proof of the correctness of Maxwell's theory.‡

But when the substances are not themselves solid, but viscous, they must have a mechanical backing. For this pure cellulose is generally used. Pure cellulose contains some loosely combined moisture. Consequently it can exist in two states. Dried below 100° C. it decreases its specific inductive capacity very much, and has very high resistance and is flexible. Kept above 100° C. for any length of time, it loses some of its combined water, has a much higher ohmic resistance, and its specific inductive capacity sinks to 1.9 or 2. It, however, becomes very brittle, and even though the temperature be only a few degrees above 100 C. it finally cannot be bent without breaking. (This brittleness must be carefully distinguished from the so-called rottonness which cotton fabrics get when dipped in linseed oil and dried. The fact that cotton tears easily in such a condition is due to the same cause as makes a wire mosquito netting tear when painted, i. e., the fibres are stuck fast by the varnish and cannot help one another. This can be proven by removing the dried oil, when the fibre will be found to have nearly its original strength.) In this condition it is best suited f r making condensers.

The paraffin itself is greatly improved, as was pointed out by Hutin and Lablanc, by heating to about 140 C. Tnree hours' heating I have found satisfactory. The dried paper, immediately on removal from the oven, is plunged into the hot paraffin, so as to protect it from absorbing moisture. The condenser is then made up and boiled, so as to remove the air, for several hours. This boiling method was described in a recent patent as a novelty, but it was used by Mr. Chesney at Pittsfield in 1891.

A condenser so made, if perfectly pure cellulose is used (perfectly pure paper is used in practice), and with pure paraffin, will sta.d 250 volts per thousandth of an inch when the dielectric is less than .01 inch, and at a higher rate for greater thicknesses, when the effect of small defects in one sheet of paper is not so serious.

Practically the same remarks apply to the making of induction coils. Here, however, we meet with the great difficulty that paraffin in cooling is sure to shrink, and will leave hollows inside. The way to get over this is to construct the coil so that when cooling the shrinkage will take place outside, just as if one were making a casting of some metal having great contraction. The coefficient of adhesion also should be less between the walls of the mould and paraffin than between the wire and paraffin; also the outside should never be let harden first, as then, of course, a hollow space is left inside. Another precaution is to expel all gases by heating the paraffin for some time above the temperature at which the coils are to be boiled. The coils should be boiled above 100° C. for some hours to drive off the loosely combined water. This destroys the mechanical strength of the cellulose, but as the whole coil forms a solid mass this is of no great consequence.

(To be continued.)

* "Elec. and Mag.," vol. 1, chapter x.

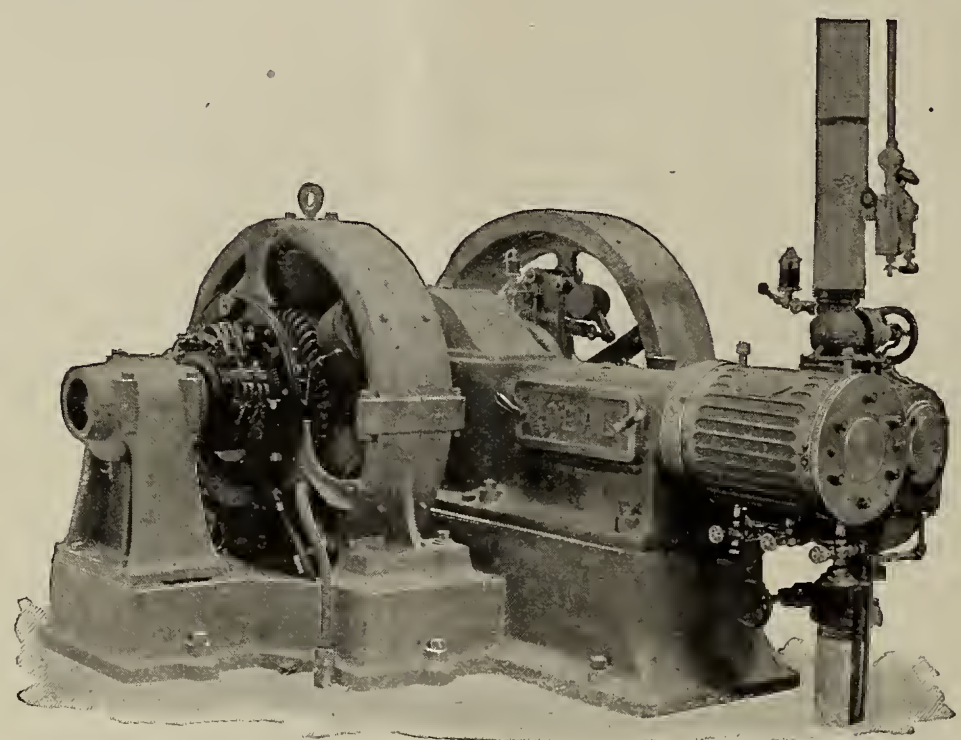
† La Lumiere Elec.; July 25, 1891.

‡ A rule connecting this effect with the sign of the Kerr's electrostatic optical effect has been given by the writer.—Elec. World, Jan. 2, 1897.

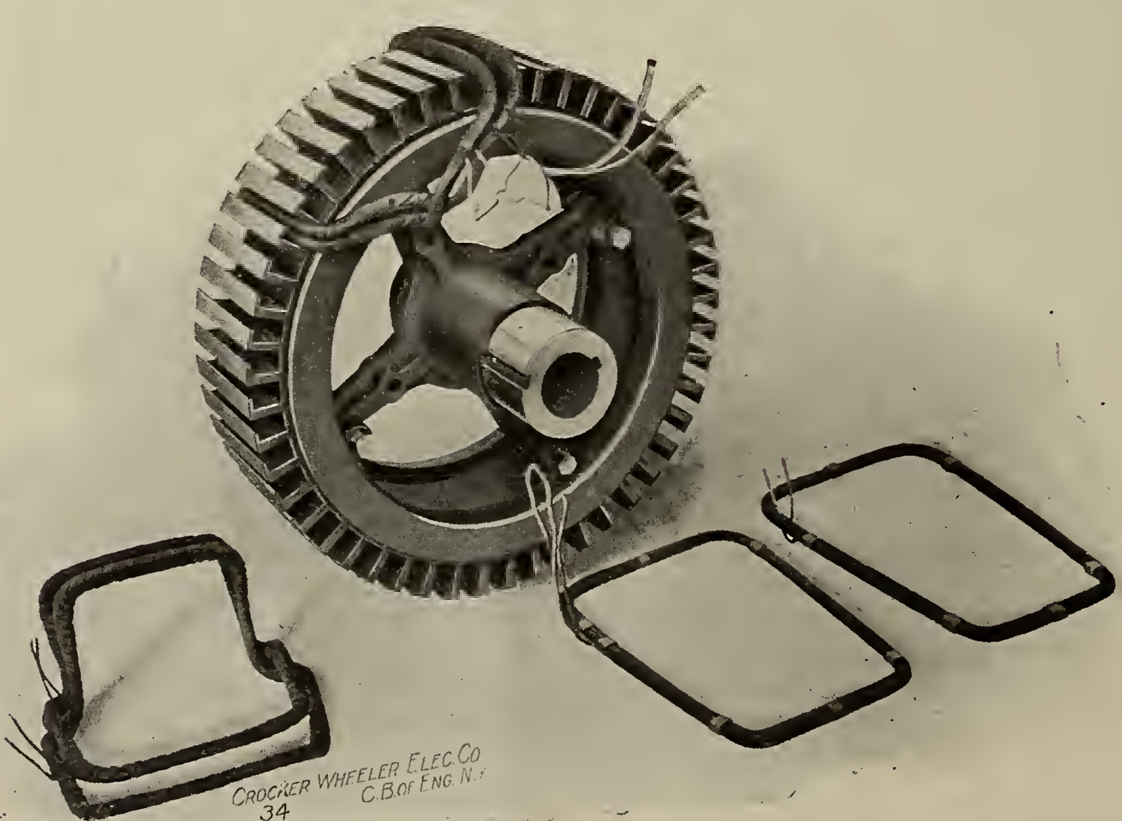
IMPROVEMENTS IN ARMATURE WINDING.

Many of our readers who have followed the subject of dynamo design will undoubtedly appreciate this sketch, showing one of the most improved methods of armature winding in vogue at the present stage of the art. The armature here depicted is of standard size and design and represents an advance beyond the customary forms of toothed armatures. The laminated body is held and clamped within a frame-work looking like a four-spoked wheel. The winding is formed before it is put on, thus saving a vast amount of time and labor. The teeth being made of sufficient cross section to carry the field sent through them do not give rise to any irregularities in its distribution. Humming and heating are entirely absent and the armature when complete is perfectly balanced magnetically and mechanically. The simplicity and consequent value this process gives rise to means sparkless commutation and the absence of dead resistance due to extraordinary lengths of end wires.

The Bradley system with copper bars offers the same advantages, but requires more care and is therefore more costly. The practice of using formed coils has grown to an extraordinary degree, making hand-wound armatures in many respects behind the times. Where speed in manufacturing is aimed at, and compactness with minimum weight, the above method must be followed out in every respect. A model isolated plant direct-connected means not only effective mechanism, with economy in operation, but cleanliness and no noise as well. There are many electric light plants owned by private individuals looking more like a ladies' boudoir than a place where heavy machinery is in operation; the æsthetic taste being now as strongly developed in competent designers of electrical machinery as the idea of having the machinery they manufacture operate to advantage from a dollars-and-cents standpoint.



30 K. W., Size 33 Direct-Connected Dynamo on Ideal Engine. Crocker-Wheeler Electric Company.



Armature Core, Showing Method of Winding and Applying Formed Coils. Crocker-Wheeler Electric Company.

VISITORS AND EXHIBITORS to the Electric Show all wonder where the mechanism is in the enclosed arc lamp lighting J. JONES & SONS' exhibit. There is no magnet or wire used in the lamp except to connect the two terminals. It operates by gravity and the gas formed in the enclosed bulb. Stop and see how simply this arc lamp works without any mechanism. They are just being put on the market.

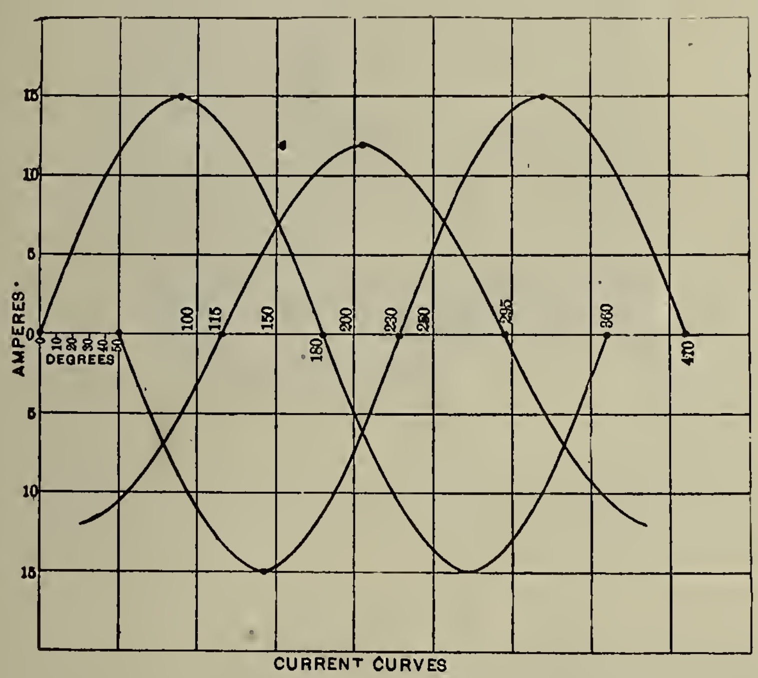
TRANSFORMERS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

(1.) The interesting methods by which alternating current apparatus is designed and constructed, and the peculiar effects manifesting themselves, have given rise to a closer study of the subject in all its varied details. Not only have some of the greater difficulties been overcome, but its introduction beside and as an active and equal competitor of continuous currents in a commercial and practical sense is plainly evident.

Alternating current motors.—For many years the sluggish progress of alternating-current practice could be easily traced to the lack of a motor which could compete in the open market with the others. It had been deemed impossible to construct one of this kind. To obtain power in the form of mechanical energy from an alternating-current circuit necessitated the use of another alternator of the same frequency. This motor, to be, was rotated up to its proper speed by some additional device, and then the current applied.

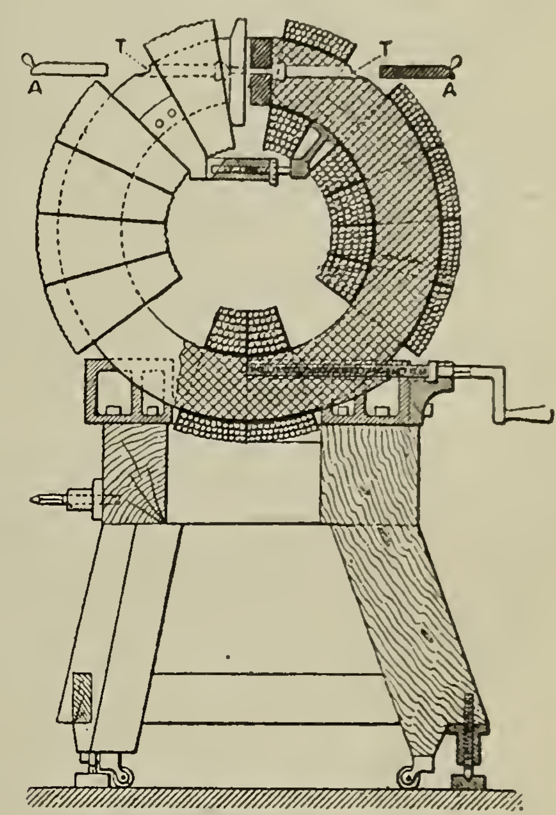


Alternating Current Curves.

Synchronism.—With the frequency or periods of both generator and motor equal, the machines are said to be in "step," or in synchronism with each other. The difficulty now arises, however; with a dropping in speed of the motor, this condition of electrical harmony, as it were, ceases to exist. Both machines fall out of synchronism, and the motor, after a short interval, comes to rest. This difficulty was for a long time ineradicable. It was impossible to start an alternating-current motor from a condition of quietude, and likewise impossible to hold it in synchronism with considerable changes of load. Any continuous-current motor, at least, possessed this qualification of being self-starting; a great handicap, therefore, stood in the way of making an even test of both systems. A difficulty of this character deprived the exponents of alternating-current machinery of a most valuable feature. Transmission of power was not very practical, although the mere laying of a long line was and has been an easy achievement.

Rotary Field Motors.—It was discovered by our famous inventor, Nikola Tesla, that if by any possibility a magnetic field was caused to travel around an iron circuit, or in any way allowed to affect an armature core wound or bare—if the metal mass in the centre is free to rotate—this circulating field will drag it around at a high rate of speed. A rotary field is produced by means of polyphasal currents—peculiar impulses, identical with an ordinary alternating current, but consisting of not one, but two or three successive impulses forward and the reverse backward.

Polyphasal Currents differ in no respect from an ordinary alternating current. A single impulse rising and falling in a wire can, in imagination, be succeeded by another before the first has begun to decrease. Likewise, the second might be followed by a third impulse, which has the same difference of phase between it and the second as exists between the second and the first. This system can be developed to any extent. To create a rotary field, for instance, with a current of these impulses or



Device for Producing Intense Magnetic Fields.

waves, a ring of iron wound with three coils each one-third round, and receiving successively a wave of electromotive force, would naturally produce a magnetic field of this description. Whether iron or copper be placed in the centre, the field will drag it around. A polyphasal current means a current of many phases; the word poly meaning many. The additional fact that when an armature is gripped at points all around its periphery it is better able to develop torque, has made this innovation decidedly practical.

A Sine Wave is the name given to a wave of electromotive force of current proceeding from an alternator. It was discovered by Joubert that the mathematical curve called the sine curve and the diagrammatic representation of a rise and fall in electromotive force differed so slightly from each other that the latter deserved the same name.

True Value of the Current.—An alternating current has no fixed or uniform value. It rises and falls like an ocean swell, beginning, growing rapidly to a hilly prominence, and subsiding again to nothing. There is no definite value to be given to the flow of an alternating current that is other than approximate. At each instant of its growth and decrease it has a decided value, but this constantly changes, varying from nothing to a maximum; that is, its highest value. We are forced, therefore, to judge by approximation of its real strength; in fact, to measure it by two methods.

Mean Current.—One of these methods is that of taking the value of the current at successive instants of its rise and fall and forming an average, calling this the mean current. If the current rose and fell and the seven tests showed the values of

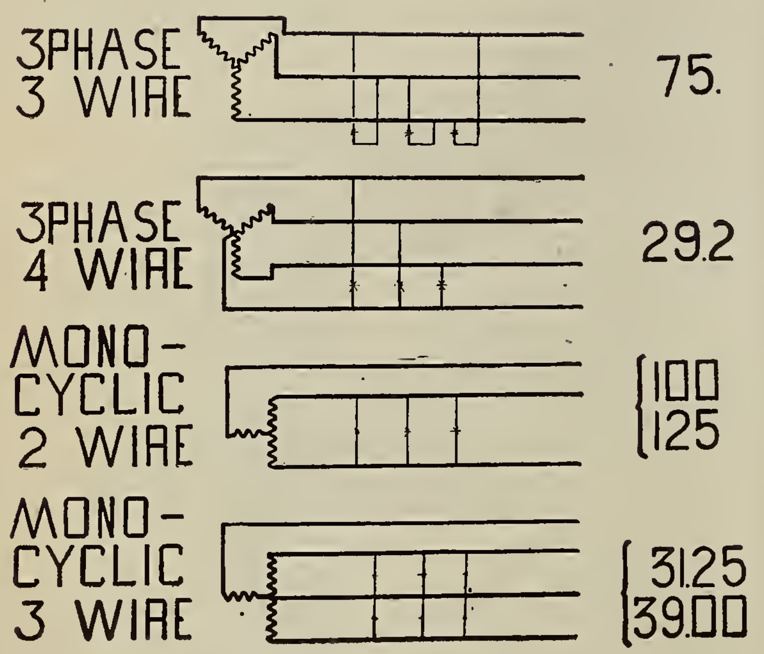
$$\begin{array}{r} 0 \\ 2 \\ 4 \\ 6 \\ 4 \\ 2 \\ 0 \\ \hline 18 \end{array}$$

the average would be therefore $\frac{18}{7} = 2\frac{4}{7}$ amperes.

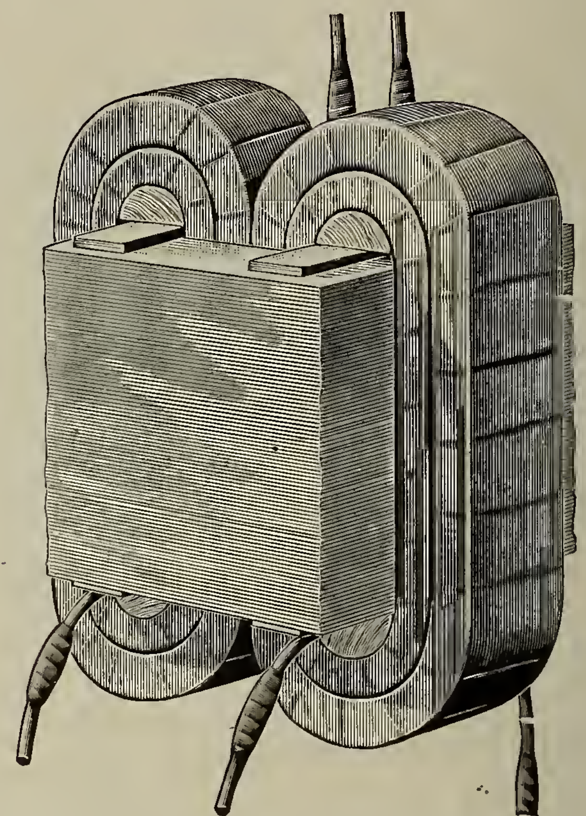
$$\frac{76}{7} = 10\frac{6}{7},$$

extracting the square root gives us 3.29 amperes. In practice this value is accepted as the nearest approximation, and is used in ordinary calculations.

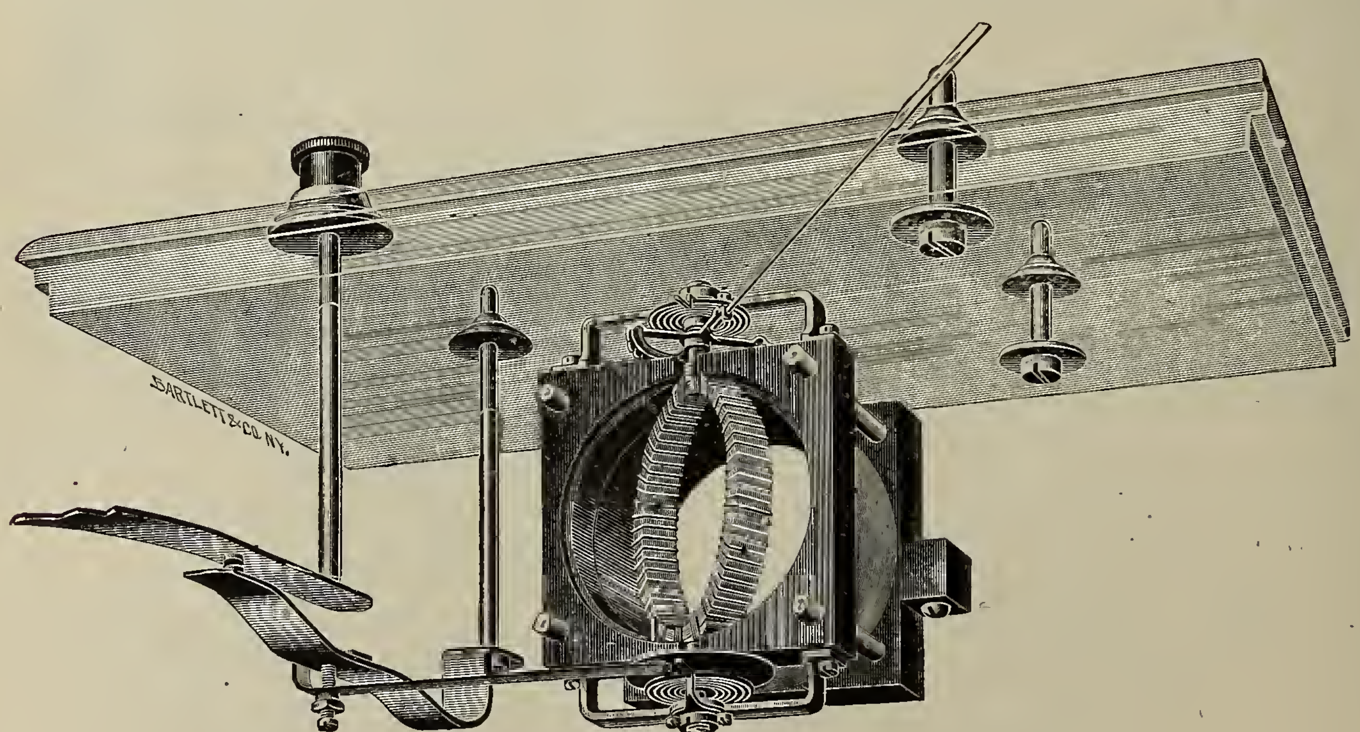
(2.) The different values of the current does not prevent the instrument maker from constructing meters which will measure the "square root of the mean square." The pulsations of an arc-light current practically consist of a



Systems of Alternating Current Distribution.



The Scheeffer Transformer. Diamond Electric Co.



Mechanism of Alternating Voltmeter.

This value, 2.57 amperes, is called the mean current.

Square Root of the Mean Square.—Another method is that of taking the same measurements, squaring each result, taking the average of the squares, and then taking its square root. The process with the same figures would be that of squaring

$$\begin{array}{rcr} 1 & = & 1 \\ 2 & = & 4 \\ 4 & = & 16 \\ 6 & = & 36 \\ 4 & = & 16 \\ 2 & = & 4 \\ 0 & = & 0 \\ \hline \end{array}$$

Taking the average square, 76

series of waves always passing onward in one direction, but virtually similar in general appearance to an alternating wave. The rapidity with which a series of alternations pass back and forth is productive of several strange effects. A piece of metal of any description when thus influenced becomes warm and possibly very hot. When a coil of wire containing a core of iron is magnetized and demagnetized by an alternating current a peculiar hum is heard. The more rapidly the current reverses the louder the hum, until its resonant sound is like a low musical tone. The iron within the core will become very warm and have a curious effect upon a piece of metal placed near it, repelling it with considerable force and likewise exciting heat in it. The explanation given of the effect produced in iron is twofold.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

FIRST FLOOR, WORLD BUILDING.

NEW YORK.

NEW YORK, MAY 14, 1898.

CONTENTS.

COMPETITIVE ILLUMINATION.

At the rate of $1.25 per thousand cubic feet of gas, the general public are well content to continue its use without evincing any strong desire to avail themselves of more improved methods of lighting. Compared with this, we find oil and electricity in great demand, and even promotors of acetylene pushing their way forward. At the Electrical Exhibition, MacFarlan Moore shows a method of producing artificial daylight on demand. If it were not for the fact that all inventions are weighed from a dollars-and-cents standpoint, as well as the methods involved in their use, all improvements in the illumination of homes would be as popular and widespread as the various grades of bicycles. But the public desire a return for every investment they make, equal to, if not better than, the last.

We would suggest, therefore, that they be advised of the true state of the art of artificial illumination by publishing the reports of a test made with all known systems of any commercial importance, with the cost, candlepower, convenience of each, etc., succinctly set forth.

Each method of illumination finds a place best adapted to its use, and it therefore follows that neither the arc, incandescent light, or the vacuum tube shall reign supreme. "Each in its proper place is best," depending entirely upon the requirements and circumstances brought into view by a proper analysis of the situation.

FORGING BY ELECTRICITY.

There have been many occasions in which it has seemed impossible to introduce to the commercial world an article of pronounced value owing to the circumstances that affect its application. In reviewing the history of invention the interdependence of one upon the other, and the wonderful development in that field may be traced to the increased advantages of those seeking original paths or striving to improve upon devices already in vogue. The electric forge has been acknowledged by authorities to be an exceedingly economical, convenient and consequently practical invention, but there is no evidence in this city that its use is being as well appreciated as at Buffalo or Niagara City. The ordinary blacksmith, as a rule, has no higher ambition than the earning of his living. The forge, its heap of coke, smoky smell and other familiar features has not varied essentially from its earliest prototype used in the days of Tubal Cain. The blacksmith himself seems to have relinquished his right to make further progress, and it therefore seems evident that advances in that line must be made by others who have seen in the improvement of his forge a series of decided benefits that will cause a revolution in so ancient a field of work. The Burton Electric Forge finds its use for brazing, forging and welding as well as the tempering of tools. No better way can be devised for producing a uniform temperature in a piece of metal than this. It simply consists of a wooden trough supported on four legs, carrying a plate of metal on the bottom connected to an out-running wire, and pair of tongs attached to the other wire. The liquid in the trough is an aqueous solution of sodium carbonate and borax having a specific gravity of 10.5. The rapidity with which a one-inch bar one foot long is heated cherry red is fifty seconds, the current required being twenty-six amperes. A half inch bar turns white hot in eighteen seconds with a current of ten amperes and 220 volts. The beauty of this contrivance and its remarkable value is due to the manner in which the current automatically regulates itself according to the size of the material being heated.

Also, the ease with which the heat can be regulated appeals very strongly to the practical iron worker. The oxydation is less, the heating quicker and the cost less than by the old fashioned method. The further use of the electric forge depends entirely upon the business enterprise of those owning patent rights and in control of these rights for certain districts. Although Buffalo and Niagara and even Rochester depend for their source of power upon electricity, and may be truly called electrical towns, New York City will in the course of a few years show so extensive a use of this agent that it will be noted throughout the civilized world as the centre of all innovations, and not the least among these will be the electric forge.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The Trunk Line Association, Central Traffic Association, New England Passenger Assocation, Southern Passenger Association and the Western Passenger Association, have granted a rate of a fare and one-third, on the certificate plan, from all points in their territory to Chicago and return, for delegates attending the twenty-first convention of the National Electric Light Association, to be held June 7, 8, 9; Convention hall and headquarters at the Auditorium Hotel. Rates: $3.50 to $5 per day on the American plan; $2 to $4 per day on the European plan for each person.

NEW YORK ELECTRICAL SOCIETY.

The 187th Meeting was held in the Concert Hall, Madison Square Garden, on Thursday, 12th inst., at 8:20 p. m. After a short session for the transaction of current business, at 8:30, Dr. Schuyler S. Wheeler lectured on "Electrically Driven Machinery."

The lecture was illustrated by experiments and lantern slides. The evolution of Electrical Machinery, as influenced by the gradual change from belt driving to electric driving was traced, and the modifications of design making for greater simplicity thus rendered possible was demonstrated.

First.—It is observed that the magnetization consumes power. A piece of iron magnetized by a current flowing in one direction will consume more power to bring it back again to a neutral condition than it did in becoming magnetic. This consumption of power is called hysteresis, and is due to a certain molecular condition causing a rigidity of the particles and therefore depending upon the quality of the iron for its extent. A piece of steel would consume more power than soft wrought-iron while undergoing the process of magnetization and demagnetization; a well annealed piece of iron, less than the ordinary wrought-iron not treated in this manner. Mr. Kapp has given figures on the amount of energy consumed in a mass of iron by hysteresis. The reversals occurred 100 times per second, giving 200 changes. These results are true for the iron of a transformer.

(At 100 complete periods a second.)

Lines of force in iron.	Volts per ton of iron.	Horse-power wasted in heat per ton of iron.
2,000	650	.87
3,000	1,100	1.48
4,000	1,650	2.21
5,000	2,250	3.02
6,000	2,900	3.89
7,000	3,750	5.03
8,000	4,450	5.97
9,000	5,500	7.43
10,000	6,650	8.90

This phenomenon called hysteresis will have such an effect upon the iron that only after the magnetizing force has been partially removed the influence steals over the iron and develops lines of force. A difference of phase, therefore, exists between the magnetizing force and the lines of force produced, or what might be called the resultant magnetization. The other effeet acting upon the iron is much simpler in its nature. It is due to eddy currents, small whirling currents induced in the iron by the fact that lines of force are cutting it, passing and repassing so rapidly that an electromotive force is set up and necessarily a current. To avoid these eddy currents the iron is subdivided into thin sheets or used in the form of wire. This treatment will not in the least reduce the hysteresis, as that is entirely due to the molecular condition of the iron, but will reduce the eddies by insulating the parts of the metal from each other. The currents then produced have so short a circuit to flow in that their volume is very slight and the heat very little. The hysteresis in iron depends upon the extent to which it is magnetized and naturally upon the rapidity with which these changes occur. These, in addition to the fact that it likewise depends upon the quality of the iron, enable us to reduce or increase it at will or hold it well in check. The importance of understanding these effects and their causes is clearly seen in the design of a transformer. A transformer is a device by means of which a given electromotive force can be increased or decreased.

There are two classes of transformers:

Step-up transformers,
Step-down transformers.

In city circuits the step-down transformer is generally used. A pressure varying from 1,000 to 2,000 volts is applied to it and reduced down for purposes of light or power to 50 or 100 volts as required. The transformer consists of a frame of iron upon which are placed two coils of wire. The coils link in with a complete magnetic circuit formed by the iron. The iron is generally used in thin plates and the two coils thoroughly insulated from it and each other are linked by it. Thus, there may be a circle of iron and a coil on each side of it at the opposite extremities of a diameter. The resistance and turns of each coil are duly proportioned to receive and give individually the proper current and pressure.

The iron being continually subject to violent reversals, must create the least possible heat and absorb little or no power. To do this both the hysteresis and eddy currents must be kept down to a certain low but definite value.

(3.) To design a transformer to meet the demands of practice, the conditions of practice must be considered in full. An induction coil and a transformer merely differ in detail; they are identical in principle.

Construction.—A transformer consists of a closed magnetic circuit and two coils of wire. The coil connecting to the source of current is called the primary, and that in circuit with the line or lights the secondary. In commercial lighting the primary is fed with a current of about 2,000 volts; the secondary delivers the same amount of energy minus loss, at 50 volts. It is natural that the transformer, like any other piece of apparatus, shculd be of a size consistent with the service it is to perform. Transformers are therefore rated as 5-light, 10-light, 50-light, 100-light, etc. The weight of iron and copper also increases with the number of lights supplied.

Design.—The iron and copper used in definite proportions will give the best effects, provided they are of the quality used by large companies. That is, the iron must be of the softest kind and the copper pure. The size of a transformer then depends upon the number of lines of force it contains. In the case at hand, if the number of lines of force per square inch be too high, hysteresis will heat and endanger the construction. It is necessary that the magnetic induction be kept very low; from 8,000 to 12,000 lines of force per square inch, or higher if the designer sees fit. The previous table will give an idea of the losses entailed with higher induction.

Having determined to keep the induction low, the ampere turns required and the weight of copper come into consideration. The rule for calculating the turns is simple, the primary and secondary being individually treated. If the primary receives 2,000 volts and the secondary reduces it down to 50 volts, the ratio between them is 2,000 : 50, or 40 : 1.

This ratio of 40 : 1 represents the proportion existing between the turns on primary and secondary.

Each turn on the secondary is counterbalanced by 40 on the primary. The rule for keeping this fact in mind is

$$\frac{\text{E. M. F. Secondary}}{\text{E. M. F. Primary}} = \frac{\text{Turns Secondary.}}{\text{Turns primary.}}$$

The method of calculating the turns on the primary is as follows:

$$\text{E. M. F.} = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000}$$

The arbitrarily adopted factors are the turns and lines of force. The frequency is from 100 to 150 at the utmost. To illustrate the above, take a case as follows: A dynamo producing 2,000 volts is to be connected to a transformer which will reduce it down to 50 volts; we now have

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000}$$

Adopting a frequency of 100 per second the above becomes

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times 100}{1{,}000{,}000}$$

Adopting 1,000,000 lines of force, we have

$$2{,}000 = \frac{\text{Turns} \times 1{,}000{,}000 \times 100}{100{,}000{,}000,}$$

which gives us 2,000 turns with that frequency and induction required. The reduction of turns for the secondary follows in proportion of the pressures. The secondary in this case requiring one-fortieth as many turns; that is to say, 50. When the transformer is at full load the current circulates freely in the primary coil, and therefore in the secondary. When the load is off, the primary being always in circuit, still receives current, but to a very slight degree. The current passing through the primary increases automatically with the demands made upon the secondary. When the lights are gradually turned on, the secondary uses more current; the primary being sensitive to these conditions, receives more, and thus keeps up without interruption the cycle of changes. Large power plants have been erected abroad and in this country that use this system of transformation and transmission. The Ferranti system in London is one of the greatest in the world.

QUESTIONS FOR REVIEW.

(1) What is meant by the term synchronism ?

(2) What is a rotary field ?

(3) In what respect does a polyphase current differ from a single-phase ?

(4) How is the true value of the current measured ?

(5) Why does hysteresis affect the efficiency of a transformer ?

(6) With an E. M. F. in primary of 2,000 volts and 1,000 turns, how many turns are required for the development of 100 volts ?

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from page 247.)

The method of producing the currents in Gauss' and Weber's experiments was an application of the important discoveries of Faraday and Henry, above referred to, in the induction of current by currents and by magnets.

On the recommendation of Gauss, this telegraph was taken up by Stenheil, who, following their example, also used induced currents. The important contributions of Steinheil were the discovery of the earth return circuit, the invention of a telegraphic alphabet and a recording telegraph. Steinheil contributes an account of his telegraph to Sturgeon's Annals of Electricity, in which the relative merits of scopic, recording and acoustic telegraph are discussed, and the advantages, which experience has since brought into prominence, of the acoustic form are pointed out.

Schiller's telegraph was exhibited at a meeting of German naturalists held at Bonn in 1835, and was there seen by Professor Muncke, of Heidelberg, who, after his return to Heidelberg, made models of the telegraph and exhibited them in his class-room. These models were seen by Cooke in the early part of 1836, and gave him the idea of introducing the electric telegraph in England. Cooke afterward became associated with Wheatstone, and a large number of ingenious arrangements for telegraphing was the result. Many of the later developments by Wheatstone are still in use and are hard to beat.

Steinheil appears to have been anticipated in the idea of making the telegraph self-recording by Morse, who, according to evidence brought forward by himself, thought out some arrangements as early as 1832. Exactly what Morse's first ideas were seems somewhat doubtful, and he did nothing till 1835, when he made a rough model of an electro-magnetic recording telegraph. Morse's mechanical arrangements were of little merit, and his alphabet and method of interpretation by a dictionary were clumsy and inconvenient. The chief point of interest in connection with the early history of the Morse telegraph was the proposal to make use of Sturgeon's discovery, of electro-magnetism of soft iron. Morse, however, seems to have known practically nothing of the subject except that iron could be magnetized by a current, and in consulting his colleague, Dr. Gale, he was unwittingly led to use the discoveries of Henry, who had previously practically solved the whole problem. Much of the subsequent improvement in the mechanical arrangements were due to Vail, who became associated with Morse, and the Morse code as we now know it was almost, if not entirely, worked out by Vail. Considerable dispute and some litigation arose over Morse's claims, but that is outside our present subject. There is no doubt that the electric telegraph was a slow-growth invention, with a view to pecuniary and other advantage, being ever ready to lay hold of each scientific discovery and try to turn it to account. The question who first conceived the idea can never be satisfactorily answered.

After 1840, there is little to record of a purely electrical character bearing only on telegraphy, but there have been many very ingenious mechanical contrivances introduced for recording signals, for reproducing pictures and handwriting and for printing, for duplexing, quadruplexing and multiplexing telegraph lines, for increasing the rate of signalling and in many ways increasing the expedition with which messages can be sent. Of course, the success of many of these contrivances, and even their invention, depended upon an increased knowledge of the laws of electricity and magnetism. For example, effective duplexing, quadruplexing, etc., depends on a proper understanding of the electrostatic capacity of the line, and this was not understood properly until the mathematical investigations of Thomson and others cleared the matter. For the impetus towards discovery in this direction again we are largely indebted to telegraphy, for much of that class of work was suggested by the difficulties encountered in the signalling through long submarine cables.

The invention of the telephone is fast becoming ancient history, and yet it will always mark one of the greatest of the useful applications of electricity. It does not call for more than a passing remark here, because electromagnetically it is all in Faraday's and Henry's papers.

The radiophone should be mentioned because it marks the application of the discovery, by May and Smith, of the effect of light on the resistance of selenium. This effect has since been found in the case of a large number of other substances, but it is still an interesting field for research. A number of experiments on this subject have been associated with attempts to make things visible at a distance. No doubt it will ultimately be possible not only to talk to a distant party, but also to see the party talked to, and thus, as it were, look the party with whom you are conversing in the eye.

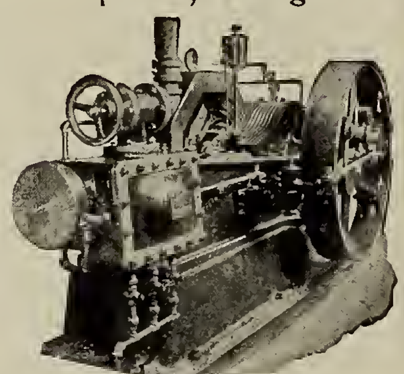
(To be continued.)

THE GREAT ARCOLIER lighting the Electric Show is the wonder of this electrical age. It is composed of 37 small enclosed arc lamps aggregating 40,000 candle-power, all of which is the conception of MR. GEORGE R. MACINTIRE, the electrical engineer and designer of the INTERNATIONAL ARC LAMP CO., of Mercer and Houston streets, N. Y. The beauty of this fixture is like a well-formed lady, when the boy said, "get on to her curves." We may say in this instance in all sincerity that the curves on this arcolier are really beautiful. The whole fixture weighs 1,500 pounds and must be seen to be appreciated.

A VERY FINE contract has been placed with Cleveland & Taylor, the electrical contractors of 5 Dey street. They will equip the fine new Fletcher residence, 79th street and Fifth avenue, N. Y., with electric light, burglar alarms, speaking tubes, bells, gas lighting, etc; the installation calls for Montauk Multiphase Cables. These cables are constantly thermostatic throughout the whole line and are a constant safeguard, giving alarm of fire at all times in case of fire. Cleveland & Taylor are experts on burglar-alarm work.

MADISON SQUARE GARDEN.

LECTRICAL EXHIBITION shone in one radiant gleam of soft white light every night this week, and every tourist present was well pleased with his visit. We went into a long account of exhibits on the main floor in our last issue. This issue will tell you what we saw in the busy whirl of the dynamos and engines down stairs. The Babcock & Wilcox boilers generate hundreds of horse power in dry steam, which is carried in covered pipes to a number of complete plants, among whom we mention the Woodbury 25 K. W. automatic cut-off engine, direct-connected to 25 K. W. Eddy dynamo, with switchboard and switches connecting with the main circuit of the Garden, and in the care of Mr. L. A. Comacho, representing Messrs. Burhorn & Granger, the agents, 136 Liberty street, New York.



draft for boilers, one of which was in full operation in connection with the Babcock & Wilcox boilers in the Garden. These machines are made by the Kensington Engine Co., of Philadelphia.

H. H. LINDEMUTH described the fuel economizer on exhibition, made by Broomwell, Schmidt & Co., York, Pa. One of the economizers was in full operation.

THE DIESEL MOTOR running a C. & C. 30 K. W. dynamo attracted considerable attention. They claim no direct combustion or explosion. The high compression of air, it is claimed, ignites the plain kerosene used in operating these engines. A reservoir of compressed air starts the engine.

THE DE LA VERGNE REFRIGERATING CO., of N. Y., exhibited several sizes up to 32 H. P. Hornsby-Akroyd oil engines. One of 4 horse power was belted to a C. & C. dynamo, and operating the lights in their exhibit. Mr. E. H. Cox was in charge of this exhibit.

J. JONES & SON, of 64 Cortlandt street, attracted large crowds to their beautiful exhibit. They have a full line of switch and panel boards, and a great variety of electrical goods. Miss Liberty, in a glass case, is the attraction. The young Miss getting the largest number of votes receives this elegantly-dressed doll. It is all enclosed in a glass case. With the use of a frictional machine Mr. Jones makes the doll's hair stand on end or raises it from its head.

THE BULLOCK ELECTRIC CO., of Cincinnati and St. Paul Building, N. Y., installed a number of their fine multipolar dynamos and motors this week. They were delayed in shipment. Mr. Lozier, the manager, assisted by Messrs. Oakman, McLean and others, held levees all the week.

THE MONTAUK MULTIPHASE CABLE COMPANY, of 100 Broadway, New York city, exhibit their famous thermostatic multiphase cable. Messrs. Price and Gould show its unique qualities to thousands of sight-seers. This cable has attracted considerable attention and is regarded as an excellent protective device.

J. Jones & Son Exhibit at Electric Show.

NEW YORK SAFETY STEAM POWER CO., of 107 Liberty street, N. Y., exhibit their improved 120-H. P. vertical automatic cut-off engine direct-connected to a Fort Wayne 65 K. W. generator, with switchboard, switches, and Weston meters furnishing current to the exhibitors.

ROBERT T. MICKEL explained the advantages of one of the Beekman automatic-control under-grate

THE CROCKER-WHEELER ELECTRIC COMPANY, of 39 Cortlandt street, New York city, have a central exhibition in charge of Blackall & Baldwin. Many types of dynamos and motors of various sizes are arranged for inspection, and a massive multipolar generator has been installed in the middle of the exhibit.

THE WARD ELECTRIC SUPPLY AND CONSTRUCTION CO., of 39-41 Ann street, New York city, have a large line of arc and search lights in their booth. Mr. Deronda Levy, the manager, is a well-known and well-liked contracting engineer, whose efforts on behalf of the Electrical Exhibition Company are worthy of great praise.

"Ward" Electric Supply & Construction Co.'s Exhibit.

Otis Brothers & Co. and H. B. Coho & Co.

THE FISCHER FOUNDRY AND MACHINE CO., of Pittsburg, Pa., exhibit one of their 125 H. P. Tandem Compound Engines, direct connected to an Onondaga, N. Y., dynamo, with switchboard, switches, Weston instruments, etc., furnishing current to the exhibitors. Mr. F. H. Sheppard has charge of the dynamo for the agents, Messrs. Fairchild & Summer, 39 Cortlandt street. Messrs. Porter & Remsen, of 39 Cortlandt street, N. Y., represent the engine makers.

HARING STEAM PLANT EQUIPMENT CO., Washington Life Building, exhibits 280 H. P. Armington & Sons Co. Automatic Engine, direct connected to a 50 k. w. Walker Generator.

F. A. LA ROCHE built the main switchboard for the Exhibition current, giving 110 volts and up to 3,500 amperes, five Weston voltmeters, six ammeters, four dynamo switches, one Edison service switch, one switch connecting the Madison Square Garden plant, six feeder switches fitted on marble and marbleized slate board, all connecting with the various auxiliary plants on exhibition and connecting with the lighting effects and illumination in the Garden.

Elmer P, Morris' Exhibit.

Fostoria Lamps and Crouse-Tremaine Carbons.

A 30 H. P. NASH GAS ENGINE was shown, direct connected to a Walker dynamo exhibited by the National Meter Co. of N. Y.

MR. ALBERT CARY, M. E., of the Monarch Mfg. Co., 39 Cortlandt street, N. Y., inventor of the Monarch Engine Stop and Automatie Speed Limit, shows several sizes of these simple and practical machines We will illustrate and describe these excellent machines in an early issue.

THE FOSTORIA LAMP COMPANY, of Fostoria, Ohio, have ornamented their booth with a large and beautiful cluster of lamps mounted on pillars and decorated with winding wreaths of many-hued miniatures.

About the middle of the great hall, to the left, is an exhibit of Otis Brothers and Coho & Company. The Otis home elevator is shown to great advantage. The car within is sent up to any floor by pressing a button, and it may be brought to any landing by a person outside in the same manner. It represents perfection and relieves the operator of all possible doubts or sense of insecurity.

Montauk Multiphase Cable Co.

C. D. MAYRE represents the Nonpareil Cork Mfg. Co., of Bridgeport, Conn. and N. Y., showing a large line of steam-pipe covered with their cork-sectional covering and cork-covered cold-storage pipe.

ALBANY GREASE AND GREASE CUPS, in all styles and quantities, were exhibited and under the supervision of Mr. A. J. Squier. This grease is greatly used in electric light and power plants, and Adam Cook's Sons, of 313 West street, N. Y., are the makers.

THE FOSTORIA INCANDESCENT LAMP CO., of Fostoria, Ohio, manufacturers of all Standard Incandescent Lamps, exhibit a full line of them in their handsome booth at the Electric Show. Mr. H. Stillson Hart, the N. Y. representative, with offices at 726 Broadway, is deserving of great credit for the manner in which he fitted up his company's exhibit at the Garden. Special attention is called to their new line of 220-volt lamps shown on a handsome board in the back of their exhibit. You must observe the line of beautiful colored miniature and standard lamps of all styles and sizes on the columns and globes that top off the pillars in front of the exhibit.

MR. ELMER P. MORRIS, 15 Cortlandt street, New exhibits a big line of specialties in card motors and dynamos, Keystone electrical instruments, Garton Daniel's lightning arresters, anti-trust lamps, switchboards and switchboard fittings, soldering compound, Forest City bonds, commutators, a full line of railway material, and the Monarch insulating paint, the best in the world for dynamos, motors, etc. The X Rays shown up the little stairs in his exhibit are very attractive to visitors.

AMERICAN ENGINE CO. of Bound Brook, N. J., exhibit one of their latest styles of Horizontal Automatic Engines, direct connected to one of their own 25 k. w. dynamos with switchboard, switches, Weston instruments, etc., furnishing current to exhibitors. Mr. F. H. Ball, vice-president, assisted by Mr. Fred. Ball and Mr. W. K. Bassford, their electrician, furnished visitors with the data relating to their specialties.

MESSRS. H. B. COHO & COMPANY show a fine line of light and power machines. They handle the Eddy dynamo, as well as the well-known Eddy plater, one of which is shown there with a double commutator for two pressures.

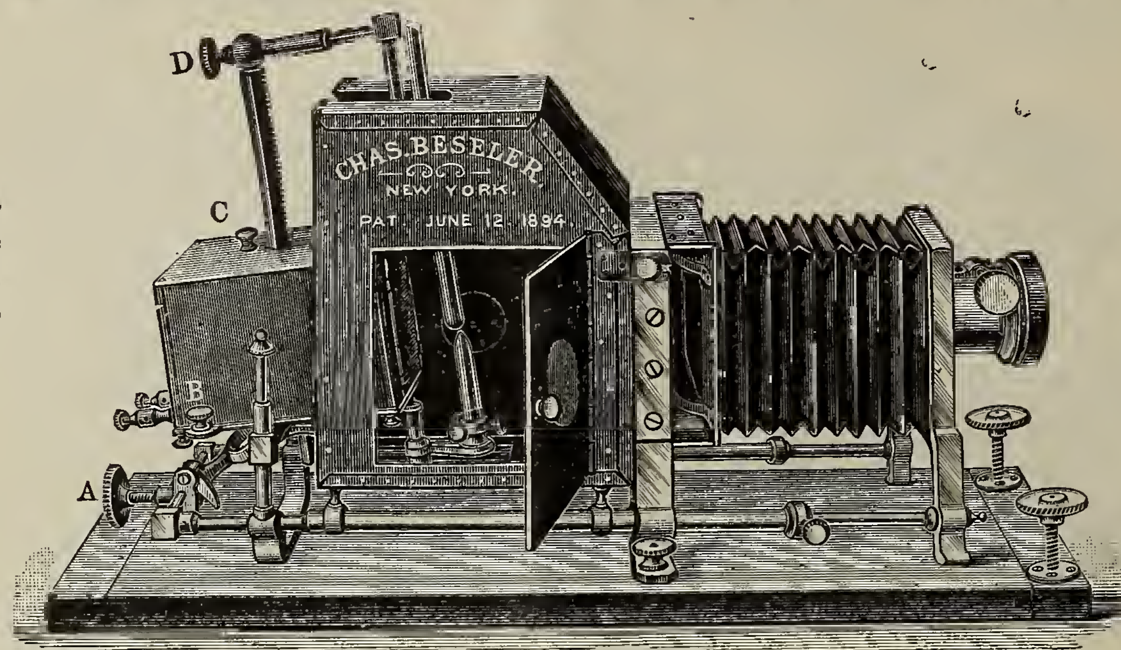
A VERY ATTRACTIVE exhibit to bicycle riders is the Pilot Electric Light made by the DOWD ELECTRIC CO., of Boston. It is a very finely-made little dynamo that can be fastened to the front of a bicycle and run on the rubber tire of the front wheel. It gives a very brilliant light. Mr. G. M. Port has charge of the exhibit at the Electric Show.

THE "Institute" or "Eclipse" Single Stereopticon

Is arranged for use with my **Automatic Electric Arc Lamp** on any low tension continuous current of about 115 volts.

Price, including a variable resistance coil frame and one selected ¼ size "Darlot" objective,

$120 00.



This outfit is especially adapted for scientific and educational purposes by means of pictorial representations given in the lecture rooms of colleges, etc.

The above lantern will also admit my "Bijou" electric arc lamp (hand feed) which may be used on either the **Direct** (115 volts) or **Alternating Current** (52 volts). Note—A well constructed carrying case is included at the above price, viz., $120.00, Send for my illustrated Catalogue No. 2.

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Successor to CHAS. BESELER. Established 1882.

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STEREOPTICONS AND MAGIC LANTERNS

Adapted for Electric Light, Lime Light and Oil Light.

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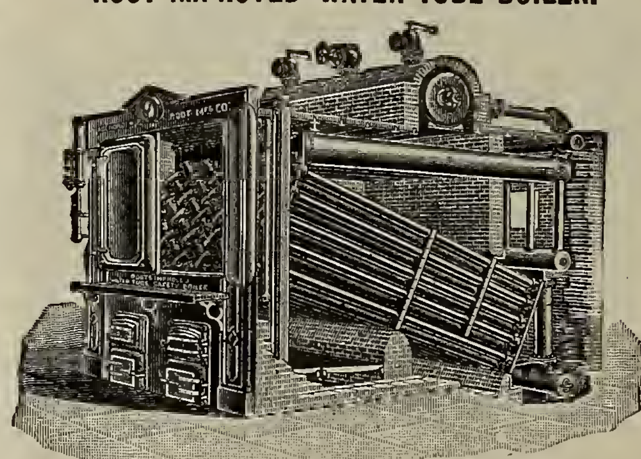


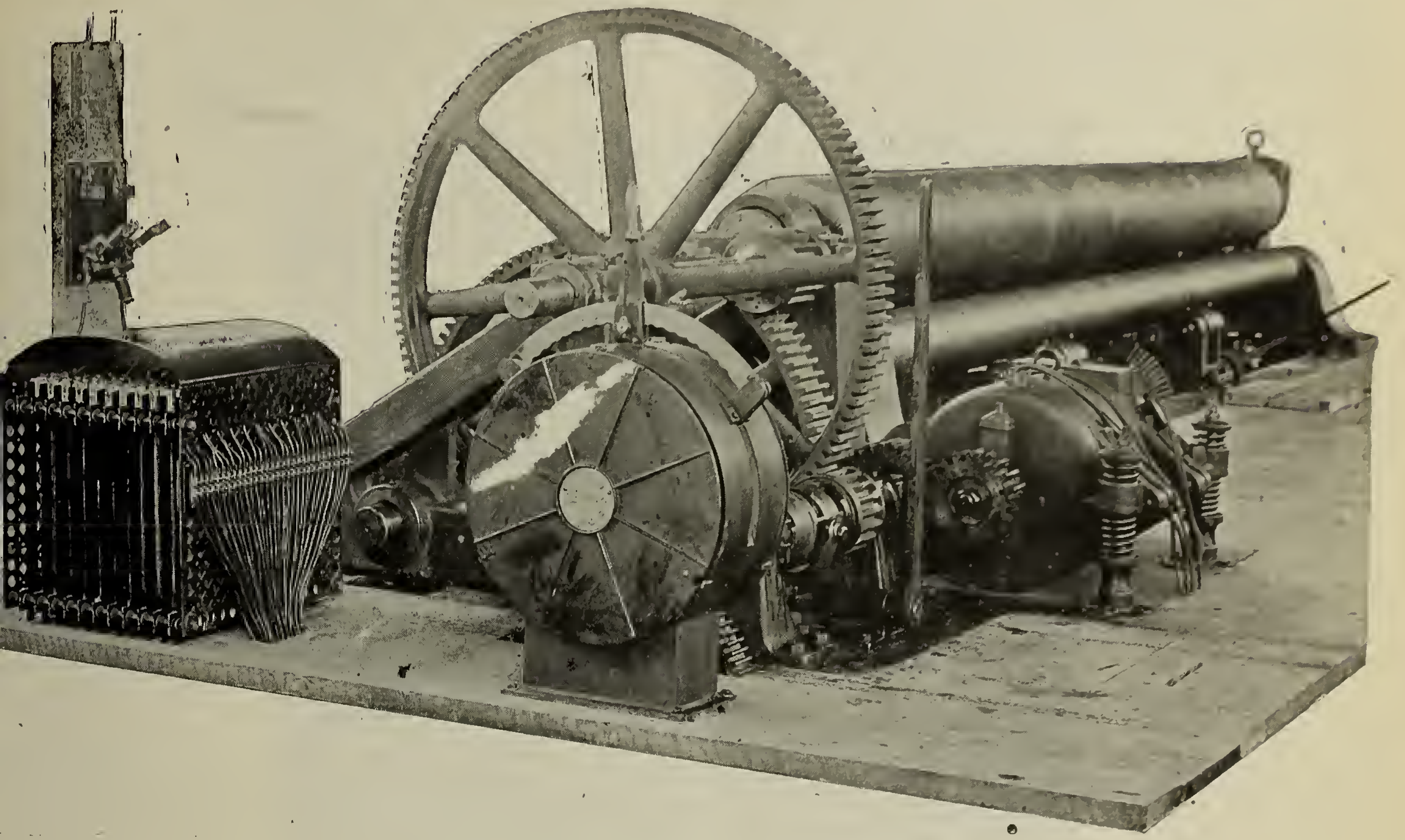
Selected by leading Electric Light Plants and Street Railway Companies throughout the United States. The following are the acknowledged requirements in water-tube boilers : *Straight tubes which can be thoroughly inspected and cleaned inside and outside; perfect suspension, allowing free movement of whole boiler expanding and contracting; perfect flexibility for the difference in expansion between upper and lower tubes; interchangeable parts, built to fixed standards; facilities for making quick and easy repairs which can be done by your own engineer or machinist; a cover joint which can easily be made tight, and frequently broken and replaced without injury; provision made to introduce the feed water where it will not chill and moisten the steam; provision made to carry feed water impurities direct to the mud drum and not past the ends of the tubes; provision made to supply the lower tubes with a bountiful supply of cool water; the use of the best materials and fittings the market can afford; the best possible workmanship; a large disengaging surface for the steam to escape from the water; small cast iron pressure parts; ample heating surface to prevent injury to parts should boiler be forced above its rating.*

Examine these Points in the Improved Root Water-Tube Boiler.
Send for our Illustrated Catalogue.

ABENDROTH & ROOT MFG. CO., 28 CLIFF ST., NEW YORK CITY.

The Electrical Age.

VOL. XXI—NO. 21 NEW YORK, MAY 21, 1898 WHOLE NO. 575



30 H. P. Motor Driving a 20 Ft. Bending Rolls.

THE ELECTRIC MOTOR FOR HEAVY MILL WORK.

[T]he electric motor has shown its value for heavy mill [wo]rk in the boiler shops of the Aultman & Taylor Ma[chi]nery Company, of Mansfield, O. The equipment con[sist]s of a 30-H. P. mill type motor, manufactured by the [Ca]rd Electric Company, of Mansfield, O , driving power [be]nding rolls capable of bending boiler-plate twenty feet [lon]g by one-quarter of an inch thick. This 30-H. P. [mo]tor runs at a speed of 325 revolutions per minute at [full] load. The motor and bending rolls are direct-con[nec]ted by gears. Controllers exercised by means of a [swi]tch, which, through the medium of a vertical [lev]er, sets into operation two trains of gearing, op[tio]nally; one set throwing the two lower rolls into use, [the] other the upper one. The ready reversibility of the [mo]tor enables the operator to bend plates to any circle [wit]h accuracy and ease. The electrical details are as [foll]ows:

[A] controller of the standard R type, made by the Card [Ele]ctric Company, affects an easy management of the [mo]tor. The current regulator is built up of iron wire [wit]h sufficient capacity to carry the full current of the [mo]tor at full load, irrespective of the speed. There is [eno]ugh resistance in the current regulator to allow ready [rev]ersing under all circumstances. As seen in the illus[tra]tion, this motor is mounted on springs, thereby allow[ing] sufficient movement of the motor to avoid the inev[itab]le shock due to sudden reversing or the throwing on [of t]he load.

[T]he great advantages of this combination appeal very [stro]ngly to the practical mind, for by this method of con[nec]ting the source of power to the machine a cushioning [tak]es place with every variation in load and a certain auto[mat]ic elasticity exists, which saves both motor and bending [roll]s from considerable injury. It has already been ad[mit]ted by mechanical experts that the application of di[rec]t-connected machines is the best the world affords, [and] in this case, as in many others, the utmost satisfaction prevails through the economical operation, convenience and certainty of action resulting from this arrangement.

The Card Electric Company have made a great success of all their heavy machine installations, their experience and careful attention to every detail giving them prominence in the eyes of many manufacturers.

BURNING LOW GRADES OF FUEL.

The methods in vogue at present for burning low grades of fuel are, generally speaking, of two kinds. First, that of mixing the low-grade with high-grade fuel; second, that of using a forced draught. The Beckman system is of this latter order, and consists of a blower with engine and regulating valves. The engine and blower may be either belted together or direct-connected. The regulating valve is placed on the steam inlet pipe to engine blower. A pressure-reducing valve is in series with the regulating valve, controlling the speed of fan and pressure of air. Under the grates an opening in the bridge wall allows the air to enter, the pressure being one ounce or less. A damper hinged to the bridge wall deflects the air so that it passes away in the same direction as the draught induced by natural conditions. A great saving of fuel or, at least, its cost, results from this device.

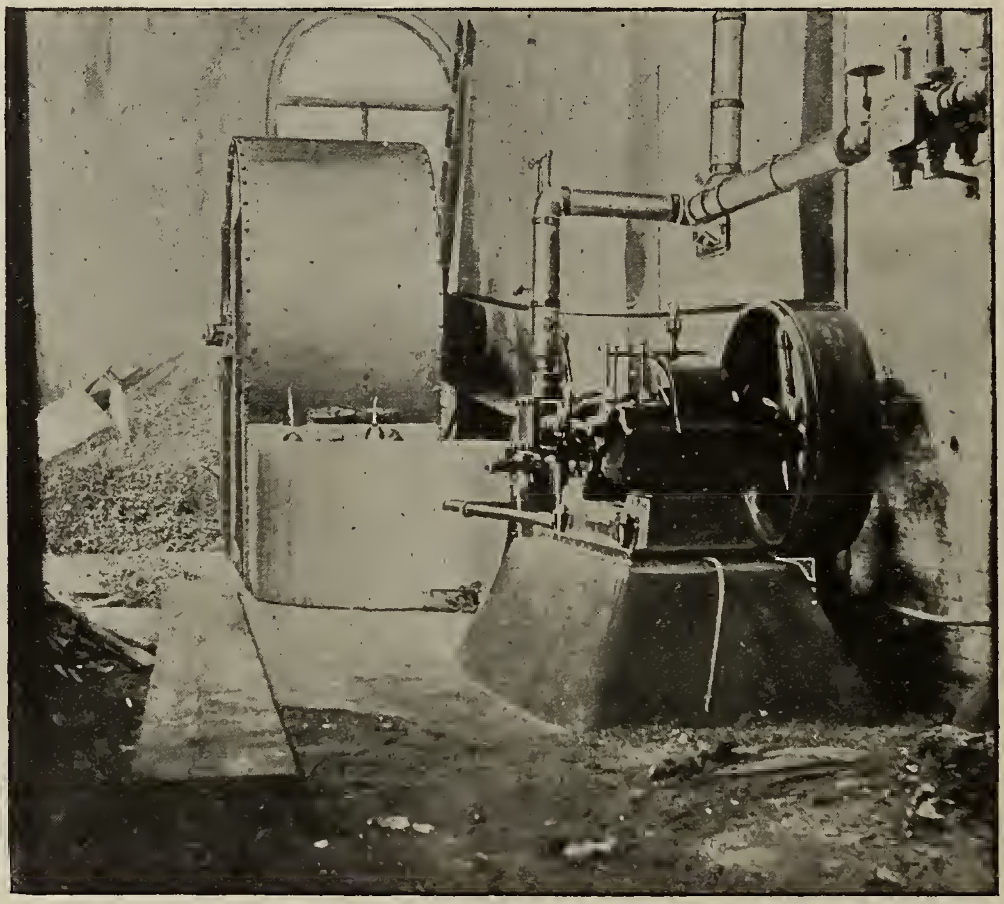
The Beckman system of automatic regulation removes all possible objections to its introduction and proves its remarkable convenience and excellence, all operations being automatic in this particular method. At the Electrical Show the boilers on the lower floor have their fires fed with air by the Beckman system. Its success there is self-evident. The illustration shows a plant of this kind installed by the Kensington Engine Works, Limited, Francis Brothers, proprietors, of 704 Arch street, Philadelphia, Pa., for the Providence Ice Manufacturing Company, of

Philadelphia, Pa., the Beckman system of automatic-control, under-grate, mechanical-draught being part of the work engaged in by the Kensington Engine Works, Ltd.

At the Electrical Show Mr. Robert T. Meickle, M. E., will be found in charge of the Beckman exhibit on the lower floor, and will be pleased to answer all questions relating to the cost and operation of the Beckman system.

It would be equally just to congratulate ourselves that we have better marksmen to-day than there were fifty years ago, without making allowance for the modern rifle.

The first absolute determination of resistance was probably that made by Kirchhoff about fifty years ago. Weber published his method in 1852, and then came the B. A. determination by Maxwell, Stewart and Jenkins in



Providence Ice Manufacturing Company, Philadelphia.

1863. Neither of these were very exact, but they paved the way for the splendid exhibitions of experimental skill which followed. Among those to whom we are most indebted for this latter work may be mentioned Kohlrausch, Rayleigh, Glazebrook, Rowland, Wiedmann, Mascart, etc. The greatest step in advance in recent years has been the invention of the revolving disc method by Lorenz of Copenhagen, and its subsequent improvement and application by himself, and by J. V. Jones. The determinations made by the latter by this method are probably almost absolutely correct.

A subject which has attracted much attention comes in incidentally here, namely, the electromagnetic theory of light propagation suggested by Maxwell. According to this theory the ratio of the electromagnetic unit of quantity of electricity to the electrostatic unit, ought to be the same as the velocity of light. In 1868 a determination of this ratio was made by McKichan under Lord Kelvin's direction, and gave close agreement with the theory. Since that time determinations have been made by various methods by Maxwell, Shida, Ayrtin & Perry, J. J. Thomson, Rosa, Lodge, Glazebrook and others, with the result that the ratio of the two units does not differ from the velocity of light by more than the probable error of observation. The work here referred to may not appear to be very directly associated with the determination of standards of measurements. It is, however, one of the investigations which has been made possible by the work of the B. A. committee in the production of instruments of precision. Prominent among these instruments stands the Kelvin electrometers, and particularly the absolute electrometer which was described in the report of the B. A. committee for 1867.

Another subject of great interest in itself and in connection with Maxwell's theory, is that of the specific inductive capacity of dielectrics. Experiments on this subject were made by Faraday, but comparatively little was done before 1870, in which year an excellent paper was communicated to the Royal Society, by Gibson and Barclay,

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from Page 275.)

The subject of telegraphy is closely associated with the present excellent system of electrical measurements and with theinvention of many of our most delicate measuring instruments. As the applications of electricity increased there gradually grew up a new branch of engineering, a branch, however, in which the foot-rule, pound-weight, chronometer and thermometer were not sufficient. Other standards of measurement were required, in order that quantities could be gauged and consistent work done. The way to connect the measurements of the new quantities with the units already in use in dynamics had been pointed out by Gauss and others, and at the suggestion of Thomson the British Association appointed a committee in 1861 to determine the best standard of electrical resistance. This led to an uxexpected amount of work, not only on a standard of resistance, but also on the general subject of electrical measurement. The committee regretted, at the end of the first year, that it could not give a final report, but hoped that the inherent difficulty and importance of the subject would sufficiently account for the delay. It can hardly be said that the final report has yet been forthcoming, as a committee with some of the original members in it still exists, and reports regularly every year on valuable work done by it. The committee worked energetically for a number of years, not only on the standard of resistance, but on those of current, electromotive force and capacity. It incidentally supplied a great deal of quantitative data on a number of subjects, and particularly as to the permanence of alloys, the variation of their resistance with temperature as depending on their composition and so forth. In looking over the results of the early work of the British Association committee one is apt to indulge in adverse criticism. It is hard for many of the younger workers to appreciate the difficulties which are met in a first attempt.

on the specific inductive capacity of paraffin. Since that time much good work has been done by Bolzman, Hopkinson, Quincke, Silow, Klemencic, Negreano and others. The theoretical importance of these experiments is due to the fact, that, according to Maxwell's theory, the specific inductive capacity of non-magnetic dielectrics should be proportioned to the squares of their indices of refraction. A wonderful verification of Maxwell's theory was carried out only some ten years ago by Hertz, who showed not only that electrical waves exist, but also how to measure their wave length and period. We have in these experiments splendid illustrations of the oscillatory discharge referred to above, as discovered by Henry and predicted by Thomson, and as a result several new ways of determining electrical quantities have been developed. It is now possible, for example, to compare the capacity of condensers by means of oscillatory currents of exceedingly short periods, and thus to determine the dielectric constants of many materials to which the older methods were not easily applicable.

It is somewhat difficult to decide where to place a reference to the recent Rœntgen and its development in photography, but probably it comes in well here. Just how to apply Maxwell's equation to Rœntgen rays is not yet quite clear, but there is no doubt as to the great importance of the discovery.

As an outcome of all this activity in the determination of standards, and in the absolute measurements of the electrical properties of materials, combined with the great commercial demand produced by the introduction of dynamo-machinery, we have now many excellent instruments at our disposal for absoluie measurement, and suitable either for practical applications or for the mo-t refined laboratory work. For the production of these we are indebted to a host of inventors, prominent among whom may be mentioned Lord Kelvin, Lord Rayleigh, Ayrton & Perry, Mather, Swinburne, Cardew and Weston.

(To be continued.)

THE EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTROMOTIVE FORCE CURVES OF AN ATERNATOR.

BY W. E. GOLDSBOROUGH.

The subject of the regulation of alternating dynamo-electric machines, considered as a function of the inductance of their armature coils, has been treated by a number of writers, and during the last few years has attracted much attention.

In looking up the bibliography of the subject, however, I find that but few records have been published of the actual value of the inductance of the generating coils of these machines, and that even less data are available regarding the real nature of the periodic fluctuations that take place in this quantity.

We are indebted to Hopkinson, Ayrton, Kapp, Sumpner, Duncan, Tobey and Walbridge, Reid, Steinmetz, Fleming, Rothert, Roessler and many others for much valuable information touching upon the theory and practice of the design and handling of machines of this type, but these writers, in so far as I am informed, have failed to furnish us with a record of the actual internal relations existing between the factors involved, freed of conventional and restricting assumptions.

With the assistance of Mr. W. N. Motter and Mr. S. L. Fox, I have carried on a series of experiments in the electrical laboratories of Purdue University for the purpose of investigating the subject.

Apparatus and Method Employed.

The experiments which I shall describe were made upon a three-light Brush arc machine fitted with the necessary exploring coils, collector rings and revolving contact-making device. The machine was selected on account of the peculiarities of its design. These were particularly valuable, as the end sought was to obtain results of an exaggerated nature in order that the factors entering into the problem could be brought into bold relief and thereby lend themselves to more ready investigation.

The core of the armature is of the ring type and is built up of laminated iron stampings, held together by laminated iron bands passing around the core between the successive layers of stampings. Each stamping, therefore, forms a portion of the surface of a cylinder having its axis coincident with the axis of rotation. The stampings are shaped so as to make sixteen large teeth of trapezoidal section, which project laterally from the core, there being eight on each side. The armature winding is composed of eight coils or bobbins of 286 turns each. The bobbins on opposite sides of the armature are connected in series, and their free ends brought out to one pair of the eight commutator segments. Previous to making the experiments, all of the copper commutator segments were removed, and two cast-iron collector rings substituted for them. Fig. 1 shows the machine with these in position, and the collecting brushes in place. Each ring was connected electrically to one of a pair of commutator segment terminals, to which the free ends of one pair of the armature bobbins were fastened. The rings were then carefully insulated from contact with all the other commutator terminals. As the armature is of the open coil type, each commutator segment is attached to the terminal of but one coil, and therefore, by the arrangement described, the arc machine was converted into a two-coil alternator. Throughout the test the remaining six coils were practically dead, being cut out and left on open circuit.

Owing to the fact that the armature bobbins are wound between large projecting teeth, and since the clearance spaces between the teeth and the pole faces are relatively small, the inductance of the coils is high. The coils are practically buried in iron, and the leakage of the magnetic lines of force set up in them is slight. There are in all 16 teeth on the armature core, or 4 to each pole face. As the armature revolves, there are alternatively 3 and then 4 teeth opposite each pole face. The latter condition occurs when two of the coils take up positions midway between the pole corners, as, for instance, coils 1 and 2 in Fig. 2. The former when four of the teeth reach positions midway between the pole corners N, S, and N, S'. The reluctance of the path of the magnetic flux through the field frame and the armature core is therefore a variable quantity, and pulsates between its maximum and minimum values eight times during each revolution of the armature.

The four field exciting coils are connected in series in such a way as to form like magnetic poles facing one another, on the same side of the armature shaft. By this arrangement the lines of force entering the armature core from abutting pole-pieces repel one another, and dividing, penetrate the armature core above and below the shaft in a direction perpendicular to a vertical plane passed through the centre of rotation and parallel to the shaft. When the armature core is at rest, therefore, and the field coils separately excited, the field flux passing through any pair of armature coils will be a maximum when they are in positions 1, 2, Fig. 2, and will be zero when they are in positions 5, 6.

The method employed in making determinations of the self-induction of the armature was as follows:

An exploring coil of 42 turns of No. 36 B. & S. copper wire was wound over armature coil 1, and connected in series with the field coils of a high-resistance Nalder ballistic galvanometer and an adjustable non-inductive resistance. A constant exciting current of ten amperes was kept flowing through the field circuit at all times. During the time of taking any one set of readings, a direct current of definite value was maintained in coils 1 and 2 except when the deflections were made. In circuit with the two armature coils and the source of power were connected a Weston ammeter, the primary of the calibrating current at each reading. Readings were taken when making and when breaking the current in the armature coils, and the average of four observations made a record for a given angular position of the coils.

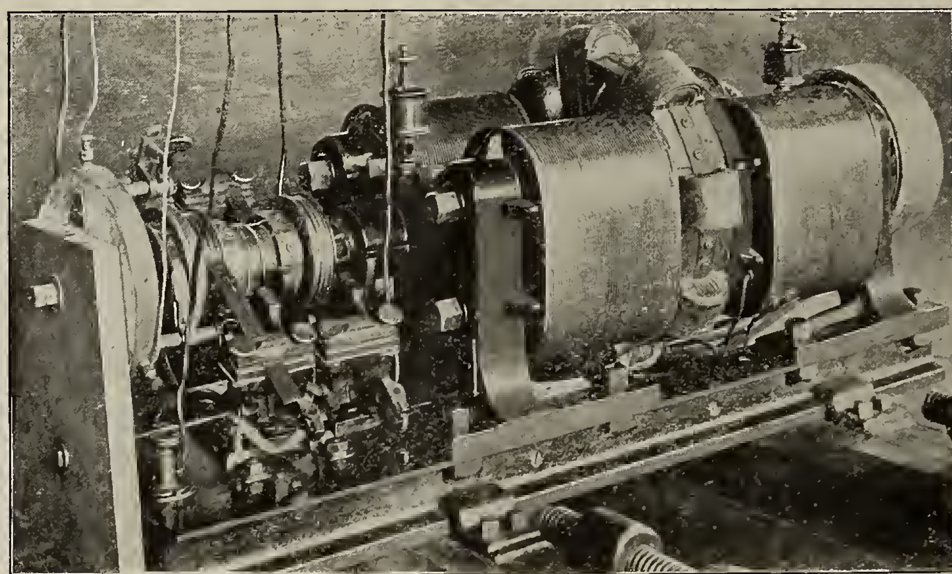


Fig. 1.

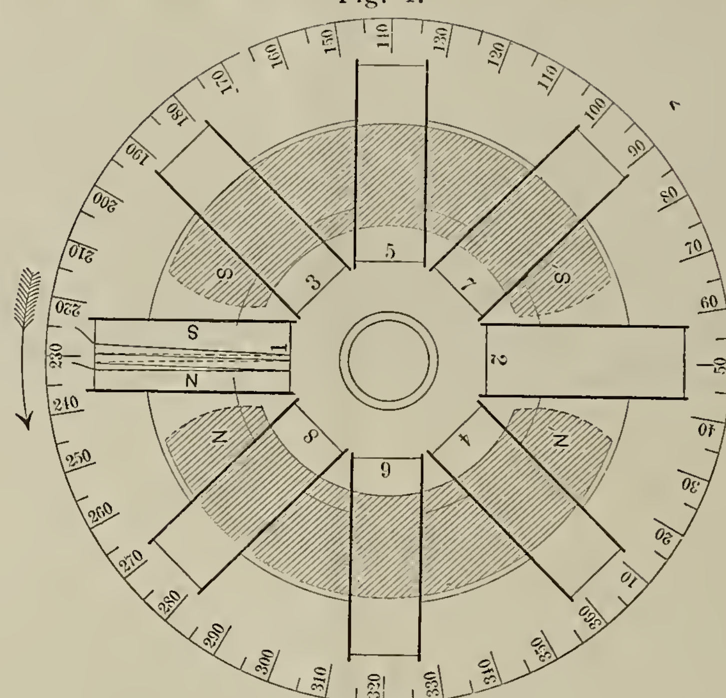


Fig. 2.—Showing Coils No. 1 and 2 at "Zero Position" between the Pole Tips N, S, and N', S'.

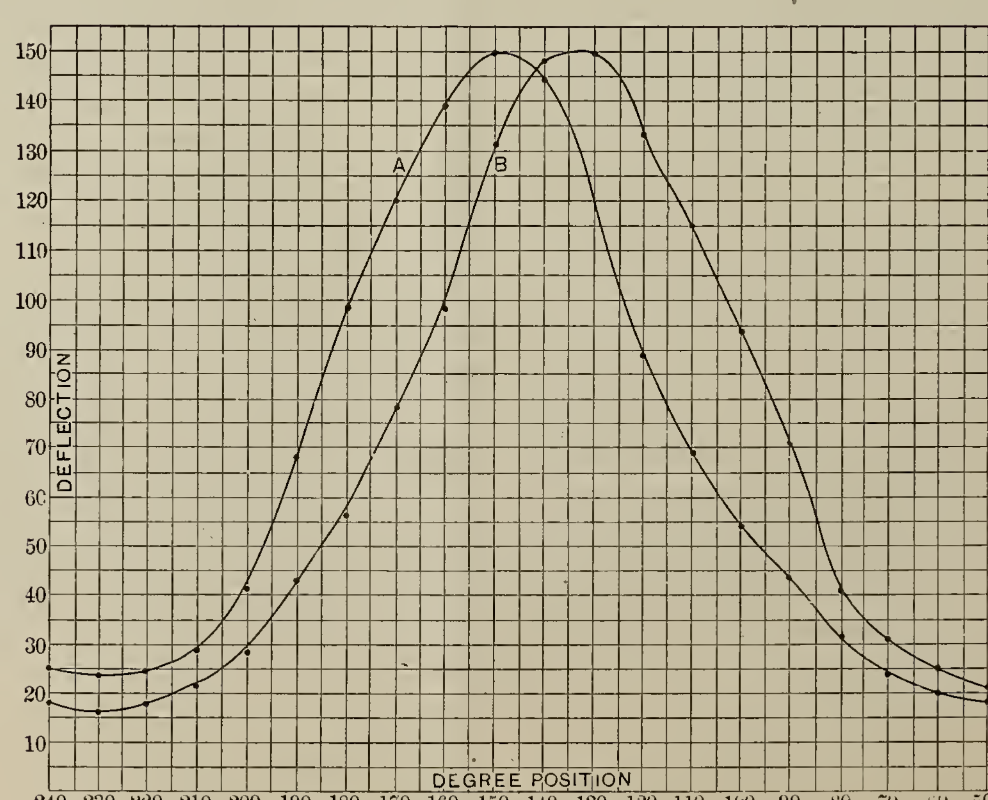


Plate 1.

coil of the ballistic galvanometer and a snap switch. The snap switch, being actuated, by a spring, gave exactly the same form of mechanical "make" and "break" of the

The angular position of the coils relative to the poles was indicated by the graduated disk of the contact-making device by adjusting it relatively to a point on the contact wheel at the time of taking each reading. Knowing the deflections of the galvanometer and having complete data covering the calibration of the instrument and the construction of the armature, the inductance of the coils at any given point was very readily calculated.

In determining the form of the electromotive force waves induced in the coils and appearing at the brushes of the machine, a form of contact-making device shown in Fig. 1 was used in connection with an improvised form of electro-dynamometer. The contact-making device possesses no new features. The galvanometer is of the Weidemann type.

The bell-shaped magnet and copper damper were removed from the instrument, and in place of these a wooden ball carrying a coil of fine wire imbedded in a deep narrow groove cut into its surface was substituted. Two pieces of copper wire were mounted upon the ball or needle in the plane of the coil, and at the extremities of a diameter to form an axis of rotation. The upper end of this axis made one terminal of the coil; it carried a small plane mirror and was connected at its extremity to a piece of hard drawn brass wire. This wire being also attached to the torsion head, both sustained the weight of the ball and balanced by its torsion the deflecting force of the current impulses passed through the needle. The lower end of the axis formed the other terminal of the coil and carried a small paddle.

It dipped into a cup containing mercury and glycerine; the glycerine sufficing to dampen the needle and the mercury making electric contact with it. When in use, the field coils of the galvanometer were excited with a constant current. The ball or needle was connected directly in series with the rotary contact, and with from two to three incandescent lamps, according to the value of voltage to be measured. The instrument was calibrated by connecting a constant current machine in series with the needle, lamps and rotary contact, and comparing the deflections of the needle taken while the contact was rotating at normal speed with the readings of a voltmeter connected to the terminals of the source of constant E. M. F.

During all the experiments the galvanometer gave deflections as constant and as dead-beat as those of a Weston ammeter. The arrangement of this apparatus is analogous to that described by Duncan* in 1892.

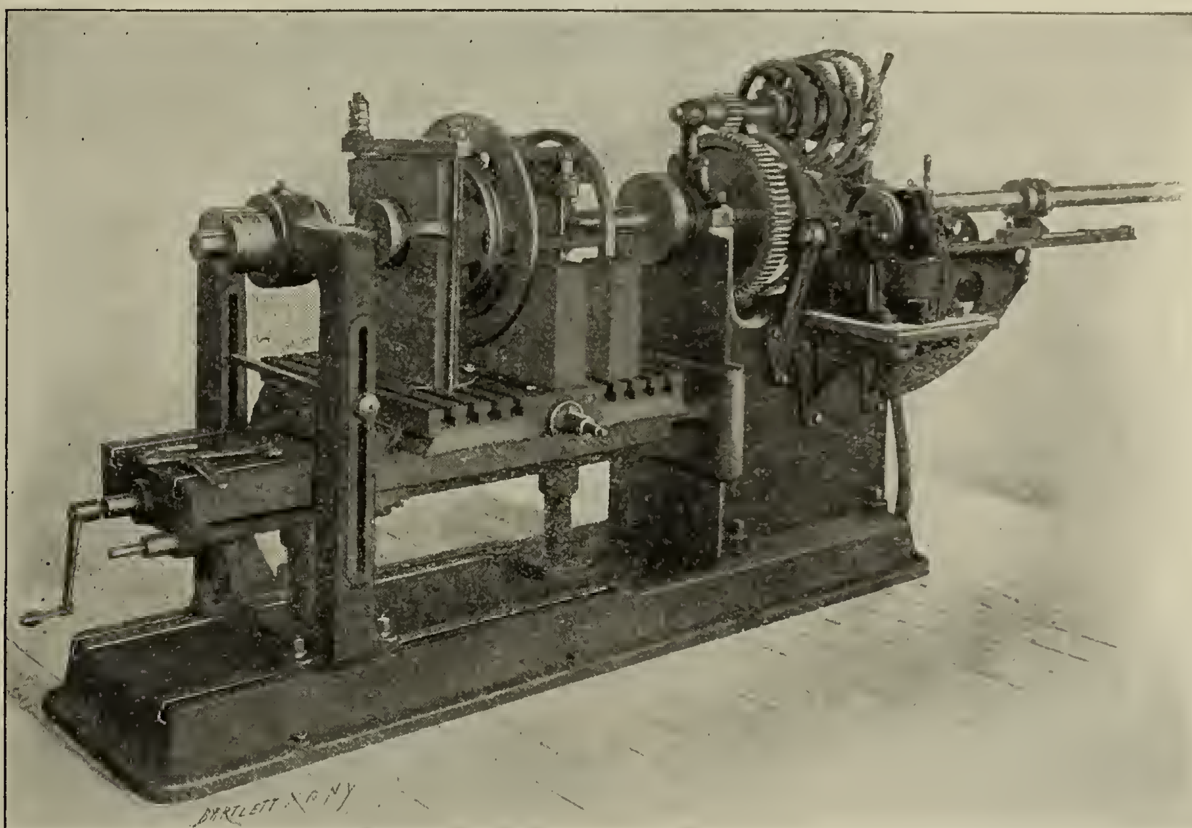
* Duncan, "Note on some experiments with Alternating Currents." Transactions, vol. ix., p. 79.

ARMATURE INDUCTANCE.

In determining the coefficient of self-induction of coils 1 and 2, coil 1 of the armature was placed at the 230° position, as indicated in Fig. 2, since at this point the magnetizing power of the coils was least, owing to the large magnetic reluctance of the circuit traversed by the lines of force emanating from the coils. The high reluctance is due to the fact that the iron of the core surrounded by the coils, and the iron of the pole tips N, N', and S, S', is all highly saturated by the field flux, and to the fact that the lines of force set up by the coils must either span an air-gap many times larger than the clearance space, or else pass through the entire field circuit of the machine.

When in the 230° position and with a constant current of ten amperes flowing in the field circuit, and a constant current of 4.3 amperes flowing in coils 1 and 2, the ballistic galvanometer gave a deflection of 25 both at the "make" and at the "break" of the current. The current in the coils at this time was flowing in the same direction as that in which the alternating current is flowing when the coils are passing out from under the pole tips, and the armature is rotating in the normal counter-clock-wise direction. From position 230° the coils were moved in a clock-wise direction, as viewed from the commutator end. This is opposite to the direction of rotation of the armature when running, but in the same direction as that in which the rotary contact brush was moved when the E. M. F. curves were taken. At the 220° position "make" and "break" readings both equal to 24 were obtained. At position 210° the readings gave 25 divisions again. At 200° they were all 30 divisions, and so on through one-half of a revolution of the armature. When plotted, these readings gave the curve A of Plate 1.

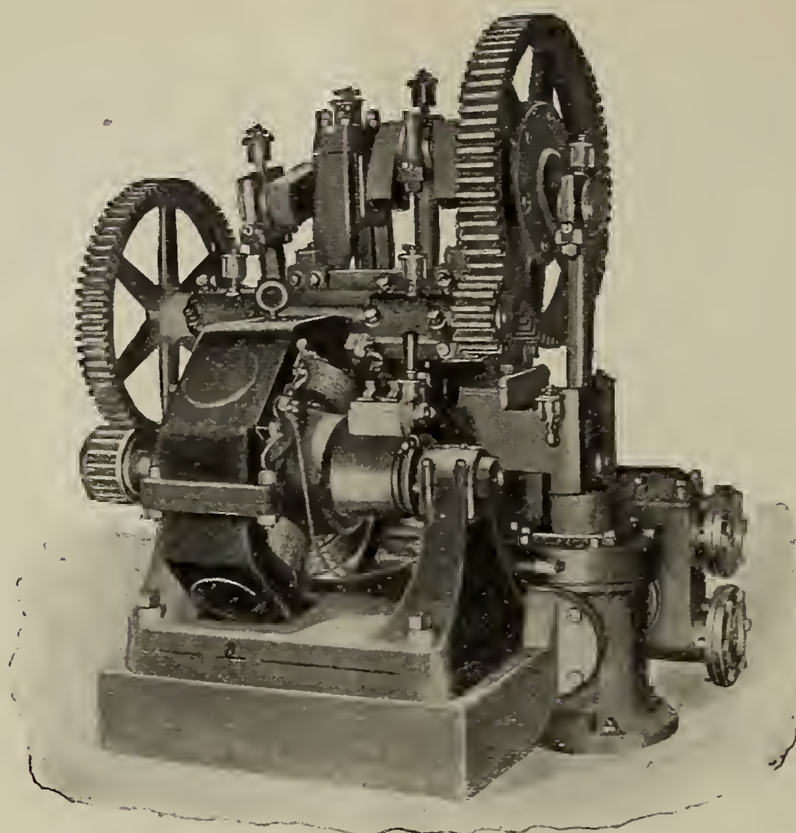
(To be continued.)



Size 1 Motor Geared to Horizontal Boring Mill. Speed Changes by Nest of Gears. Crocker-Wheeler Electric Company.

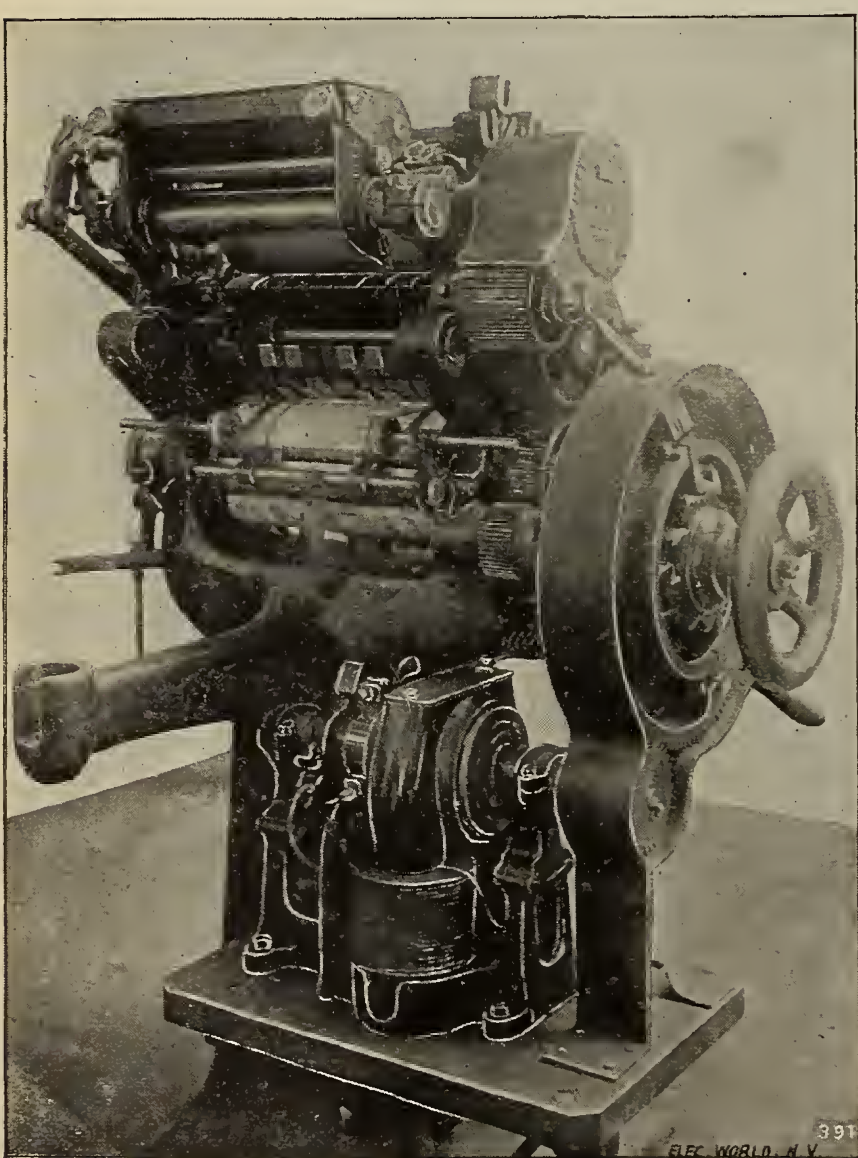
NEW TYPES OF ELECTRO-MECHANICAL DEVICES.

The system employed in modern shops of having each piece of machinery driven by a separate motor has become highly perfected and well developed by the Crocker-Wheeler Electric Company, of Ampere, N. J. The modern machine shop can and is being run in a most economical manner on this basis. It has been estimated that from twenty to forty per cent. of the power is wasted in main and countershafts, which means, that without a single tool operating, many tons of coal are burnt per annum to drive an assemblage of belts and shafts which have been used simply for the purpose of



Size 25 C.-W. Motor Geared to Deming Triplex Pump

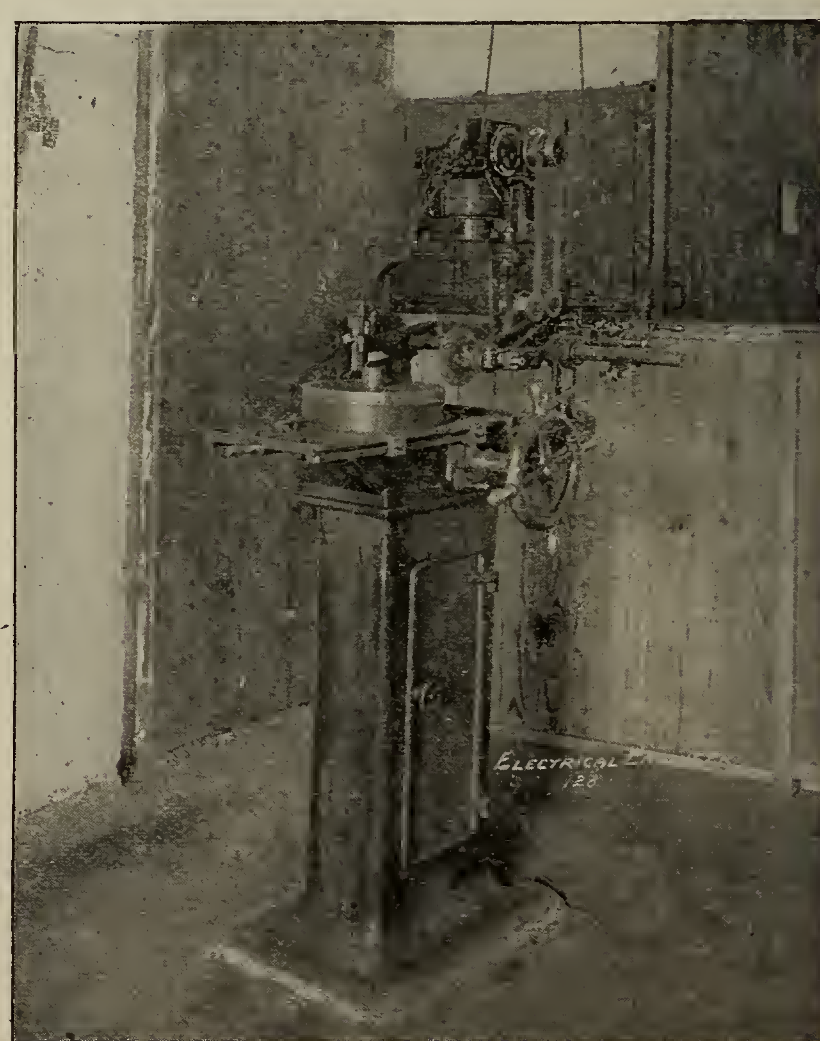
distributing the power in a way which has been proven to be wasteful and unsightly. The modern method as shown by the various photographic reproductions contained in this article prevents this waste of power by



Size ½ Motor Geared to Harris Automatic Envelope Press. Crocker-Wheeler Electric Company.

having a motor control each machine, which implies no waste of power when said machine is not being used. It is necessary, of course, to consider the cost of wiring and motors with the expense of operating as against the cost of the paraphernalia of shafting and belting with its cost of power. It will be seen in the long run that the advantages accruing from an electrically driven machine shop or its equivalent from many standpoints, give ample proof of the superiority of this means of distributing power over the old-fashioned countershaft and belt method.

It does not seem as if the general public were fully aware of the great benefits of direct-connected machinery, and it is extraordinary to realize that in many cases the



Size ¼ Motor on Electric Surface Grinder. Motor travels with the Emery Wheel. Crocker-Wheeler Electric Company.

manufacturers having a multitude of small machines and their own electric light plant have not investigated the

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year, - - - $2.50
One Copy, six months, - - - 1.25
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Cable Address (all Cables,) "Electage," New York.

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NEW YORK.

NEW YORK, MAY 21, 1898.

CONTENTS.

THE RŒNTGEN SOCIETY.

In a recent address delivered by Prof. Silvanus Thompson before the Rœntgen Society, of London, the subject of ether waves and X-rays was discussed. In the opinion of Prof. Thompson the discovery and application of Rœntgen rays could be classed with Lister's antiseptic system and the use of anæsthetics. It seemed from the tenor of the speaker's address, that operating surgeons owe as much to Rœntgen as they do to the promulgators of the above mentioned departments of medicine. It has been found, according to Thompson, that when the X-rays fall upon an electrified body they tend to dissipate the charge, exercising an ionizing effect on its particles of matter. He classified the opinions of our eminent thinkers regarding the nature of X-rays; speaking of the theories of Nikola Tesla and Dr. Crookes as indicating a rapid motion of material particles so disassociated that they can hardly be regarded as atoms in the ordinary sense of the word; then the opinions of those that consider X-rays a species of ether wave of a longitudinal character, and finally the speaker referred to Sir George Stokes, who believes Rœntgen rays to consist of transverse impulses. The general reader of scientific literature can very easily conclude from these remarks that no fixed opinions could possibly exist of a reliable nature in consequence of the doubtful attitude of such men as these. There are two effects produced by X-rays which can be considered from a popular standpoint. The semi-optical and the physiological. It may be that the production of X-rays brings into existence a secondary influence, casting a shadow of doubt over the real and absolute nature of the waves. The Rœntgen Society have for their object a better comprehension of the nature of these mysterious waves, and although subjects will be discussed that do not relate entirely to Rœntgen rays, the endeavor of this scientific body will be the displacement of the term "X-rays" by one having a more definite meaning.

THE OPEN CONDUIT ROAD.

The increasing popularity of the open conduit road indicates a change of opinion among engineers of a highly beneficial character. The open conduit road was a failure some eight years ago at the start, not only in New York City but in European towns. During the course of fifteen years' careful experimenting sufficient experience was gained to show experts that the open conduit road must be built as strongly as the substructure of a cable road. In addition they quickly realized the importance of an ever present means of drainage. With a road constructed so as to provide both drainage and solidity, the question of insulation became an incidental one. In the original Lenox Avenue road conductors were used composed of brass pipes through which steam was to have been sent in case ice accumulated around them during the cold spells. Subsequently, in the new Madison and Second avenue roads the current-carrying conductor was shaped like a T-rail insulated at intervals and bolted into position. The public are well satisfied with this system of transit; the municipal authorities believe it has come to stay and will eventually replace the cable systems at present in vogue in certain large cities in the United States. The day an automatic block system is laid, of any considerable length, will be one noted in the annals of electrical engineering as the first practical outcome of a long series of costly experiments. No less an authority than Silvanus P. Thompson believes in the future of automatic electric roads, and those undertaking improvements in this direction will if successful in their efforts meet with universal commendation. The open conduit road, however, is a pronounced success from a practical engineering standpoint.

THE ELECTRICAL EXHIBITION.

At the Electrical Exhibition held in Madison Square Garden the genius of Edison shines forth as brightly as ever. On the sidewalk outside the building, at the entrance, and within the hallway may be found huge boulders of iron-bearing rock, each weighing many tons. A working model showing the process through which this rock is put shows the remarkable simplicity of the apparatus and means by which the iron is separated from the sand after the crushing process is completed. Thomas A. Edison may become a second Carnegie, although his name, present life and past history more than compare with that of the multi-millionaire, who like himself is self-made and individualized. A great deal at the Electrical Exhibition has been moulded into shape by the hand of Edison, and we are glad to see his son also in the field of commercial activity fighting for prominence and reputation. More than two hundred and fifty thousand men are laboring at the inventions of Thomas A. Edison through the medium of different corporations, for the magic power of this man's touch has awakened into being tremendous enterprises that add year by year to the world's quota of prosperity.

Montreal, Que.—Mr. J. A. Corriveau states that the Montreal and South Shore Railway will be proceeded with early in the spring.

Hamilton, Ont.—The Hamilton Radial Railway Co. have, it is said, abandoned the idea of the extending of the road beyond Burlington.

advantages of this system. It is highly probable that more than a million dollars is annually wasted in driving heavy belts and long lines of shafting in the factories of this country, though the supplanting of this heavy machinery by wires would certainly save a large percentage of this sum.

The Crocker-Wheeler Electric Company thoroughly believe in the universal use in the near future of direct connected machines, and have been making every effort to introduce their system in all the large manufacturing establishments in the United States. Their belief is so absolute that they have begun by following out this practice in their own works at Ampere, N. J., where every machine is individually operated by electricity.

Unique Exhibit of Zimdars & Hunt.

MADISON SQUARE GARDEN.

EVERY VISITOR to the Exhibition, particularly the exhibitors themselves, noticed the rapid increase in attendance each successive night. The Electrical Show represents in detail the best ever given in the East and compares favorably with the great Chicago exposition, which may have exceeded this in the magnitude of its display, but could not equal it in the varied nature of its novel exhibits.

THE EXHIBIT OF ZIMDARS & HUNT has called forth much favorable comment from visitors to the Exhibition. Situated on the 26th street side, not far from the main entrance, it is one of the first exhibits met with by the visitor in his tour, and the glittering array of bright copper objects attracts his eye before he has come up with the booth. Upon closer observation these objects are seen to be a display of the panel boards, switches, automatic motor starters, etc., which have given this firm such an enviable reputation. Here will be seen the most complete exhibit of panel and feeder boards heretofore attempted, all of the very latest forms as well as the older and better-known types being shown mounted on marble and slates in innumerable variety.

In the rear of the booth all types of the well-known Zimdars & Hunt automatic switches and motor starters are shown. These devices are now so well and favorably known that it might be expected that they would have no special interest here for the technical observer; but in this we would be mistaken, for there are here to be seen many new types recently brought out, and which contain many new features of merit. A new type of automatic motor starter, known as type D, is here shown for the first time, and so well has it been received that the firm has already received many orders for them in their various sizes.

One wall of the booth is almost entirely taken up with a display of knife switches, lugs, connections, etc. These will well repay a close examination, as the closer they are examined the more clearly will their many valuable features be brought out. All types are shown and in the various sizes. The copper-back connection which this firm has recently introduced also comes in for considerable attention here.

The instrument switches should be examined by those not already familiar with them. These, though but recently introduced, have so many points of superiority clearly evident that they immediately sprang into the favor of engineers and contractors, and one now looks for them on the latest and most up-to-date switchboards.

In addition to the above, there are many other devices or real merit on exhibition here which the visitor will do well to look up.

The booth is enclosed at the front by copper bars representing switchboard bus bar work, a gigantic knife switch serving for a gate. As might be expected, this novel feature is not overlooked.

THE SPRAGUE ELECTRIC COMPANY are meeting with considerable success in placing their Lundell Horseless Carriage Motor on the market. Quite a number are in use in this country, and very many abroad, particularly in England. In London, the Lundell Motor Equipment has recently been placed upon the mail-van service, and excellent results are reported. Since the vans have been so equipped, it is stated that none has ever been behind time—a record which no other vehicle ever succeeded in obtaining.

THE SPRAGUE ELECTRIC COMPANY announce

t the advance sales for their Lundell Fan Motors are ater than in any previous season. Doubtless, their dsome new catalogue will serve to increase orders, as reat variety of handsome designs is therein displayed great advantage.

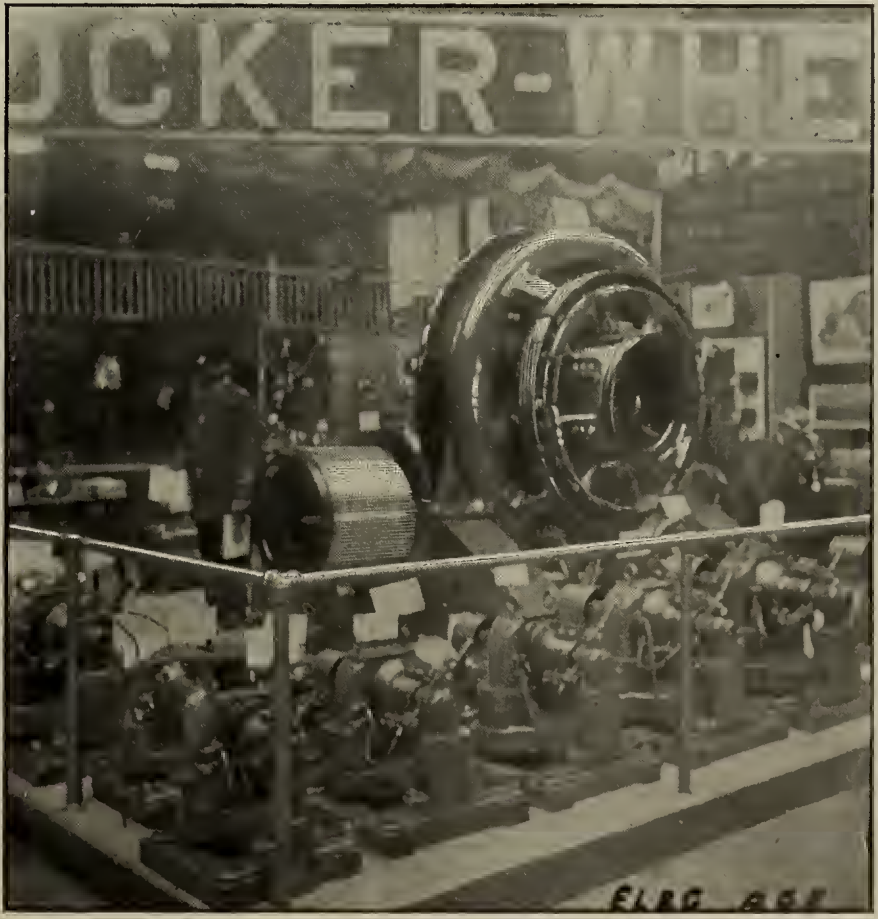
THE STEAM PIPES at the Electric Show are one of the features of the great power plant in the basement Throughout the basement, connecting all the various automatic engines, are to be seen numerous white pipes; these are the steam pipes, and are covered with the

Garvin Machine Company and Peru Elec ric Mfg. Co.

I'CARTHY BROTHERS & FORD have been apnted agents for the Sprague Electric Company for falo, N. Y. The headquarters of the house are in the new Caxton Building in that city. Other appointed nts are Morton, Reed & Company for Baltimore, Md., ker & Kepler for Philadelphia, and Pettingell-Anvs Company for Boston.

popular Nonpareil Cork Steam Pipe Covering made by the Nonpareil Cork M'f'g Co., of the Gerken Building, West Broadway and Chambers street, N. Y. This is said to be the best non-conductor of heat extant. Write for circular of references.

ONE OF THE MOST INTERESTING FEATURES OF THE ELECTRICAL SHOW is the booth of the



Crocker-Wheeler Electric Company.

VERY POPULAR EXHIBIT is that shown by Elmer Morris, a name so well known among the trade that her remarks are unnecessary. All kinds of electrical aratus for light, power, and transmission, as well as road work, are there for inspection. Mr. Morris car- a great trade and bears a most excellent reputation as onservative and reliable business man.

International Correspondence Schools of Scranton, Pa., whose New York Enrolment office is located at 14 East Seventeenth street. No better proof of the popularity of the methods of instruction employed by this institution could be shown than to watch some of their old students taking their friends away from the spectacular end to have them talked to by representatives of the schools. The large number of friends they have around them is accounted for by the fact that they have now over 45,000 graduates and students throughout the world. The booth of the Scranton Schools is very attractive. A picture of the school buildings 5 x 7 feet in size, surrounded by electric lights, showing the picture off to great advantage, hangs at the back of the booth. All the engineers and electricians attending the Exhibition who desire to obtain a technical education in engineering or electricity will find it to their advantage to visit this booth.

NEW YORK NOTES.

MR. SAMUEL INSULL, president of the National Electric Light Association and of the Association of Edison Illuminating Companies, was in New York last week. He takes a very lively interest in the progress of the exhibition, and has informed the management that he will take the utmost pleasure in coming on specially from Chicago, in behalf of those two representative bodies, to participate in the opening exercises on May 2nd. These exercises as now arranged promise to be of an unusually striking and interesting character.

MR. REYNOLDS, the steward of the old Electric Club, is managing the Manhattan Hotel and Restaurant, 1281 Broadway. It has been refitted and was opened April 18th. Messrs. Holloway & Irish are putting in the electric plant, dynamos, electric fans, lights, etc.

CHAS. L. WARRICH, arc and incandescent lamps, electrical supplies and lamp material, is now at 76 Morris avenue, Newark, N. J.. office of the Essex Incandescent Lamp Co.

ELECTRIC MOTORS AND THEIR APPLICATIONS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

If a motor be considered as a machine in which electrical energy is converted into mechanical energy, its convenience and usefulness cannot be misunderstood. There is at present no device of higher efficiency. Its rating is of the highest order and its universal application a matter dependent entirely upon the cost of electricity. There are many types of motors and dynamos on the market, whose features may be critically examined. The general classification of the windings and a division of the magnetic circuits into groups is most instructive to the reader.

Windings.—The dynamo and motor are both made up of two distinctive parts,

Armature,
Field.

Each of these has a distinct function to perform. The armature, by rotation or otherwise, cuts the lines of force and thus creates within its turns an electrical pressure called electromotive force.

In the great majority of dynamos and motors the armature revolves, and thus performs the work it was intended for.

The field is of a different construction from the armature in this respect, that it simply supplies magnetism to the armature. The greater the strength of this magnetic field, the higher the speed of the armature, and the greater the number of turns on the armature, the higher will be the electromotive force (E. M. F.) produced.

The field merits our first attention; it is generally wound in three ways:

Series,
Shunt,
Compound.

Series Winding.—The series winding is one in which the entire current from the armature flows around the magnet winding, both being connected in series in order to obtain this result. Also, if used as a dynamo, the current which issues from the armature passes through lamps, etc., before it reaches the field.

Therefore, we have a complete series circuit; from armature through outside circuit, through field back again to armature. Arc light machines are series wound and in the Thomson-Houston, Brush, Excelsior and Wood dynamos this winding is characteristic.

Shunt winding.—This type of winding, as its name implies, is in shunt or multiple with the terminals of the dynamo. The field magnets are wound with a size of wire whose resistance prevents it from taking more than enough current to provide the magnetic field required. The current from the armature splits up into two parts. One portion, which is the greatest, supplies the outside lines with current. The other portion is taken away by the magnet winding. The amount required for this purpose varies in dynamos of different sizes from forty per cent. to two per cent.

Nearly all continuous current incandescent light machines are shunt wound; such types as the Edison or General Electric dynamo, the Eddy, Walker, Card, etc. This reference applies only to the magnet, or, as it is generally called, the field winding. The majority of continuous current motors are shunt wound.

Compound Winding.—To obviate certain difficulties in incandescent lighting, such as armature reaction, loss of pressure in the armature and loss of pressure in the lines, a winding partaking of the nature of both series and shunt, called compound winding, has been adopted. Its inventor, Brush, was the founder of a great arc light system. In a dynamo the field winding may be to a certain extent neutralized, due to the fact that the armature in carrying current also acts as an electromagnet.

It sends its magnetic lines oppositely to those produced in the field, and thus reduces the effective or resultant field more and more with each increase of current.

The current proceeding from the armature is made to regulate the machine in a very ingenious manner. The coil effects just described may be compensated for by a device which will strengthen the field to the same extent that the armature tends to reduce it; and it may be further strengthened so that the volts lost in the armature and line will be generated in addition, as needed. To effect this result the ordinary shunt winding is first applied; then a series winding is placed beside or on top of this. The series winding has passing through it the entire current of the machine, practically speaking. If this increases when more lamps are applied to the dynamo, the current in the series coil increases; that is to say, its magnetomotive force or ampere-turns increases. If the magnetism supplied by these ampere-turns exactly equals that which the armature neutralizes, the machine is compounded for armature reaction. If it supplies sufficient extra magnetism to make up for that lost in the armature and line besides, it is entirely compounded and the dynamo will act automatically with all loads. The drop in the armature, it must be observed, is measured by the product of the current and resistance.

$$\text{Current} \times \text{resistance} = \text{drop}.$$

If the armature has Resistance = .1 ohm,
Current = 100 amperes.
Lost volts in armature $= .1 \times 100 = 10$ volts.

These calculations apply likewise to the line. If the line resistance = .002 ohms,
and current = 100 amperes.
Lost volts in line $= .002 \times 100 = 2$ volts.

The field may be cut down by armature reaction 10 per cent. when the armature is carrying 100 amperes; if 110 volts are to be generated, there would be a total loss as follows:

Due to armature reaction, 11 volts,
" " drop, 10 "
" line " 2 "
—
Total, 23 volts.

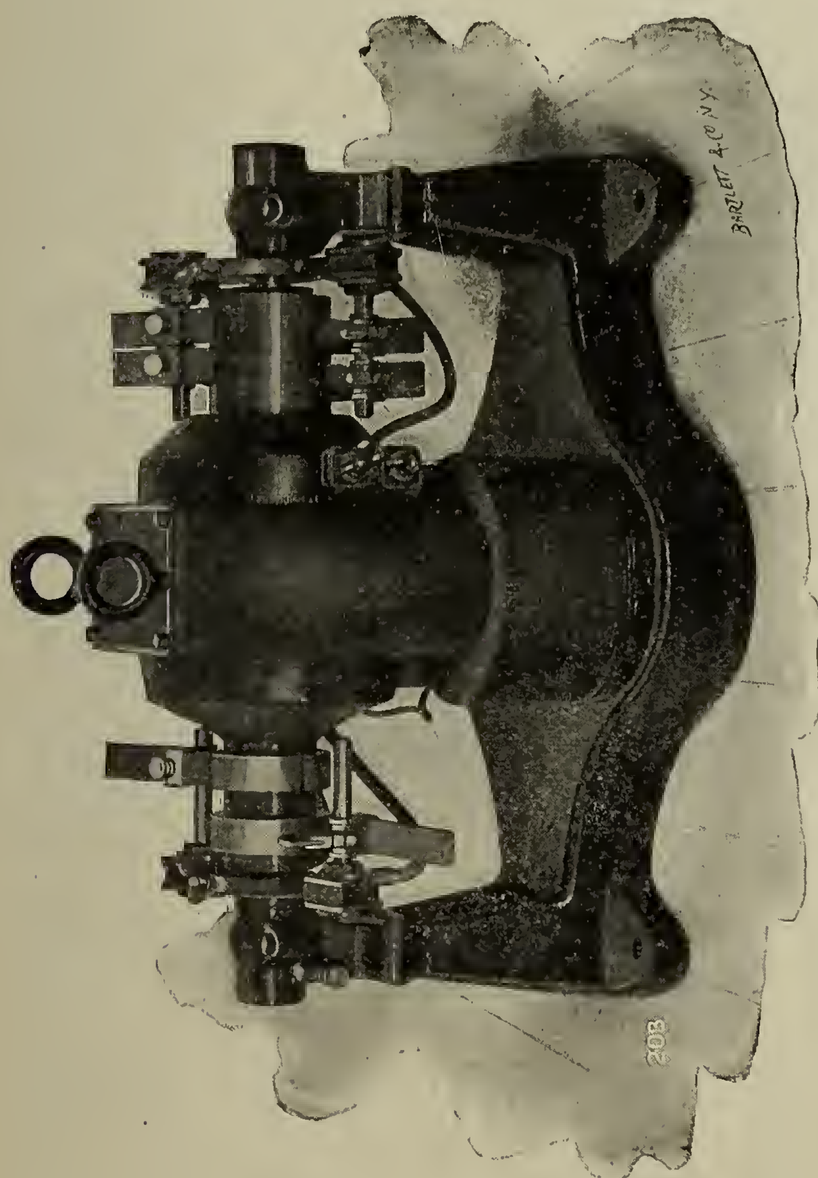
As a rough estimate the compound winding would be called upon to compensate for this loss, which, as noted above, equals 23 volts.

Types of dynamos.—The shapes of dynamos and motors are classified under two general headings. The number of magnetic circuits determine this:

Single magnetic circuits,
Multiple " "

These may be expressed by the names:

Bipolar or two-poled dynamos,
Multipolar or many-poled dynamos.



Dynamotor, Low Voltage and Low Frequency, Alternating Secondary.

Multipolar dynamos have poles in pairs, in multiples of two. They are being extensively used at present in all large stations and in many large isolated plants. The arrangement of the poles to complete the magnetic circuit gives rise to many curious shapes.

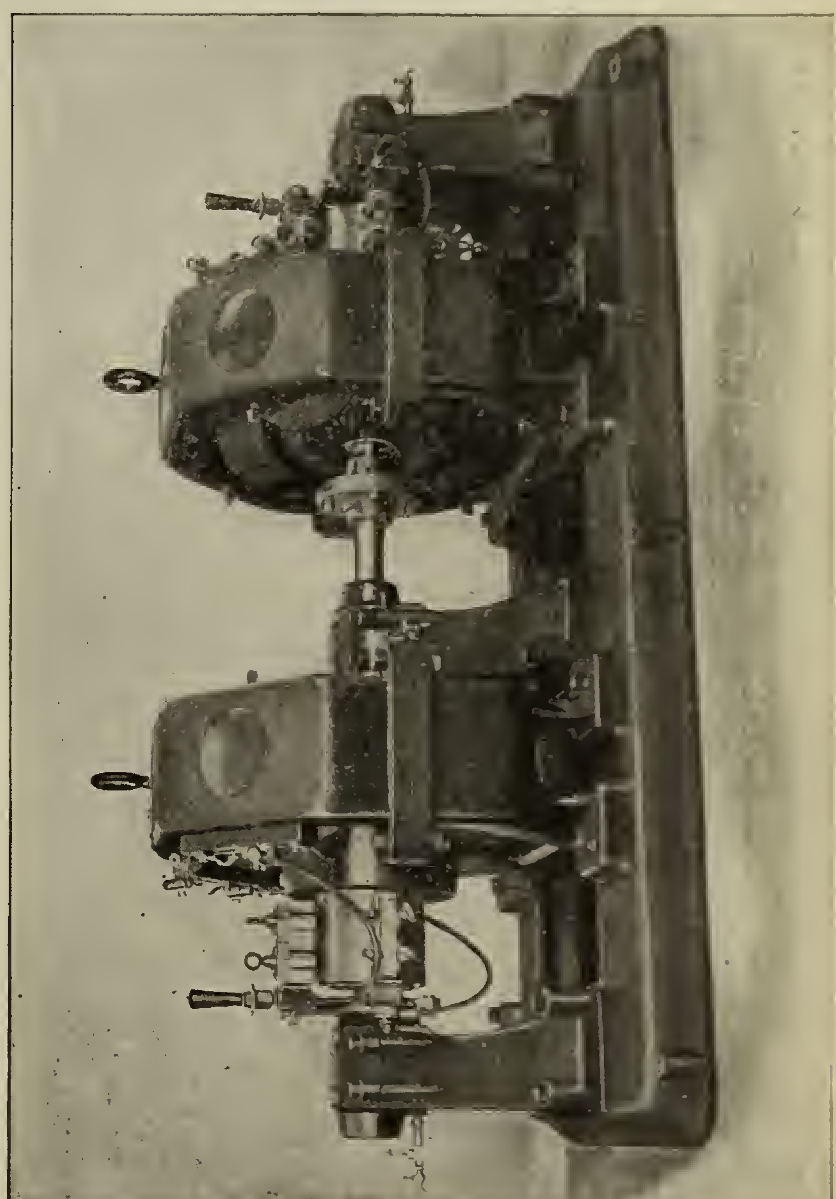
The ironclad dynamo, with its poles entirely inside, the ordinary horseshoe pattern resting on its keeper or on its poles, and the consequent pole types, in which two magnetic circuits feed into one pole, are very interesting to the student. Whilst it is a matter of opinion in many cases as to which is the best, they must be examined from a mechanical as well as an electrical standpoint to appreciate the benefits of each.

When a motor is to be installed certain precautions must be observed in order that no injury from fire can result and no danger from shock exist.

The fire underwriters of every large city impose limitations upon contractors and prevent them from doing careless work. It is usual to mount the motor upon a fireproof foundation and have a large pan underneath to catch the oil drippings. A zinc pan is frequently used for this purpose, the motor being mounted in the centre of it. The starting box must be of slate, and have under it a large sheet of asbestos paper. The fuse blocks, devices used for the protection of a line, must be covered to eradicate the dangers of fire from the vaporized metal.

In total the installation of either motor or dynamo must be based upon the fact that the risks from shock and fire are to be entirely removed. A low voltage motor or dynamo does not introduce much danger from mere shock; in this respect, up to about 400 volts the person in charge is secure, but the chances of fire always exist.

A loose hanging connection, a short circuit on the line, a bad ground, etc., may bring about this danger unless regular tests are made to keep the line clear aud dynamo insulated. A lightning arrester is a very necessary adjunct to a plant having an outside line. Frequently a station is destroyed by lightning, according to report. This may not be true, although lightning is in many cases



Latest Application of Motors. Size 40 Motor-Dynamo "Booster." Motor end. C.-W. E. Co.

the original cause. Lightning by striking a line, or dynamo through the line, usually sparks across every available gap.

An arc is thus started and continued by the generator itself. It is thus very likely that in many instances the burning is done by the dynamo current, although the original cause—lightning—has long since disappeared. Protectors in many cases fail to protect because there is a certain element in lightning arresters that must be improved, and a peculiar oscillatory nature to the discharge that must be better understood in its many variations before they can be used with certainty in every case.

Both dynamo and motor are protected from an overflow of current by means of a safety fuse, cut-out or automatic circuit-breaker. The cut-out is simply a piece of lead wire inserted in the circuit and of such a size that a flow exceeding the regular amount will melt it and open the line. The danger being over it is then replaced by another piece. Good insulation to either dynamo and motor, good safety devices, in the shape of either cut-outs or lightning arresters, and a drip-pan to catch the oil, comprise the essential elements of a good installation.

QUESTIONS FOR REVIEW.

(1) What are the important parts of a dynamo or motor?

(2) How many kinds of winding are employed in the field?

(3) In what manner is the series coil effective in producing regulation?

(4) Name the types of magnetic circuits.

(5) What means are taken to obviate fire and shock in installing motors?

INSULATION AND CONDUCTION.

(Continued from Page 269.)

Silk should never be used where high insulation is required, as pure cellulose dry and boiled in paraffin is so much superior to it that there is no comparison. With pure cellulose, coils with only 1700 feet of wire per inch of spark stand perfectly, *i. e.*, the spark may be five times longer than the coil. In ordinary use, coils having a a spark length 3⅓ times that of the coil have been run for long periods with no break-downs.

As regards oil insulation for ordinary induction coils, the writer has not had sufficient practical experience. I believe, however, that very good results are obtained. With regard to the Thomson high-frequency coil,* there is no question of the efficacy of oil there, especially with regard to ease of repair. As is well known, however, the oil and coil should always be heated above 110° C. for some time if the best results are to be obtained. A very curious increase of insulating power for high frequencies in oil has been noted by Elihu Thomson, who has suggested that it might be due to inertia of the molecules of oil. To test this, one of the writer's students, Mr. Bennet, constructed a two-phase high-frequency electrostatic field. Though insulators placed in this rotated even when placed within a $\frac{1}{16}$ inch glass flask, the effect was found to be due to air currents, and when these were eliminated no movement was obtained, so that the cause of this effect is still unknown, and it is doubtful if true dielectric hysteresis has ever been observed.

So far as Mr. Chattock's experiments and the experience of the writer go, there is not a great deal of difference between the dielectric strength of different substances. It is probably related to the tensile strength. As mentioned previously, the writer† pointed out that there was strong evidence to show that the tensile strength of a substance was due to the mutual attraction of charges on the atoms, and that the observed values agreed well with the calculated and followed the same law. Some time later Chattock‡ in a very interesting and able paper showed that, as the results of his experiments, the dielectric broke down when the slope of potential was great enough to pull apart atoms having charges of the same dimensions as the ionic charges. This was shown for gases, fluids and solids, and forms a very interesting —and, I believe, independent- corroboration of the writer's electrostatic theory of cohesion. Consequently, the nearer the atoms are together and the greater their rigidity, the greater also their dielectric strength.

Chattock's experiments give for solids and fluids—

SUBSTANCE	VOLTS PER CM. FOR BREAKING DOWN.
Glass	919,000
Water	1,050,000
Oil	930,000

which agrees well with the theory.

From the above it will be seen that if the materials are pure, the ohmic resistance is of not much importance, a compound having its molecules held together tightly will have a good dielectric strength for D. C. voltages.

(To be Continued.)

NEW YORK ELECTRICAL SOCIETY.

The second lecture of the Society's Exhibition series was given in the Concert Hall, Madison Square Garden, on Thursday, the 19th, at 8:30 p. m, by Professor I. Fujioka, of the Imperial University, Tokyo, Japan, on: "Electricity in Tokyo and the Kingdom of Japan."

INDIA RUBBER AND GUTTA PERCHA INSULATING Co., J. W. Godfrey, New York manager, assisted by F. W. Harrington and J. B. Olsen, are exhibiting a full line of rubber and gutta percha covered wires for all carrying capacities; also a full line of submarine and ærial cables. The samples represent cables and wires in actual use and have not been made specially for this exhibit. It has been intimated that these samples were made abroad, as it is said there is no factory in this country with facilities for producing the same. We note particularly the 3-conductor concentric cable, each conductor of 1,000,000 C. M. capacity. This cabie is in use in the Power Transmission plant of Salt Lake City.

J. E. FULLER, 22 Spruce street, New York, has just opened a fine electric jobbing and repair shop. Dynamos installed and kept in repair; millwright and machine work done at short notice. All at reasonable rates. Electric lights installed; motors and fans put up and kept going; call-bells for offices and residences; burglar alarms of every description; gas lighting and apparatus; hotel, house and office annunciators. Suburban orders solicited.

The business of A. L. Bogart Co. has been removed to 123 Liberty street in order to be nearer to the centre of the electrical trade. The offices at 50 E. 20th street will continue open until the first of June for the reception of orders, etc.

Kingston, Ont.—The Kingston & Smith's railway promoters will, it is said, seek for a new charter with power to build an electric road between this city and Ottawa.

Berlin, Ont.—The Galt and Preston electric railway will likely be extended to this town.

Victoria, B. C.—The Mountain Tramway and Electric Company will seek incorporation by private bill at the approaching session of the legislature.

Bobcaygeon, Ont.—A meeting was held here last week to discuss the electric railway project. A committee was appointed to take steps to form a company to build an electric road connecting Fenelon Falls, Bobcaygeon and Peterboro. W. J. Reed is acting secretary.

The Electrical Age.

VOL. XXI—NO. 22 NEW YORK, MAY 28, 1898 WHOLE NO. 576

Mr. Marcus Nathan, Manager of the Electrical Exhibition.

THE GROWTH OF ELECTRICAL ENTERPRISE.

The influence of an enterprising spirit upon those engaged in an established industry is doubly beneficial to the general public. The electrical fraternity have, through the efforts of Mr. Marcus Nathan, been taught to regard an electrical exhibition as an excellent opportunity for them to compare notes in a practical manner, increase their business and meet the great masses, direct contact with whom is only occasional. The public are, after all, the best judges of progress and are keenly alive to the benefits derived from an electrical exposition. It is absolutely necessary for them to have one each year, as the advances made in this wonderful field of science are sudden and startling.

Mr. Marcus Nathan, the manager of the Electrical Show at Madison Square Garden, also of the last that occurred in New York City, at the Grand Central Palace, is peculiarly in touch with our electrical friends as well as the eager and curious public. This clairvoyance with both enabled him to select features of interest for the show which will remain in the memory of visitors for a long time.

Artificial daylight, wireless telegraphy, X-rays, electric heating and cooking, welding, and a great variety of other things too numerous to mention holds the attention of visitors night after night. It may be that five years years hence these advances will have become prosaic, but the public owe their knowledge of them to-day to the enteprise and skill of Mr. Marcus Nathan, whose management of the exhibition and arrangement of exhibits deserves the highest credit.

The immense amount of labor involved in the care and growth of this enterprise can only be fully appreciated by those connected with the exhibition during its inception and progress. The limited time at Mr. Nathan's disposal for the full development of the show led many to wonder whether it would be ready the opening night. Mr. Nathan's persistence and resolution overcame all obstacles, however, which included strikes, etc., and showed what well directed efforts can do in the face of many opposing circumstances. Judging from the success of the 1896 and 1898 exhibitions we firmly believe that the next will far surpass them in turn.

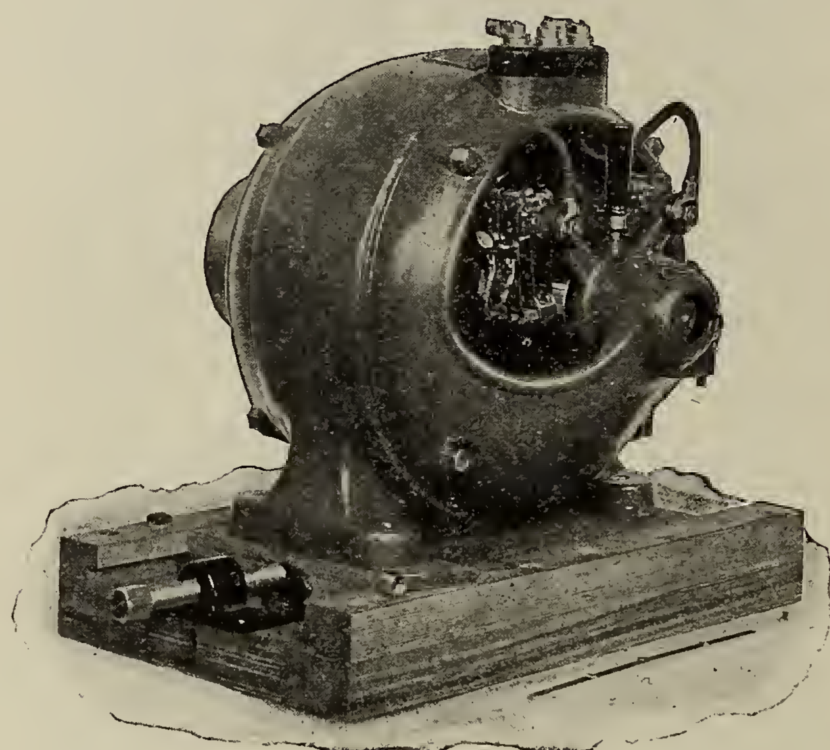
As a fixed institution an annual electrical exposition would add to the advantages of an educational and instructive nature offered in this city, and become in the course of time famous throughout the United States and possibly the civilized world.

SLOW-SPEED MOTORS.

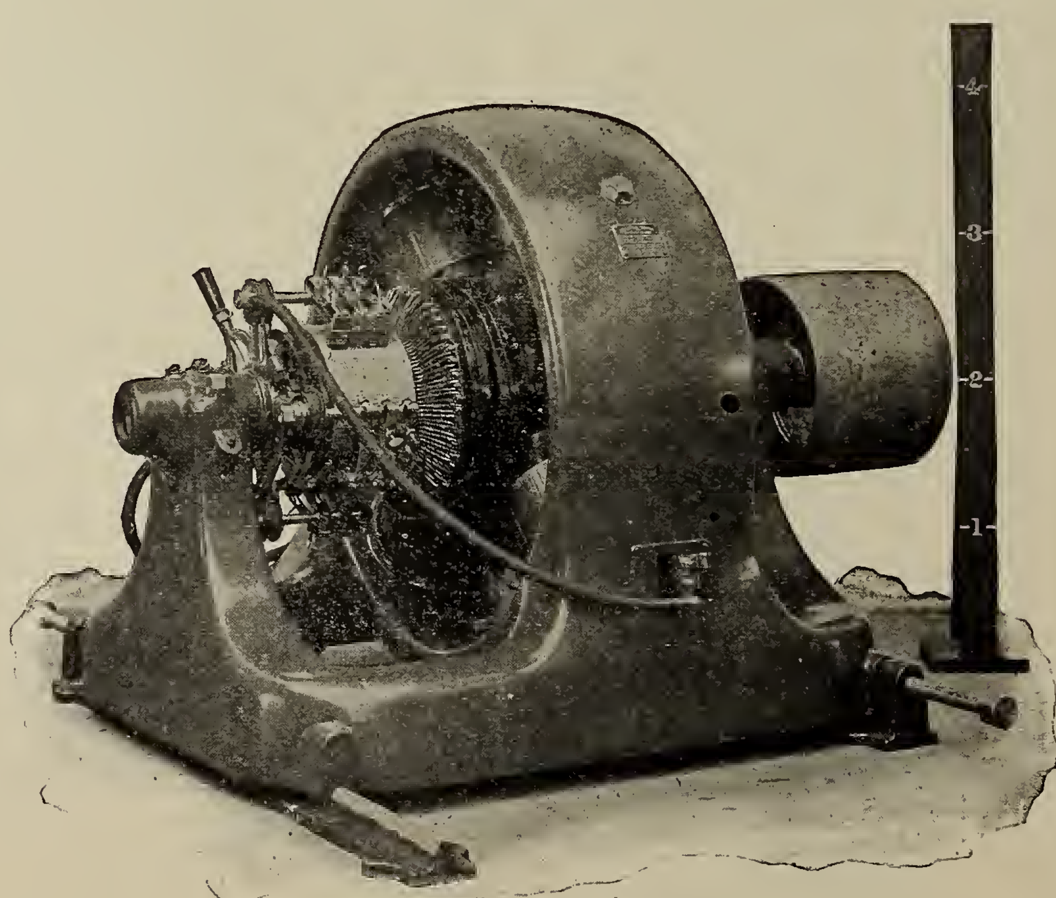
In redesigning its line of motors to run at slow and moderate speeds, the General Electric Company has adopted valuable improvements, which experience with motors of former types and careful observation of their operation under actual commercial working conditions have proved advisable. The motors of the present type are for their output, perhaps, the lightest and most compact built.

For all powers up to and including 5 H. P. in the slow speed and 8 H. P. in the moderate speed, the motors are bipolar; in larger motors, up to and including 95 H. P., four-pole construction is used. The latter method of construction has been adopted for large and moderate-sized motors on account of its many manifest advantages, viz.: shorter magnetic circuits, with consequent reduced exciting current; greater output and higher efficiency for given weight and speed; economical distribution of magnetic material and minimum of floor space. While in motors of a given design reduction of speed necessitates increase of weight, if the same output and excellence of construction is obtained, the four-pole design of the General Electric Company effects such economy of material that the output is extremely large, compared with the size and weight of the machine.

The frames are of iron of the highest quality and the pole pieces of special, soft steel. As the pole pieces are readily removable, the field coils may be taken off and changed without disturbing either the frame or armature. The frame is divided horizontally, and the upper part may be easily lifted off to gain access to the armature. The pillow blocks of the four-pole machines are cast with the bed plate and the lower part of the machine, thus ensuring perfect centring of the armature. The bearings are all self-aligning, self-oiling and of ample size. The core is built up of laminations slotted to receive the armature coils, which, lying below the outer surface of the core, are protected from mechanical strain and abrasion. The spider carrying the core is prolonged at each end in two flanges, upon which the ends of the coils lie without being bent. The armature is wound with the well-known G. E. barrel winding, which provides a large radiating surface for armature conductors and reduces the length of wire to a minimum, thus reducing armature resistance losses and increasing the efficiency of the motor. The coils may be readily removed and replaced, and, being embedded in the slots, can neither move relatively to the core nor vibrate. When the armature turns, air is drawn into the ventilating ducts provided in the core and to circulate throughout the entire armature structure and reduce its temperature. The exceptionally low running temperature of these motors is obtained by designing every part so as to reduce losses to a minimum and providing a complete system of air circulation. The coils are made on forms and separately tested before assembling on the core. The insulation is the same as that used in the G. E. railway motors and vari-



G. E. Slow Speed Motors.



G. E. Slow Speed Motors.

ous tests have shown that it is tough, impervious to moisture, and practically indestructible, even under heavy overloads, or by lightning. The commutator segments are of hard-drawn copper, supported on a separate spider, and the connections between them and the armature coils are carefully made to prevent the possibility of open circuiting.

The brush holders have a solid casting connecting the brush box with the stud and an adjustable pressure spring, giving an even pressure and firm and accurate contact of the carbon brushes and the commutator—an important factor in securing sparkless and noiseless operation. A flexible conductor permanently attached to the brush connects it with the brush holder and allows of free movement of the brush in the holder, while avoiding any resistance from imperfect connection. Change from no load to overload can be made without changing the position of the brushes and without sparking. The only wear on the commutator is the friction of the brushes, which is practically negligible.

In the bi-polar machines the projecting field effectually protects the spools and armature from injury. Stability is secured in these machines by so designing the heavy parts as to bring the centre of gravity very low. All parts of both the four-pole and bipolar motors are accurately made to gauge, and are thus interchangeable. The substitution of new parts requires no special skill and can readily be made by the man in charge of the machine. On account of the slow speeds of the four-pole motors they may be belted directly to ordinary slow speed line shafting without intermediate counter-shafting. They are therefore especially adapted to all factory, mill and shop requirements. The bipolar type is adapted to the driving of lathes, printing presses, fans, drills, pumps, and indeed, to almost any work where small units of power are required and little space is available. They are arranged to run in any position, whether suspended from the ceiling, attached to a wall, or set upon the floor.

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from page 283.)

Magneto-electric and dynamo-electric generators and motors have now become so common that we are apt to forget that their introduction on an extensive scale has only taken a few years. Faraday's disk dynamo was, as has already been stated, produced in 1831, and a machine for generating electricity was made by Pixii in the following year. Pixii's machine consisted of a horseshoe permanent magnet which was rotated in such a way that its poles passed alternately in front of the poles of a similar electro-magnet. An alternating current was thus induced in the circuit which included the coils of the electro-magnet.

This machine was improved by Clarke, who removed the coils and put a commutator on the axis. Other machines were made or suggested by various physicists, and an important observation which has since been frequently overlooked, was made at this time by Jacobi, who pointed out the importance of making the cores of the coils short. Sturgeon, in 1835, made a dynamo with a shuttle-shaped armature; a similar form has long been identified with the name of Siemens. Woolrich made a multipolar magneto machine in 1841 for electroplating, and Wheatstone about this time produced his small multipolar magneto, long used for telegraph purposes. In 1845 Wheatstone and Cooke patented the use of electro-magnets in place of the permanent magnets, and Brett suggested, in 1848, that the current from the machine might be made to pass round a coil surrouding the magnet and thus increase its strength. A similar suggestion was independently made in 1851 by Sinsteden. In 1849 Pulvermacher proposed the use of thin laminæ of iron for the cores of the magnet, a proposition which has since, but probably for a different reason, been almost universally adopted. Sinsteden used iron-wire cores and made a number of experiments on the effect of varying the pole face. About this time another class of machines was proposed by Ritchie, Page and Dujardin. In these machines both the magnets and the coils were to be stationary, but the magnetism was to be varied by revolving soft iron pieces in front of the poles. Modern representatives of these machines are to be found in the dynamos of Kingdon, Stanley and others. All the machines up to this time had been of very small dimensions. In 1849 Nollet began the construction of an alternating machine on a larger scale, but died before it was completed. Machines of Nollett's type were afterwards made by Holmes and by the Compagnie l'Alliance of Paris, the latter being called the Alliance machine. These machines were used for lighthouse purposes. Holmes's earlier machines were continuous current, but later he left out the commutator, and still later again introduced it on part of the coils for the purpose of obtaining current to excite his field magnets. This latter plan was introduced after the self-exciting principle had been introduced by Siemens and Wheatstone.

A remarkable machine historically was patented in 1848 by Hjorth. In this machine a combination of the permanent and electro-magnet was used, the first to give magnetism enough to produce a current with which to excite the other. A similar idea was developed fifteen years ago by Wilde with the difference that the permanent magnet part was a separate machine. The idea of using part of the current from the armature to excite or partially excite the field magnets was at this time in the minds of a number of workers, and some remarkable machines were patented by the brothers Varly, one of which containing both a shunt and a series winding has been held by some to anticipate the compound winding now in use. In 1867 it seems to have occurred independently to Wheatstone and E. Werner Siemens that the permanent magnet part of the Hjorth and Wilde machines might be dispensed with, the resident magnetism being used to start the action. Siemens gave the name dynamo-electric machine to this type and it has stuck. In order to diminish the fluctuations in the strength of the current during one revolution of the armature Pacinotti devised his multigrooved armature in 1864. This machine did not receive the notice it deserved for a number of years, and in the meantime Gramme produced his smooth ring armature in 1870. Gramme's machine was soon recognized as being of great merit, and its gradual introduction gave rise to increased activity. In 1873 the Hefner-Alteneck improvements on the Siemens armature were introduced and in the remaining 70's quite a number of forms of dynamo were invented, the Loutin type introduced in 1875 with improvement in subsequent years being one of the best. The early 80's saw tremendous activity; the patent offices in Europe and America were flooded with inventions of various types of dynamos and motors, of lamps for electric lighting and so forth. It is curious how few of those machines have stood the test of time and how well the old types of Pacinotti, Gramme, Siemens-Alteneck and Loutin in some one of their modifications hold the field. Great progress has been made in the last fifteen years. Machines have assumed enormous proportions and the number of branches of industry to which they have been applied is now very large. Much has been learned during this time, particularly with regard to alternating currents and their application to the transmission of power, the introduction of multiphase systems being of considerable importance in this connection. In the direction of high potential and great frequency the work of E. Thomson and Tesla is of great interest.

Of the application of electricity to the production of light and heat little need be said in this connection.

The difficulties to be overcome were largely mechanical, and with the progress made we are all familiar.

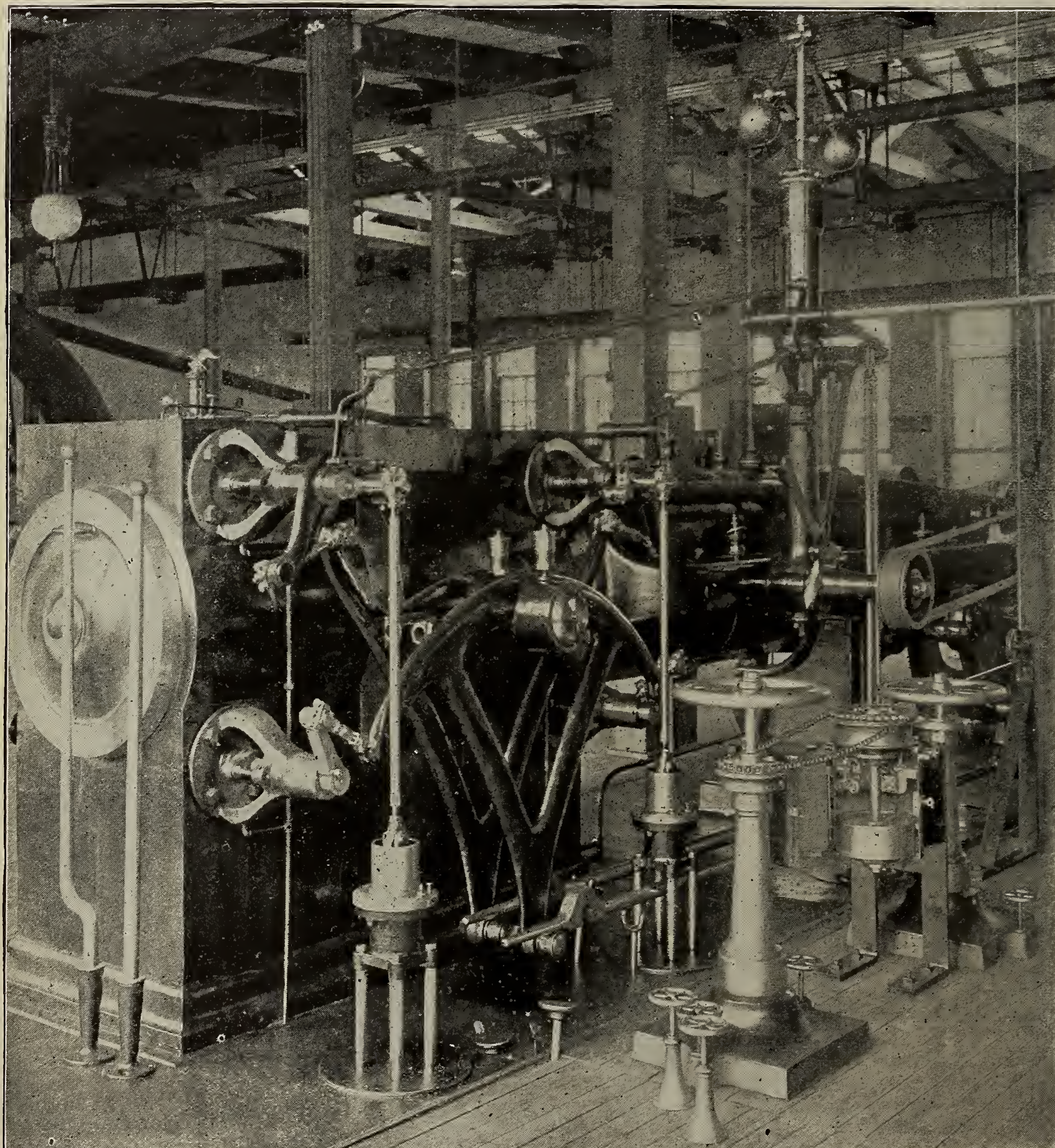
As regards primary batteries there has been, of course, as we all know, considerable progress since the time of Volta. The number of forms brought into use has been enormous and they have been important in increasing our knowledge of the relative electromotive force of various combinations and in their bearing on chemical knowledge. It can hardly be said that an ideal primary battery has yet been obtained, when we look at the subject from a commercial point of view. Although the subject is not very much to the front at present, however, it is destined to come again, and will, I have no doubt, be, in a comparatively short time, one of our leading industries.

(To be continued.)

Oakland, Md.—The Mayor may be addressed concerning erection of electric light plant, for which $25,000 worth of bonds will be issued.

MONARCH STOP AND SPEED LIMIT.

We wish to call the attention of our readers to one of the most ingenious inventions on exhibition at the Electrical Show in this city. This is a practical and reliable device for shutting off steam by a touch of the finger. It is called the Monarch Stop. The stem of the throttle valve is connected by sprocket wheels to this Stop by means of a sprocket chain. By touching an electric button an electro-magnet operating within the Engine Stop

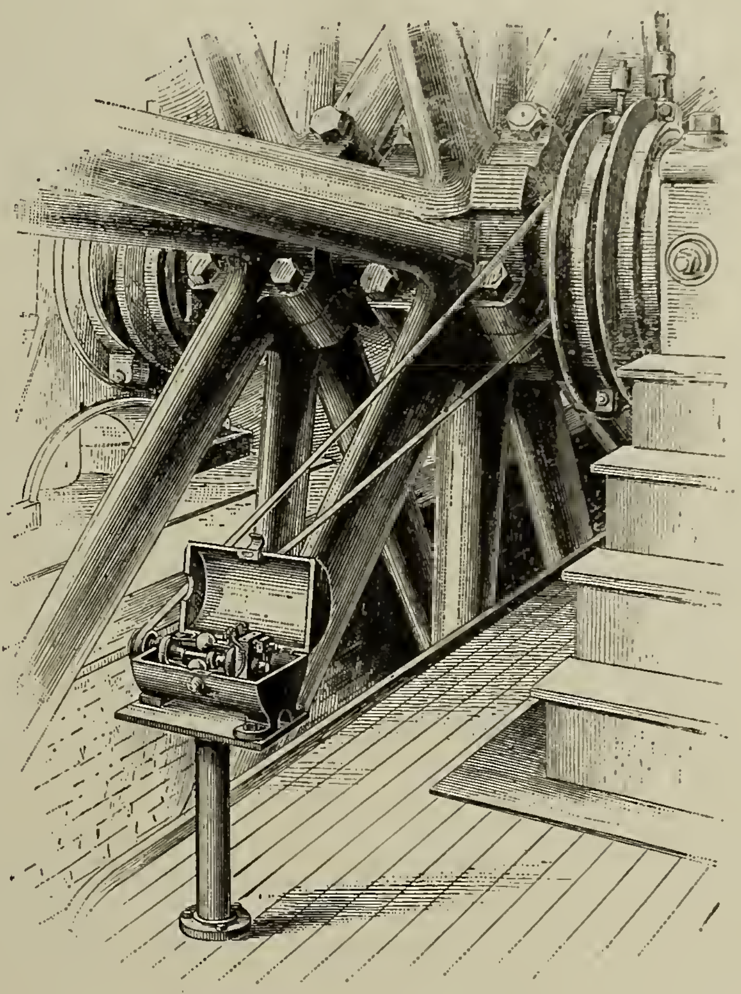


Engine Stop Placed on Floor.

allows this sprocket wheel to turn, and it thereby shuts off the steam supply. The sprocket wheel is set into rotation by means of a weighted flexible wire rope coiled around an adjoining drum, so that it will instantly uncoil when a small pawl operated by the electro-magnet withdraws its restraining hold. A spring would perform the function of rotating the sprocket wheel as well as a descending weight.

When the button is pressed the magnet is energized, its armature is attracted, the pawl pulled out of the ratchet wheel, and the sprocket wheel, rotating, cuts off the steam supply, but not too rapidly. A dash-pot delays the last few revolutions of the throttle-valve stem, and thereby allows it to close gently and without jamming down hard upon its seat. This device is merely used for shutting off the steam, and this action may be controlled from any part of the building where a push button may be installed for this purpose. Thus the risk attending the operation of dangerous machinery, belting, shafting, etc., is reduced to a minimum, to say nothing of the saving of property following the breakdown of machinery. This Stop can be used for closing any valve, and it has met so far with wide application.

The Monarch Speed Limit makes a fly-wheel accident impossible. It consists essentially of a governor so mounted that it will close a circuit when rotating at a certain maximum speed limit. It is always used in connection with the Engine Stop, being driven by a belt running over the crank-shaft of the engine. The movement of the governor balls advances a sliding collar. The position of this collar is determined by the speed at which the balls rotate. It is possible to adjust this speed limit so as to make it applicable to an engine of the high or low-speed type.



Speed Limit in Position.

Both of these devices, the Speed Limit and Engine Stop, are enclosed in dust-proof iron boxes, provided with Yale locks. The Monarch Manufacturing Company have their office at 39–41 Cortlandt street, New York city, where they will receive correspondence and orders relating to these machines.

THE EFFECT OF ARMATURE INDUCTION UPON THE ELECTROMOTIVE FORCE CURVES OF AN ALTERNATOR.

(Continued from page 285.)

An inspection of this curve shows that it is distorted in the direction of the normal rotation of the armature Thinking that its unsymmetrical form might not be entirely due to a magnetic reaction between the armature and fields, and that possibly it was caused, in part at least, by a variation in the width of the air-gap space, owing to the core of the armature not being quite true, the curve was continued through the complete revolution. The result of the test, however, gave another curve exactly like curve A. This indicated conclusively that lack of symmetry in the mechanical construction of the machine played no part in causing the distortion. The current in the coils 1 and 2 was then reversed in its direction while being kept at the same volume. The exploration resulted this time in giving the curve B, of Plate 1. As before, the "make" and "break" gave the same deflection for any given position, but the curve was found to be drawn over towards pole tips S′ and N, Fig. 2, instead of towards S and N′, as in the case of curve A.

The distortion of these curves, the ordinates of which are proportional to the inductance of the coils in various angular positions, is entirely due to the variation of the permeability of the iron composing the armature core and pole faces as the energized armature coils are moved through the half revolution. When curve A, Plate 1, was taken, the current passing through the coils tended to produce a magnetic field in opposition to that induced by the field circuit when the coils were in the 185° position, and one aiding the field flux when they were in the 95° position. In other words, poles were generated in the coils as indicated by the small N and S on coil 1 of Fig. 2. With the coils in the 95° position, when the circuit was made, a number of ampere turns were brought into action, which increased the induction in the surrounding masses of iron and at the same time decreased their permeability. With the coils in the 185° position, making the circuit through the armature, decreased the magnetic density in the surrounding iron and thereby increased its permeability. Breaking the armature circuit in either case brought the induction back to the same initial value, since the two positions assumed are symmetrically located relatively to the pole faces. The introduction of the same magnetizing force into the coils, however, does not cause the same variation in the induction threading the coils. Since the variation in the value of the permeability is in opposite directions in the two cases, the variation in the flux in the 185° position is greater than that which occurs in the 95° position, and therefore the self-induction of the coils in the former is greater than in the latter, under the assumed conditions.

Magnetic hysteresis also plays a part in the variability of the armature inductance. As the armature revolves, the iron of the core passes through a complete hysteretic cycle once every revolution, and in making determinations of the armature inductance, account must be taken of the fact that the magnetization of the iron of the core follows the perimeter of the loop of hysteresis and not the "B and H curve," as the permeance of the core changes.

To determine the extent of the error introduced by neglecting to adhere to the true magnetic changes through which the iron passes, as is the case in the method so far described, a rather laborious process had to be resorted

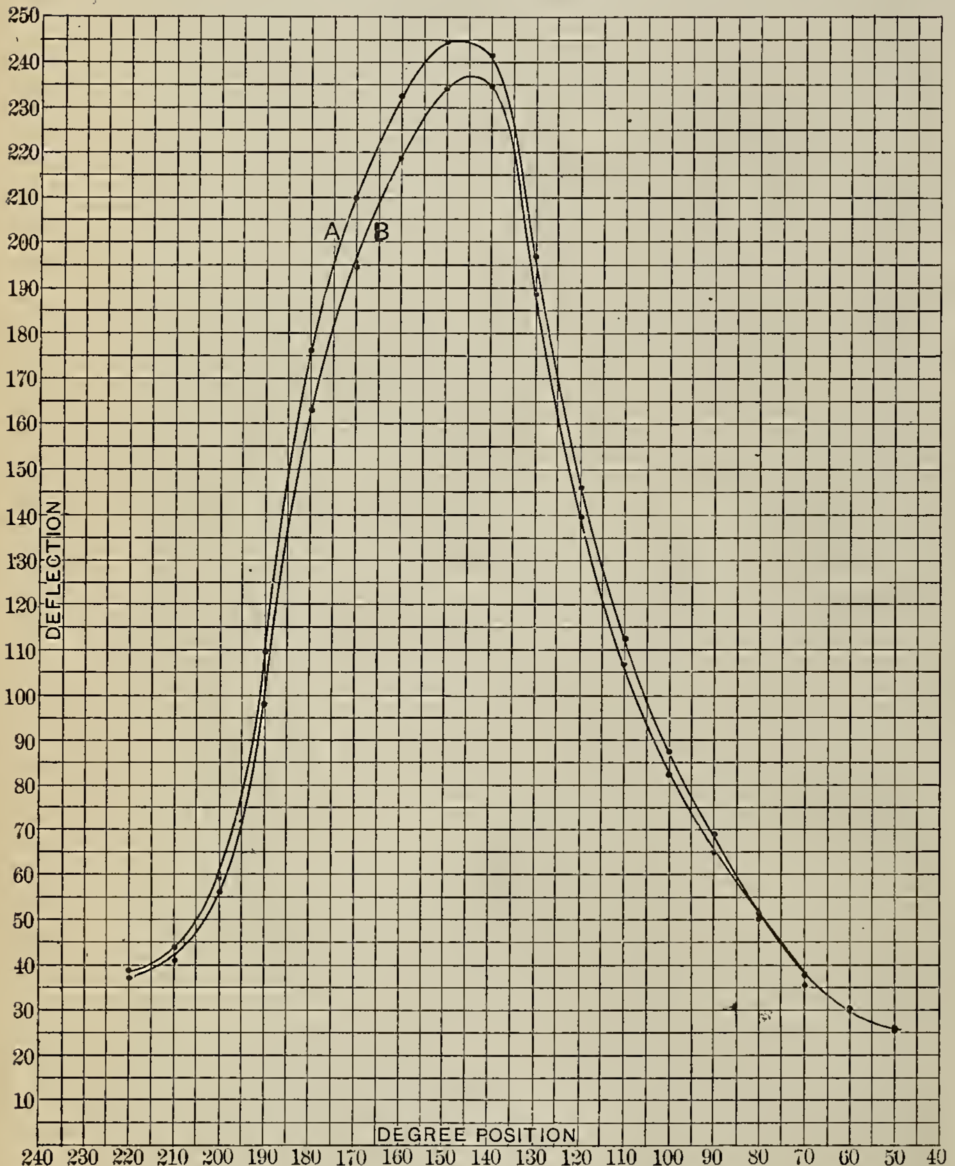


Plate 2.

to of carrying the iron in the core completely through the hysteretic cycle before taking each reading. By this means, owing to the fact that when a coil is between the pole tips the laminated core of the coil is highly saturated, it was possible to get a very fair estimate of the influence of hysteresis.

Suppose we take the hysteresis loop of Fig. 3 to represent the cycle through which the magnetization of the iron passes during a revolution of the armature. Let *a* represent the magnetic density in the core of coil 1 when it is in 230° position, and no current flowing in the coil. As the armature is revolved in a counter-clock-wise direction, the intensity of the magnetization in the core will decrease until at the 320° position it will have a value equal to *o*, *b*. At some point farther on, say at 330°, there will be a sufficient negative force to reduce the residual magnetism to zero, as at *c*, Fig. 3; and finally, when coil 1 reaches the 50° position, the magnetism will have been brought up to a negative maximum within the coil as at *d*. If at this point the circuit is made through the armature coils, and a constant current sent through them in the direction which aids the field flux, the density in the core will be increased to a still higher value, and rise up to *e*. Suppose now that the armature is revolved still further round, for instance, to the 120° position. The flux penetrating the coil will diminish to *f*. If at this point the armature current is broken by the snap switch, a current impulse will pass to the galvanometer needle from the exploring coil due to the decrease in the induction threading the coil from *f* to *g*. If, without changing the position of the coil, the current is made again, the density will rise to *h*, but will not come up to the original value at *f*. In other words, any number of "makes" and "breaks" can be made after the first "break" with the same result, but the first "break" will give a larger reading than the others. The first "break" gives the most accurate result. By this method, however, coil 1 has to be brought back to the 230° position before taking each reading, then revolved counter-clock-wise to the 50° position, and, after the current is made, has finally to be moved to a position between S′ and S, to take the reading at the "break."

Following out this method for one set of readings, curve A, of Plate 2, was obtained. Curve B is a curve plotted from an average of the readings due to the second and third "breaks" and their corresponding "makes." It is identical with a curve taken by the method used in

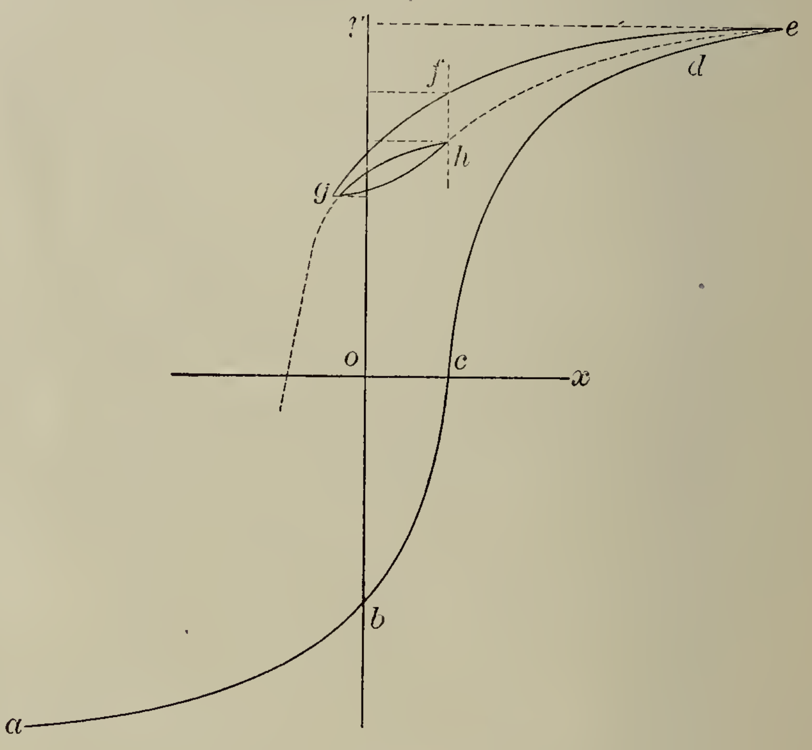


Fig. 3.

obtaining curves A and B, of Plate 1, but with the same armature current as that used in obtaining the curves of Plate 2. An inspection of the curves of Plate 2 shows that the maximum percentage variation occurs at the 190° position, where it amounts to 12 per cent., and that the maximum actual variation occurs at the 170° position, where it amounts to 15 divisions, or 7.8 per cent. of the deflection at this point. This represents an actual difference of .0117 henrys at the 170° position.

As was to be expected, from the considerations outlined above, the curve A of Plate 2 shows a greater distortion in the direction of rotation than does the curve B, taken by the less exact method. It reaches a maximum later in the cycle, and although of uniformly greater amplitude than curve B, the differences are most marked in the last half of the cycle, counting time from right to left.

Curves A and B are, however, exactly similar in form and so nearly alike, that it was not deemed necessary to follow out the more elaborate and exact method in succeeding determinations of the variable inductance, as the end in view was to determine the character of the changes occurring rather than the absolute value of them.

Plate 3 exhibits a series of these inductance curves. They represent five explorations, made with direct currents of different intensities flowing through coils 1 and 2, while the field exciting current was maintained constant at 10 amperes as usual. The readings have been

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

FIRST FLOOR, WORLD BUILDING.

NEW YORK.

NEW YORK, MAY 28, 1898.

CONTENTS.

THE MOST UNIQUE OF METALS.

The most precious metal is not always the most useful, and the demands of each age bring into prominence entirely through its use that metal which adds most to the comforts of man. The most precious metal in the strict sense of the word is, at the close of this century, undoubtedly iron, and not gold. When the proper amount of labor has been spent upon a piece of iron so as to mould it into the shape of hair springs, or the small blued screws used for watches, the ratio of value between one pound of iron thus formed and an equal weight of gold is at least fifty to one. The strangest property of metals is not to be found in their strength, density or hardness, but in what we might consider as something most unique; for instance, selenium, so to speak, winks when light falls upon it. This is made evident by the construction of a circuit in which a battery, galvanometer and piece of selenium form part. When a ray of light falls upon the selenium a deflection of the galvanometer needle is immediately noticeable, the light having reduced the resistance of the selenium, thereby allowing an increased current to flow.

The metal bismuth displays an equally interesting phenomenon; its resistance is greatly increased by the influence of a transverse magnetic field upon it. To state how far this effect is observed we might say that the resistance of bismuth isolated from a magnetic field and then exposed to one having a specific induction of one hundred thousand lines of force per square inch would vary as one to two. This wonderful property of bismuth is made use of for measuring the intensity of a magnetic field. It is very likely that this metal could be put to other uses, as, for instance, the measurement of the permeability of iron or any other magnetic material, or possibly for telephonic purposes where the magnetic field in a receiver is subjected to constant variations.

The discovery of these properties lead us to expect something of a similar nature in other metals. The effect of ether waves upon all the metals has not been tested at the present moment. The discrimination shown by selenium for visible rays and bismuth for magnetic waves may lead to the conclusion that all metals respond in a greater or less degree to the play of ether vibration upon them. No explanation has been made to account for the mysterious change due to light or magnetism striking these metals.

It seems likely to suppose that minute changes do occur in every case in which a metal is exposed to an ether stress, although why it is more pronounced in the case of selenium and bismuth than in that of zinc or silver is a sphinx-like puzzle. In considering the rather uncommon properties of selenium and bismuth, the extraordinary multiplying effects of iron upon a magnetic field must not be forgotten. We have in this case the theory of Ampere to believe in, but it is unfortunately only a theory, and the everlasting polarity of each iron molecule prevents its unbiased acceptance.

It seems as though a stress in the ether directly affected the molecular adjustment in both selenium and bismuth, although a higher rate of vibration was required for selenium than the other metal. We can only conclude from the above consideration that of all the laws operating in this universe very few are known to man; otherwise the rate of progress from an intellectual and commercial standpoint would be too rapid for our thorough comprehension.

"New Catechism of the Steam-Engine," by N. Hawkins, M. E., published by Theo. Audel & Company, New York, with chapters on gas, oil and hot-air engines, is in many respects a compilation covering the latest types of engines used for electric lighting and power. The great strides made in the use of appliances that are absolutely automatic have enabled the engine-builder to attach to the compound-wound dynamo a machine as reliable in its way as the generator itself, and these two automatic devices in conjunction require but a minimum of care and attention from the engineer in charge. It is a class of engines of this description that the New Catechism of the Steam-Engine mainly covers; other departments of the work include other types of engines and touch upon the principles of valve setting and the requirements of an able engineer, the chapters devoted to a description of gas and gasolene engines possess a deep interest for the enterprising contractor and builder. By carefully reading the contents of the New Catechism of the Steam-Engine the reader may become so familiar with the qualities and differences between types of steam-engines for high-speed work, and the valuable features of gas and oil engines, as to be able to judge of the suitability of any one that a contract may call for. As a book of instruction the above volume will meet with favor, but more as a compilation of a purely practical character than as a text-book or a piece of scientific literature.

Halifax, N. S.—The Halifax and Bedford Electric Company, which is seeking incorporation, is composed of Dr. Chisholm, ex-Mayor Keefe, E. F. Freeman and others of this city. The proposal is to build a road between Halifax and Bedford, with such extensions as may be approved by the municipalities. The head office of the company will be in this city. The capital stock is estimated at $250,000.

Chicontimi, Que.—Mr. Jos. D. Guay and Joseph Gagnon contemplate the construction of an electric railway in this vicinity.

reduced to henrys; the calculation of the values being based upon the supposition that the inductance of the two coils at any point is proportional to the change in the number of lines of force existing in the coils at that point, divided by the current flowing in the coils and producing the change. The plotted values, therefore, represent the inductances of the two coils in series, proper allowance having been made for the fact that the exploring coil was only wound about one of them.

The curves of Plates 4 and 5 have been derived from those of Plate 3. They show the relation between the

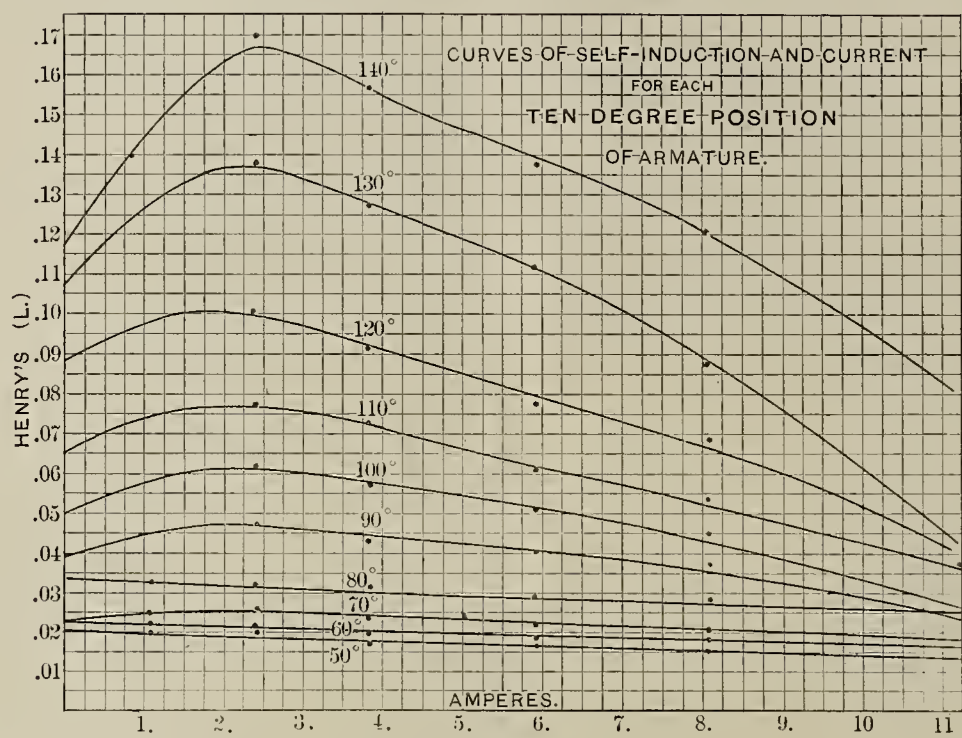


Plate IV.

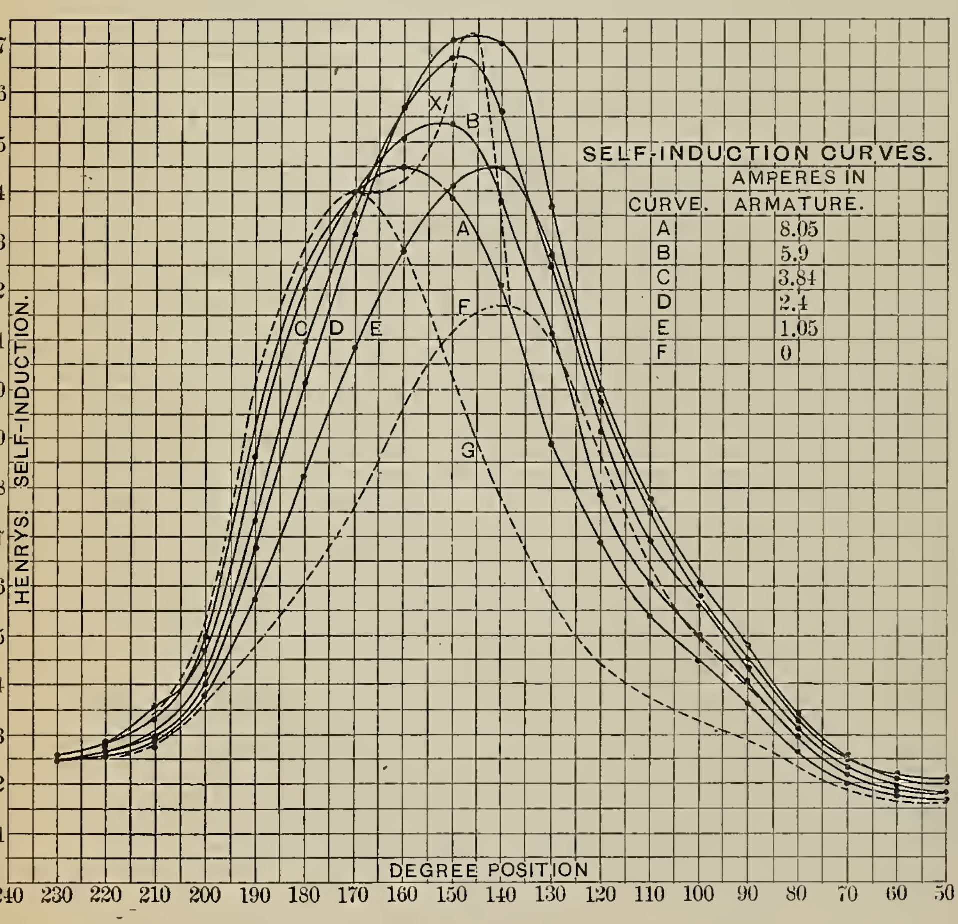


Plate III.

direct currents flowing in the coils and the inductance of the coils, and are useful when it is desired to determine the curve of instantaneous inductance that corresponds to a given alternating-current wave.

The curves of Plates 3, 4 and 5 bring to light some very interesting facts. They show that the maximum coefficient of self-induction occurs when the coils are in the 145° position and the current flowing in them has a value of 2.5 amperes; under these conditions their inductance is over .172 henrys. They indicate that as the armature current is varied from zero up to its maximum safe value, the inductance of the coils undergoes very marked and relatively rapid changes. The dotted curve F has been plotted from the ordinates of the curves on Plates 4 and 5 that correspond to the zero value of current. It represents the initial inductance cycle, and is the basic curve to either side of which the inductance curves for the various currents fluctuate. Curve F is practically symmetrical relatively to the pole faces. Its crest occurs as the coils pass the centre of the pole faces, and it slopes equally on either side. The line X, drawn from its crest through the crests of the other curves, indicates the successive positions and values assumed by the maximum inductance corresponding to different constant currents, as the volume of these currents is increased from zero. The maximum-current capacity of the armature is 15 am-

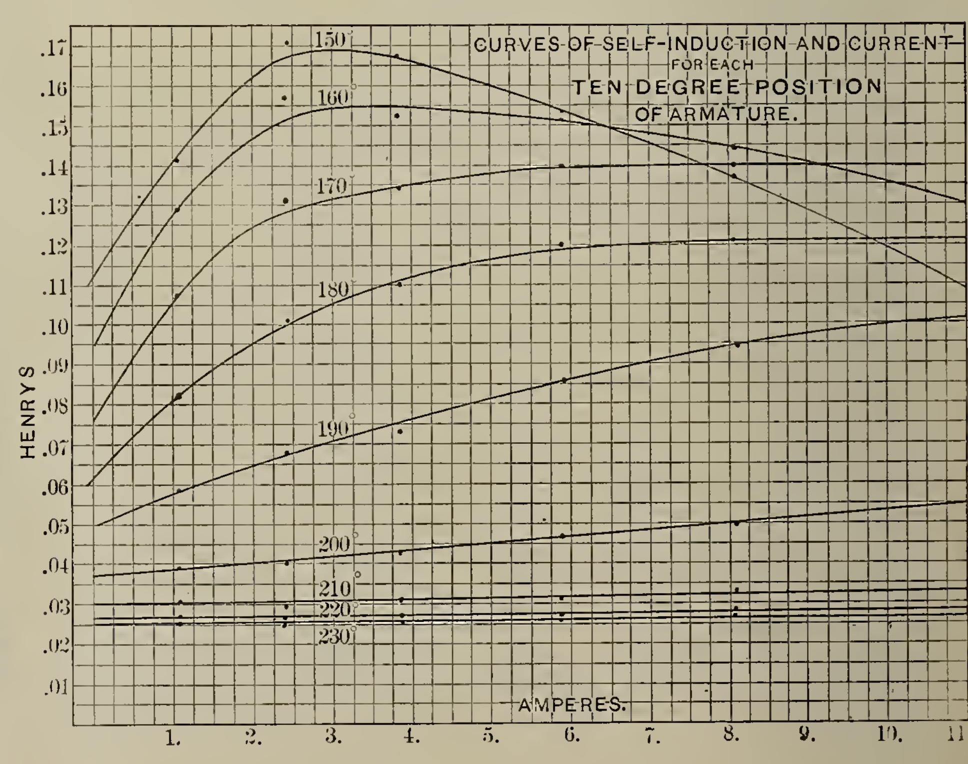


Plate V.

peres, but the inductance is changed from its maximum initial value of 117 henrys to its maximum possible value of .172 henrys when the armature cunrrent reaches 2.5 amperes. Any further increase in the current causes the amplitude of the inductance wave to diminish and at 8 amperes it is only 85 per cent. of what it is at 2.5 amperes.

Besides varying in amplitude, the inductance waves undergo a lateral shifting in the direction of the rotation of the armature. The dotted curve G has been taken from Plates 4 and 5, and represents the inductance curve corresponding to 11 amperes. An inspection of Plate 5 shows that this curve practically marks the limit of the variability of the inductance. For a further increase in the current, the 170° curve of plate 5, tends to remain horizontal, and the 180° curve exhibits no disposition to rise appreciably beyond the 11-ampere point, there will therefore be practically no further shifting of the crest, or change in the amplitude of the induction curve.

To better appreciate the extent of the distortion that occurs, it is well to note that at the 170° position there is a difference of about .065 of a henry between curves A and F of Plate 3, showing that the inductance of the coils at this point has double the value at full load that it has at no load. This fact is brought out strongly in Fig. 4, which shows the differences between the ordinates of curves D, F and G. In this figure, the amounts by which the ordinates of curves D and G of Plate 3 differ from those of curve F have been plotted as ordinates relatively to curve F reduced to a horizontal base line.

(To be continued.)

The Big Arcolier at the Electrical Exhibition.

MADISON SQUARE GARDEN.

XPERT ENGINEERS visiting the Electrical Show have remarked that the race between the different manufacturing concerns is a very close one for best place. The exhibits will add greatly to their opinion that electrical machinery from a mechanical as well as an electrical standpoint represents the finest of workmanship. Visitors passing through the lower floor of the exhibit cannot fail to be impressed with the variety and excellence of the plants operating there. The development of electric lighting has increased wonderfully in the last few years, leading the engine manufacturer to higher and higher standards of excellence. Oil engine as well as gas engine men have the utmost faith today in the ability of their engines to stand the severest test that can be put upon them, namely: the running of a dynamo for electric lighting. In such a case uniformity of speed is so necessary that even an occasional variation would cause a fluctuation of light which would immediately condemn the source of power as being at times unreliable and deficient.

The Fort Wayne Electric Corporation, of Fort Wayne, Ind., exhibited in their booth an eight-light, 2000 c.-p., Wood arc dynamo, belted to and operated by a four-pole direct-current motor. The dynamo is fitted with the latest and most unique type of regulator, presenting the simplest, most compact and efficient constant current maintaining device known to practice. The regulator being complete on the machine does away with all wall controlling devices and outside regulator connections. The Fort Wayne exhibit consists in addition of one 37½ K.W., compound wound alternator of the low-frequency type (7200 alternations per minute) operated by a direct-connected multipolar motor. The alternator is loaded with enclosed, alternating current arc lamps and a bank of incandescent lamps, which by switches can be thrown singly or in groups on the corporation's latest types of ampere-hour, lamp-hour and K.W.-hour integrating recording meters. A five H.-P., single phase, self-starting, alternating current motor also receives its current from the alternator. An interesting mechanical device is shown in the shape of a commutator truing attachment which enables the operator to true a commutator by hand with all the accuracy obtained in a lathe. A combination arc and alternating-current switchboard transformer, small motors and several styles of arc lamps, complete this very interesting exhibit. It is one of the most interesting in the show and represents to a large degree the advances made in modern electrical engineering.

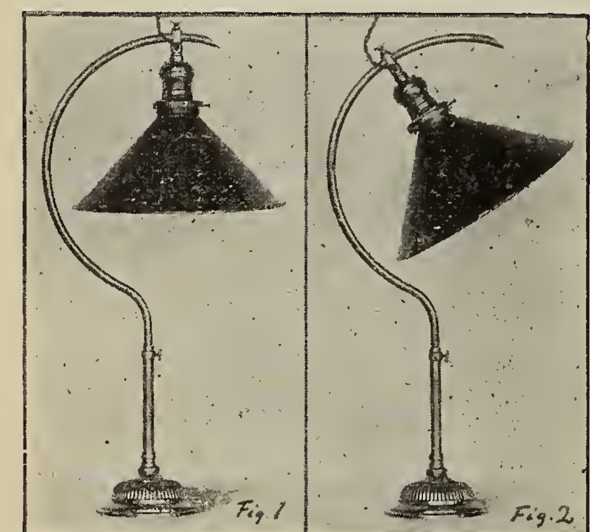
THE FARIES M'F'G CO.

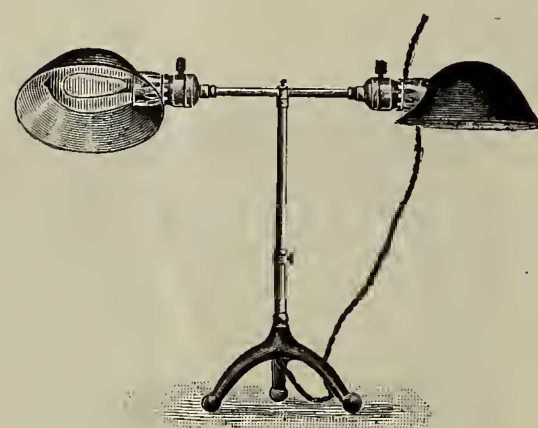
The Faries M'f'g Company, of Decatur, Illinois, manufacturers of the Faries universal adjustable electric lamp holders, aluminum and steel electric lamp shades, and fire and water-tube boiler cleaners, have recently established an office at 136 Liberty Street, New York City, under the management of A. W. Koenig, and they request their patrons in the eastern states to send their inquiries and orders to this office, in order to save time and expense in shipping. Mr. Koenig has arranged a very neat, attractive and interesting exhibit at the Electrical Show, which you will find illustrated in this issue.

The exhibit is located on the promenade just above the main floor, adjoining the New York Telephone Company's Theatrephone exhibit, and we would advise all our readers who visit the show to call and see it, as we are positive the universal adjustable electric lamp holders exhibited by this company will interest everybody, both electrical contractors, engineers, electricians, electrical supply dealers, as well as the general public, who are fortunate enough to burn electricity in their offices or private residences.

are all very unique and attractive in design, while not at all elaborate, thus making the cost very reasonable.

The aluminum and steel electric lamp shades or reflectors are made in three styles : the parabola or half shade, the cone shaped, and the ceiling shade. They are not only shades, but reflectors of the highest order. The holder reaches well over the shank of the lamp, leaving the shade to begin at the top of the filament, thus enabling a smaller shade of the same angle to cover the lamp as well as a larger one with old style of holder. Being smaller, it is lighter and less in the way ; being lighter, it is easier to handle and to be borne by light fixtures at different angles, and is not apt to rack or pull the socket to pieces as heavier shades are, They fit any socket and





Faries Student Lamps. Portable Tripod Stands.

Faries Universal Adjustable Lamb Holder

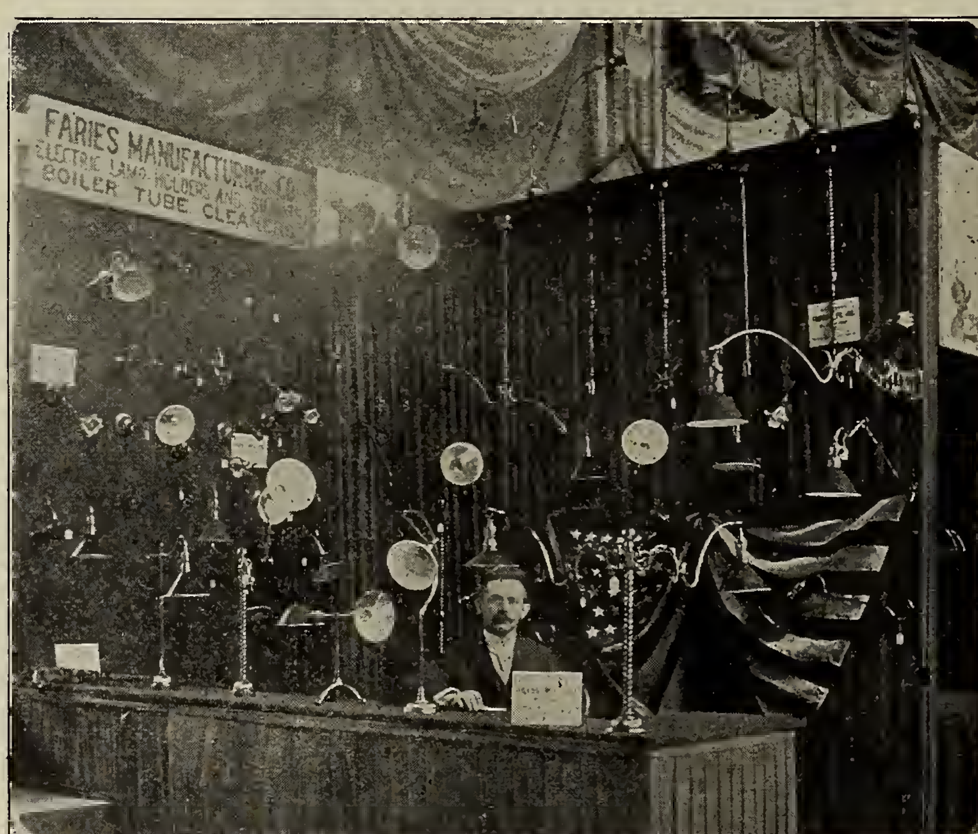


Exhibit of Faries Mfg. Co.

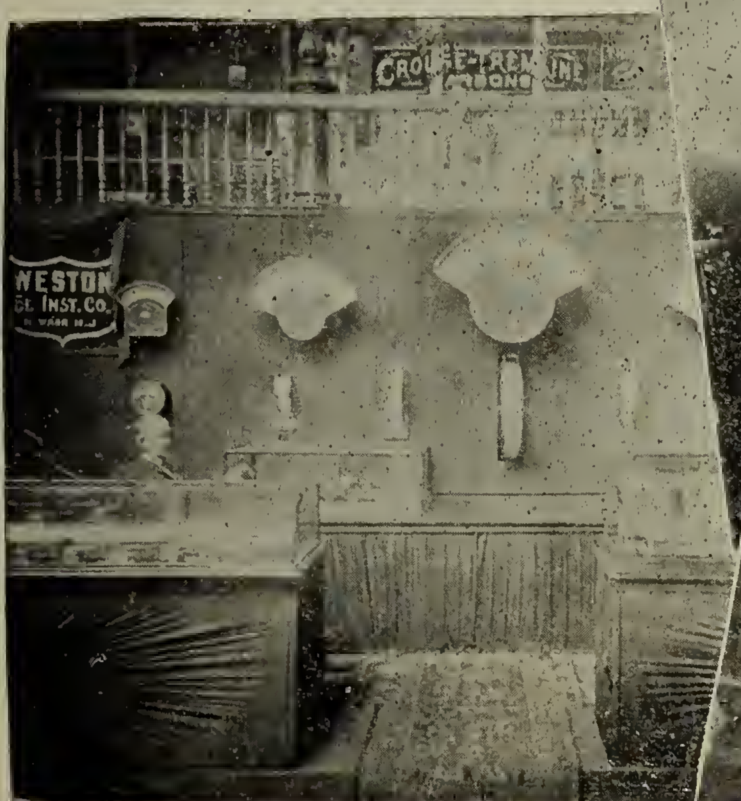
The placing of the Faries universal adjustable electric lamp holders before the public meets the long felt want of being able to get your light just where you want it, and where it will be of service to you both in reading and working. Some of them are adjustable in four or five places, so that it is very easy to arrange them to throw your light anywhere you may wish it, by merely adjusting the fixture at any angle necessary.

These fixtures are manufactured of the finest material, and the best of workmen only are employed by the firm, so that no efforts are spared to turn out the best fixtures on the market at the most reasonable prices. They are made in about thirty different designs of portable and stationary desk and table lamps, side wall fixtures, chandeliers, pendent hall lamps, and dental lamps. They

ore easier put on or off, and have a neater appearance than the old style of shade and holder. They are seamless, and are made both of steel and aluminum; both are enameled either black or green outside, and the steel ones are finely enameled white inside, while the aluminum ones are highly polished inside. The parabola has the further advantage of throwing the light to any angle.

The advantage of the fire and water-tube boiler cleaners manufactured by this company is that it expands when shoved forward, and collapses when pulled backward, so that it will never get stuck. It is easily adjusted for variations in sizes of tubes, and has a ram which enhances the ease and facility of operation, especially when tight and uneven places in the tubes are encounered. There is no leather or rubber about the cleaner, nd it does the entire work without the use of steam or ater. We would advise all our readers to visit the exibit of this company, but if you cannot find it conven-ent to do so, write them for a catalogue, which they ill be pleased to send you on application.

THE BIG SEARCHLIGHT of the Ward Electric upply and Construction Co. is attracting universal at-ention at their exhibit at the Electrical Show. It is the rgest searchlight at the show and lights up even the r corners of the immense amphitheatre. The com-any is constantly receiving inquiries in regard to the earchlight, and have sold a number of similar ones to istant points in the United States. The Ward Com-any's exhibit of carbons for open and enclosed arc lamps as already brought in a large return of orders. Their rray of arc lamps is the talk of the show and a number f orders for the same have been booked. The Ward lectric Supply and Construction Company are general lectrical contractors and dealers in "Ward" and Knight" arc lamps. They are also the Greater New York agents for the "Washington" carbons and general electrical supplies. The officers of the company are Eugene H. Levy, Jr., president and treasurer; Chas. O'Keeffe, vice-president; and Deronda Levy, secretary and general manager. Mr. O'Keeffe, the vice-president of the company, is deserving of great praise for his energetic efforts in behalf of the success of the Electrical Show, and also for the fine showing his company is making there. He is a practical electrician of many years standing, having held a number of very responsible positions, and is always on duty at the store of the Ward company. The office and salesrooms at 39-41 Ann Street, are filled with electrical supplies of every description.



Weston Electrical Instrument Co.

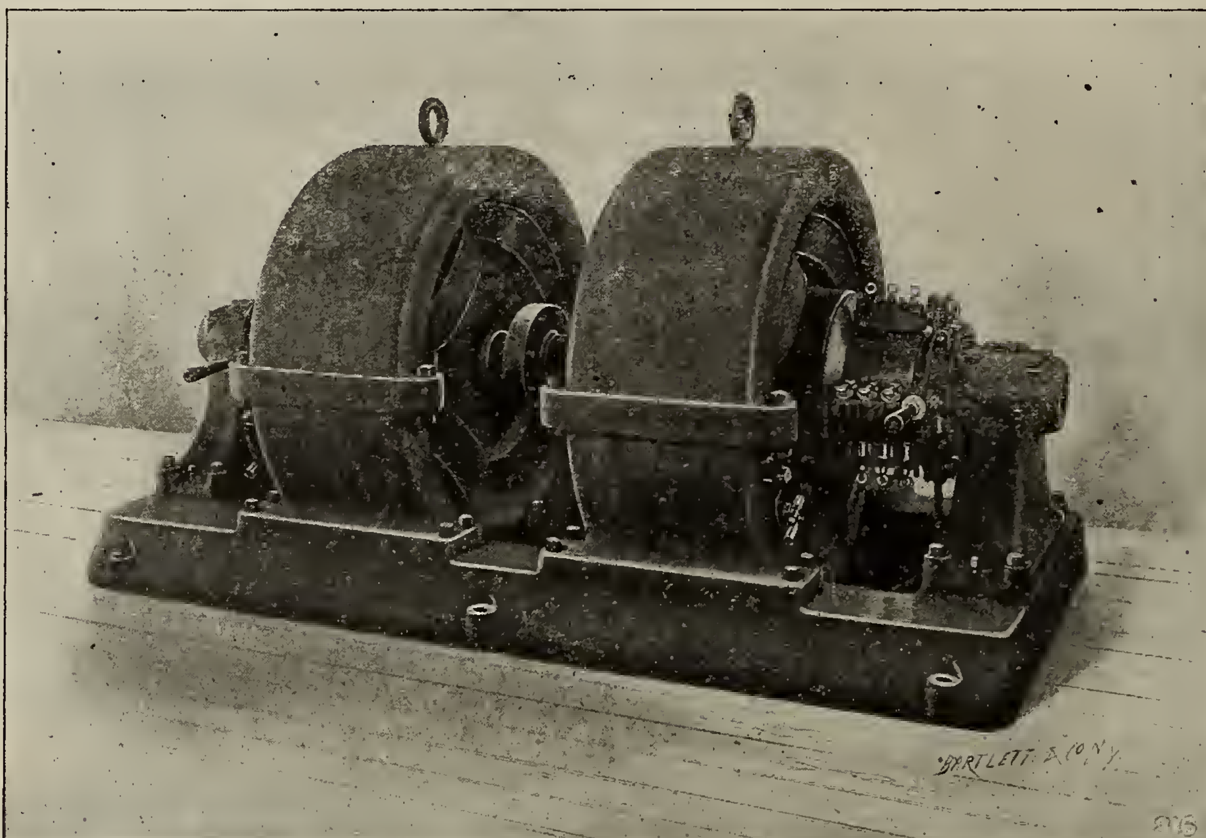
View in Basement of Garden.

Fort Wayne Electric Corporation.

WALTER DIXON, M. I. E. E. and F. R. M. S., of the firm of Miller, Dixon & Co., electrical engineers, Glasgow, Scotland, has been visiting the Electric Show all the past week. He is closing contracts for all of their electrical goods for his market.

By a general inquiry among exhibitors at the Electric Show we find that a fine trade has been carried on; many orders have been placed and some valuable missionary work has been done.

THE BEAUTIFUL MISS LIBERTY in J. Jones & Sons' exhibit is attracting unusual attention. The Miss whose name is drawn first from the box gets this fine doll. Mr. Lowe, the general manager of J. Jones & Son, 64 Cortlandt street, was in attendance during the past week and was in great demand. Mr. Lowe takes personal pride in their new enclosed arc lamp in the exhibit. This lamp attracts the attention of buyers and electrical engineers generally. There are no magnets, dash pots or mechanism operating the lamp. All that operates the lamp is a thermostat in the top, which actuates a clutch near the top of the enclosed bulb.



Continuous-Current C.-W. Transformers.

The Gordon-Burnham Battery Company have removed from 82-86 West Broadway to more commodious quarters at 594 Broadway. They report the business outlook as favorable, and are being taxed to their utmost capacity to fill the constantly increasing orders for their popular line of goods.

THE CONTINUOUS CURRENT TRANSFORMER.

The larger manufacturing concerns are now paying particular attention to the design and construction of continuous-current transformers. The great advantage derived from their use has added to their popularity and provided a place for them which is as well defined as the position occupied by the alternating-current transformer. Continuous-current transformers or boosters merely represent a combination consisting of a motor coupled direct to a dynamo of equal power. For electric lighting, railway work, etc., the use of these machines supplies a long felt want.

One of our most enterprising concerns, the Crocker-Wheeler Electric Company, make a specialty of building boosters, one of which we illustrate in this article. For power transmission there is no machine that can take its place. They are perfectly automatic, have self-oiling bearings and all the proper requirements in the shape of a perfect magnetic circuit, cool running windings and sparkless commutators.

The Crocker-Wheeler exhibit at the electrical show contains, besides this innovation, many other types of machines of a highly interesting character. The booster, however, fulfils its functions in a most unique manner, as it can be used not only for boosting but for lowering the pressure when required.

"LESSON LEAVES" and article on "Insulation and Conduction" will be continued in our next issue.

OBITUARY.

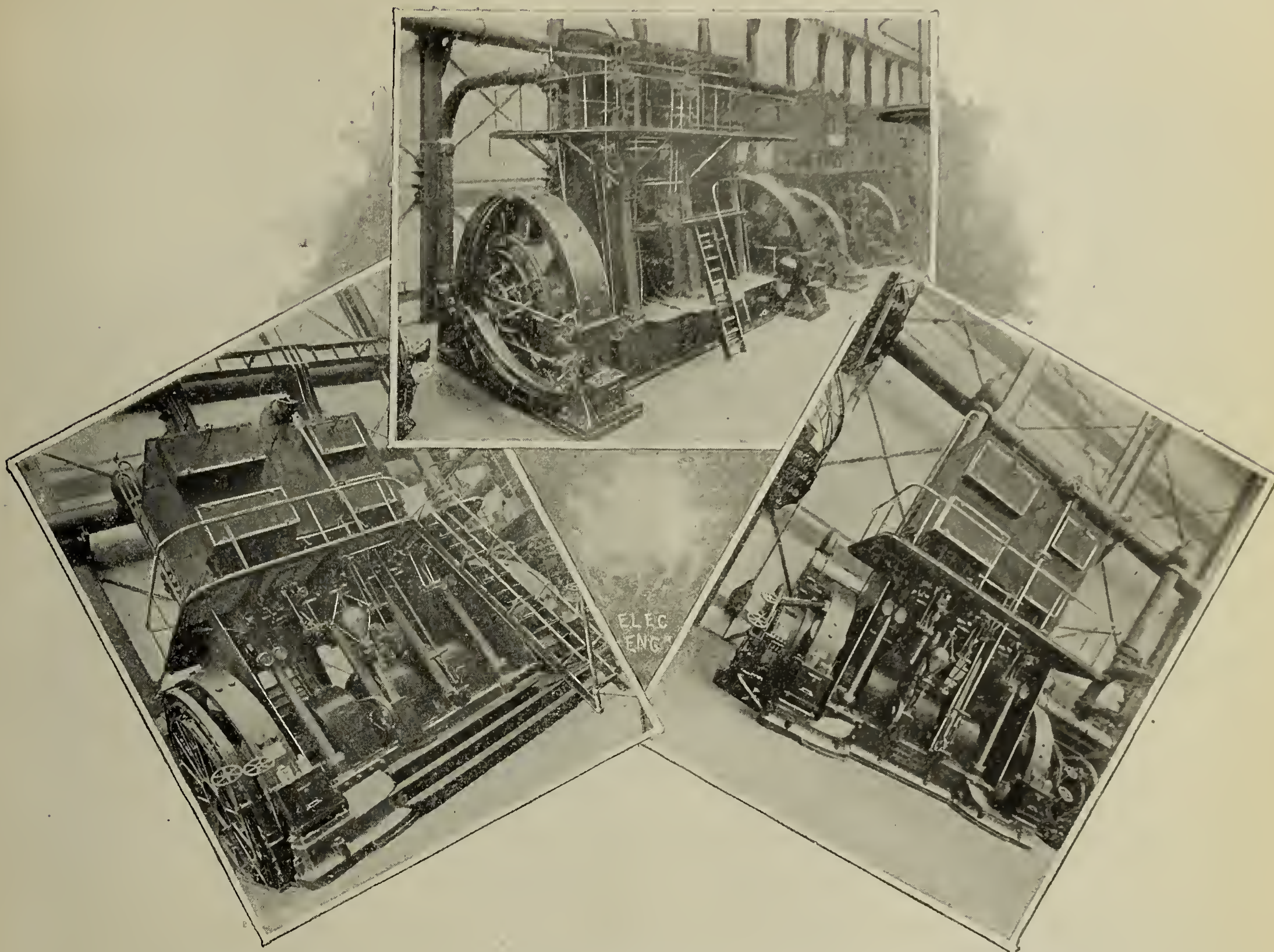
May 30.—As we go to press with our May 28th issue, we learn the sad news of the death of Mr. Fred Noll, so long associated with the Interior Conduit Company and Sprague Electric Company. No. 1 R. A. M. Masonic Order are to hold services at his late residence, Plaza street, Brooklyn. We mourn his departure.

Philadelphia, Pa.—The Philadelphia Electric Light, Heat and Power Company has been incorporated by G. R. Green, J. R. Enbery, H. R. Barramore, J. J. McCarthy and Henry Watts. Capital stock, $1,000.

Montreal, Que. — Messrs. Prefontaine, St. Jean, Archer and Decary are solicitors for the North Shore Electric Railway Company, which propose to build an electric line on the north shore of the St. Lawrence river.

The Electrical Age.

VOL. XXI—NO. 23 NEW YORK, JUNE 4, 1898 WHOLE NO. 577



Southwark Engine. World's Fair Engine. Southwark Engine.
The Three Types of Engine, Harrison Street Station.

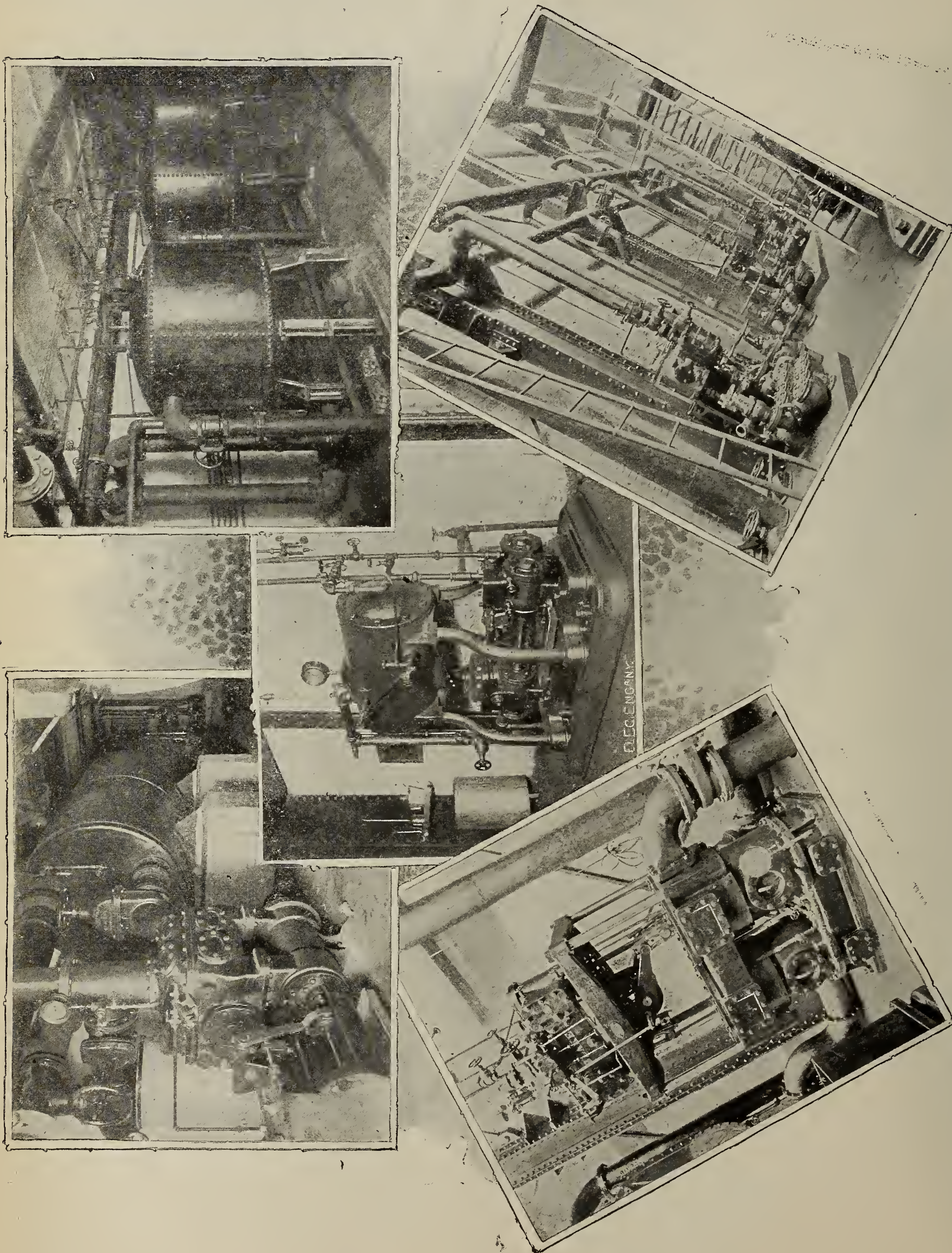
THE CHICAGO EDISON COMPANY'S ELECTRIC POWER PLANT.

The development of electrical enterprises in Chicago has been unequalled in the record of any other American city. The gigantic plant installed there by the Chicago Edison Company marks an epoch in the history of mechanical and electrical engineering, which is in its way as great as that period of architectural design which gave rise in ancient Egypt to the great pyramids and obelisks and mighty Sphinx.

Through the Chicago Edison Company Chicago is brilliantly lighted at night and its cars all run by electricity. The original company was incorporated in the year 1887, on April 30th, and from it arose the great concern we now write about. The Harrison street plant in Chicago is situated on the river front, being bounded by Pan Handle, Chicago & Alton Railroads and Harrison street. The entire building is built of steel frame-work. The engine and dynamo room are over two hundred feet long, more than sixty feet wide, and sixty feet high. The magnificent equipment within of switchboards and direct-connected engines makes this generating station one of the most remarkable extant. More than 24,000 amperes is being fed to the different lines radiating from this station like the nerves of a great ganglion. This plant is doubly interesting; first, on account of its size, and, secondly, because the boilers are heated by burning oil, of which 9,000 gallons per day is used. The Standard Oil Company send it up on oil engines, which are shunted off to the station and their load of oil pumped into a receptacle consisting of four great tanks, each twenty-five feet long and eight feet in diameter. Each boiler is heated by means of five burners, the steam being atomized before use. The boiler pressure resulting from this combustion is 175 pounds. Each of the above-mentioned tanks holds 9,300 gallons, the entire series when full being capable of supplying fuel for four and one-half days. Water is fed into the boilers from the Chicago River, being filtered before use. The pumps forcing it on its way have a capacity of delivery equal to 5,000 gallons per minute.

The cleanliness of this plant due to the use of oil; the absence of all smell and smoke, makes it superior to all plants of its kind in the world. The ten triple-expansion engines are used for driving the dynamos, each engine operating in direct connection with two General Electric multipolar generators. The engines represent two sizes; four smaller rotating the armatures of eight 200 K. W. generators, the other six engines turning twelve 400 K. W. generators. The Southwark Foundry & Machine Company, of Philadelphia, supplied eight of these engines. Special condensing apparatus is supplied with each engine, Wheeler surface condensers being used. Two large Edison engines that came from the World's Fair, along with the eight Southwark engines, complete the number in use. Of these, the smaller run at 157 revolutions per minute, and the larger at 128 revolutions per minute. Every means has been taken to build this plant so that it will represent the best possible arrangement in the utilization of floor space.

stand all load variations without fluctuations of pressure. The armature of each is slotted and filled with bar conductors. The 200 K. W. machines have eighteen brushes apiece, three in a line and six sets. They give



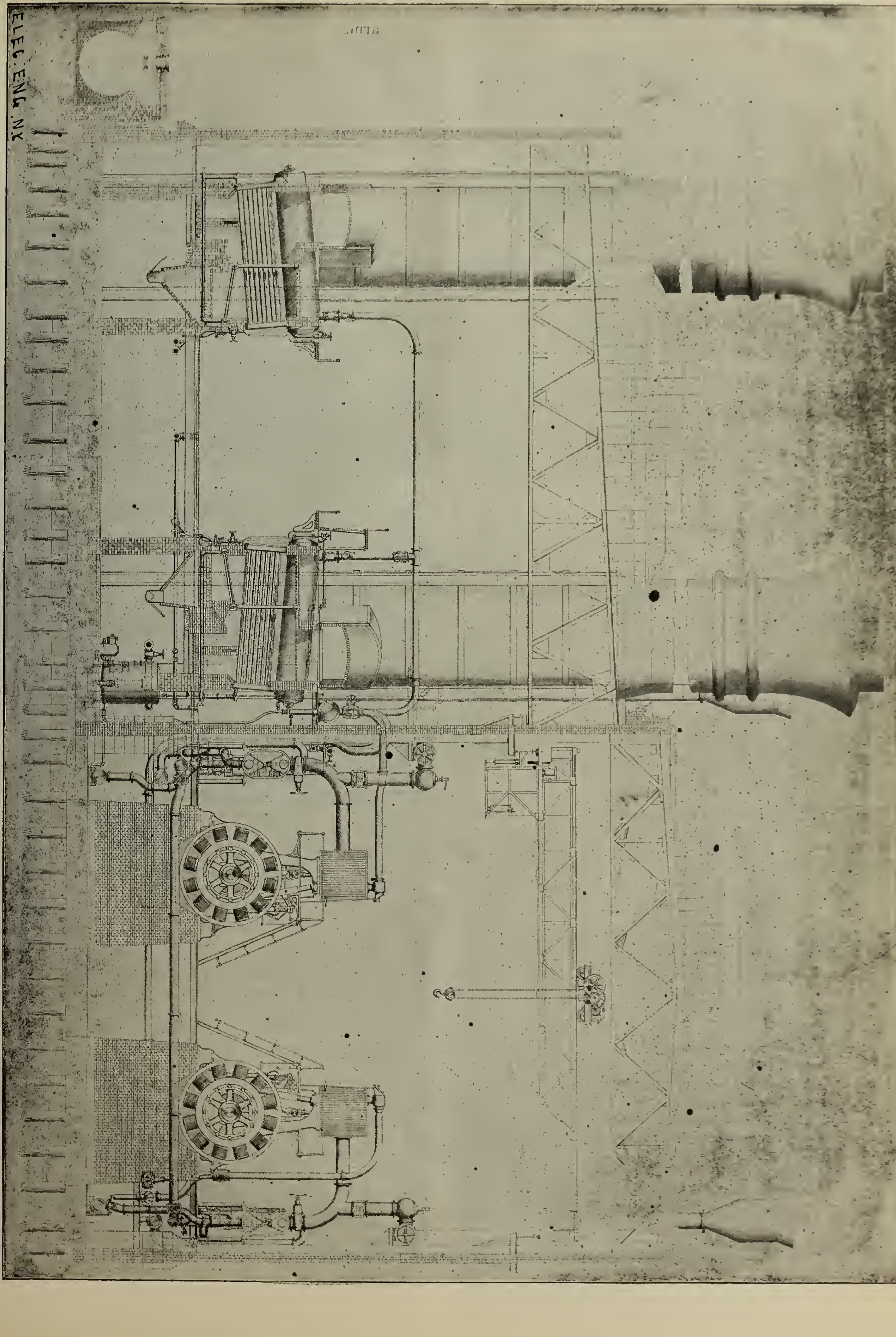
Filter for Chicago River Water. Boiler Feed Pumps. Oil Pump Under Smokestack. Worthington Pump and Hotwell. Blake Pump.

Some Detail Apparatus of the Harrison Street Station, Chicago Edison Co.

In the illustrations are shown the types of engines used in the Harrison street station; also a view of the pumps for oil and water, as well as the filters purifying that taken from the Chicago River.

The large dynamos installed operate sparklessly and fifteen hundred amperes at 155 volts. The Edison three-wire system connects to this plant and includes the lines stretching out and circling the city.

The growth of the Chicago Edison Company's work in the six years dating from 1889 to 1894 shows an increase



Section of Harrison Street Station through Engine and Boiler Room.

of over 140,000 lamps, the total in 1889 amounting to 18,000, and in 1894 to 162,000. The use of electricity for power purposes likewise increased, so that the capacity of the plant was called upon to supply the equivalent of more than a quarter of a million 16 candle-power lamps. Many of the large buildings of Chicago prefer to use the company's current instead of installing their own plant. Monadnock Block, for instance, takes 8,000 lights, and the other large buildings in proportion.

The immensity of this great plant and the tons of copper buried underground carrying its current to all points within the city limits stamps this installation as one worthy of historical recognition in the annals of the world's progress. The president of the Chicago Edison Company, Samuel Insull, is likewise president of the National Electric Light Association, which meets in Chicago during the week of June 6th. Mr. J. W. Doane is vice-president, and F. S. Gorton secretary and treasurer. C. H. Wilmerding acts in the capacity of general superintendent, and W. M. Anthony fills the office of comptroller. The electrical engineer of this great plant is L. A. Ferguson; purchasing agent, Chas. Holmes; superintendent of low-tension system, W. L. Church; superintendent of high-tension system, R. S. Kelsch. Mr. Fred. Sargeant is the supervising engineer. The great switchboard, which is one of the most prominent features in the generating station, was designed by A. B. Herrick.

Since the subject of electric light and power has become one of great commercial importance, the study of electric light and power plants built on a large scale has occupied the attention and time of many eminent engineers. The great problems relating to the choice of fuel and its combustion, the utilization of waste heat, the generating of high or low pressures, and the most economical lamp to use, involve sums of money amounting to millions. The financeering and management of these large installations in consequence requires the aid of men of veteran business experience and broad mental grasp. The advances made each year in the great field of electric lighting calls upon the intelligence of those entrusted with the responsibilities of a large plant in a peculiar way, forcing them to be keenly alive to innovations of benefit and use and to refuse to consider those inimical to the growth and success of the corporation. A power of discrimination backed up by sound commercial experience are the two necessary elements upon which depends the income and dividends of any great electric light plant. In the past and present history of the Chicago Edison Company these factors have been actively operating for its benefit and prosperity.

THE MOORE EXHIBIT AT MADISON SQUARE GARDEN.

It is doubtful whether any exhibit, at any show in times gone, surpassed in interest that arranged by Mr. D. McFarlan Moore, the pioneer in practical vacuum tube lighting, and on exhibition at Madison Square Garden.

It is spectacular and therefore deeply interesting to the general public, but at the same time it is intensely scientific, and therefore interests the whole scientific world, so that everybody, from the conservative college professor to the simple child, is pleased. It comes at an opportune time because of the wide publicity already given to Mr. Moore's work and inventions. It will be remembered (especially by the 86,000 eye-witnesses) that Mr. Moore was the first to show the public, in 1896, what vacuum tubes really were. But that exhibit is making ancient history by his present effort, which is making scientific history.

All scientists say that vacuum tubes will be universally used some day, and from present indications that day is not far distant.

In July, 1894, Mr. Moore wrote a magazine article—the first of its kind—in which he made a sketch of how he thought vacuum tubes could and would be applied to church lighting. His present exhibition now makes his prophecy a reality. His architectural design—pure Gothic—for the chapel could not be improved upon.

In connection with the chapel exhibit Mr. Moore has carried out a pet idea of his, which in itself is an enormous attraction—viz., to give the public a chance to become personally acquainted with electricity.

One enters through a narrow passage-way—Fig. 1—noting the steeple of the chapel in the distance. On a table extending along the side of the passage are arranged, in the order of one at a time, the special attractions, everyone of which is operated by every visitor by closing the various switches in succession. In fact, they comprise a five-minute course in electrical engineering.

The first is a simple bell outfit, consisting of battery, bell and push button, arranged so simply that everybody can understand it. Then follows an electric motor, which starts so suddenly as to frighten the innocent visitor into wondering what he or she had done. Next, a front door name-plate in vacuum tube letters. Electric fishing, poaching eggs by electricity, tube lighting by induction, and finally as one is handed a most beautiful souveuir in the shape of a miniature vacuum tube they all receive a shock.

The passage turns abruptly, and one sees in front a beautiful stone village church, steeple, clock and all—Fig. 2. The front doors are open, above the arches of which shine forth in vacuum tube letters, "Moore Vacuum Tube Chapel," and within is seen the vaulted roof ribbed with the most beautiful arches ever constructed—viz., made of long curved tubes of glass about two inches in diameter and glowing their entire length with a pure white light.

All artificial lights now generally used radiate from single points, while this light emanates from long tubes, making it the closest counterpart of daylight that can be obtained. The color of the light is such that it is invisible in daylight—proving their similarity. The temperature of the tubes is that of the room—that is, it is practically "light without heat."

The ear is also gratified with melodious strains from the magnificent pipe organ, which fills the far end of the chapel behind the nicely and thoroughly equipped altar—even to the Bible—Fig. 3. The soft, rich carpet under foot attracts one's attention to the specially-designed quartered oak pew with luxurious cushions—Fig. 4. The predominating color of the frescoing is yellow, and the stained glass windows look perfectly natural. The tube arches spring from pilasters, each capped with a highly-polished, specially-designed brass fixtures—Figs. 5 and 6. They take the form of a crown, while at the apex of the Chapel ceiling, where the tube arches meet, they are joined by a highly-decorated brass cylinder—Fig. 7—bent at its centre. The fixtures supporting the longitudinal tubes at the apex of the ceiling are shown in Fig. 8.

Of course, these are the first vacuum tube lighting fixtures ever designed, and are a striking example of the manner in which Mr. Moore has worked out the 1000 and 1 details of his lighting system. In this connection it should be mentioned that the chapel is wired completely with iron armored conduit, again inaugurating that which will soon become standard.

As one passes out of the exits on the sides of the organ it is noticed that the chapel is ventilated by two 24-inch exhaust blowers over the organ pipes. A last look is attracted by the colored vacuum tube letter sign over the rear door, "Let There Be Light." This is the same historic sign used by Governor Morton in opening the exhibit of 1896.

The church is wired with the Moore Three-Wire System of Vacuum Tube Lighting—viz., all of the tubes—16 arch and 3 ridge tubes—are connected in multiple arc between three wires, the common or positive wire extending along the ridge, while each of the two negative wires extend horizontally along the sides of the chapel back of the side fixtures, which rest on top of the pilaster caps. The three wires enter the top of a polished oak cabinet, 2 feet by 2 feet by 4 feet, which contains all of the lighting apparatus, and is situated on one side of the entrance passage-way, as seen by Fig. 1. There also enters this cabinet (see Fig. 1) at the top the three wires connecting with the street service of the Edison Electric Illuminating Co.—again fulfilling a point first called attention to by Mr. Moore—viz., that vacuum tube lighting must make its start by being adaptable to the present commercial circuits.

It will be remembered that one of the salient points of Mr. Moore's system is breaking a current in a vacuum. This he accomplishes by means of a beautifully constructed scientific instrument which he calls a rotator—Fig. 10. Surrounding this rotator, which is of glass—3 inches in diameter and a foot long—is the gramme ring with its highly-polished brass mountings, which, as a whole, makes as beautiful a piece of scientific apparatus as has ever been constructed. This is all of the apparatus where multiphase currents are available, but in this instance the lower compartment of the cabinet contains a small rotary transformer. The system at its present stage of development has an efficiency about equal to incandescence, but since there are great opportunities for the development of the tubes—a problem Mr. Moore is about to take up—the final efficiency will be remarkable.

Besides the rotary vacuum-break, Mr. Moore has gotten into commercial shape a vibratory vacuum-break. This apparatus will be extensively used for advertising purposes (see Figure 11) for either direct-current circuits or alternate-current circuits.

There are also many other applications for this system of lighting. For example the color of the light, even to the most delicate shades, can be changed simply by changing the degree of vacuum of the tubes, making it the ideal light for special decorative lighting. Another large field is in connection with photography—for photographers have long been longing for a light which they could regulate to a nicety and thereby obtain uniform results. At the Electrical Exhibition in 1896 Mr. Moore took instantaneous portraits by his light.

It has long been a matter of expectation as to when and by whom vacuum-tube lighting apparatus would first be placed on the market, and the fact that Mr. Moore is now taking orders is extremely interesting, since it is a beginning of a new department of electrical business which is destined to grow to immense proportions.

BERNARD DECISION.

SEWARD DAVIS.

Judge Coxe has just rendered a decision in the suit of Edison Electric Light Company vs. E. G Bernard Company, et al., upon the Edison patent No. 264,668, for the compound winding of a dynamo, dismissing the complaint.

The Edison patent is declared to be invalidated by the patent to Charles F. Brush, No. 217,677, granted to Mr. Brush for this same improvement some three years prior to Edison's patent. The old Brush dynamos of 1878, built in accordance with his specifications, show completely satisfactory automatic regulation from no load to full load when running incandescent lamps of low voltage, such as are used at the present day in large cities for telephone exchange signals, where they are operated by compound-wound dynamos in all essential respects like the Brnsh compound-wound dynamos of 1878-9. In fact the Brush dynamos of twenty years ago can be put into operation where a modern compound-wound dynamo is used, without any modification or change whatever, so that if the Edison patent were sustained, it would involve the enjoining of the use of dynamos built for the same purpose as that set forth in the Edison patent No. 264,668, and built four years before the date of his application.

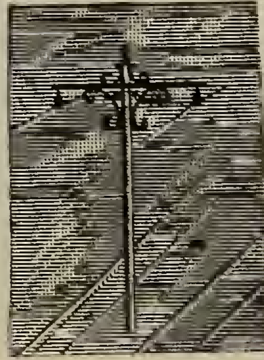
The opinion is very flattering in its commendation of Mr. Brush and his early work. The decision is very far-reaching, as stated, since the General Electric Company sought to extend the scope of the patent to include in its broad claims any dynamo having a compound winding of its field magnets, whether separately or self-excited, in combination with any translators in multiple-arc, whether lamps, motors, or electroplating baths.

A GOVERNMENT ORDER FOR THE CRESCENT TELEPHONES.

The Pennsylvania Electric Company of Marietta has received a large order for telephones from the War Department, to be used for all the forts, coast defences and signal stations along the Atlantic Coast. The company received instructions to rush the order. This is quite a compliment to the Crescent Telephone apparatus, as no doubt all other makes were considered before the order was placed. The Crescent Telephone embodies later improvements than any other make of telephones on the market.—Marietta (Pa.) Times.

The litigation over the right to make and sell music records and other sound records for talking machines, has been brought to an interesting point by an order made by Judge Wheeler in the United States Circuit Court of the Southern District of New York, adjudging Messrs. Cleveland Walcutt & Edward F. Leeds guilty of contempt. The proceeding against them was commenced last fall by the American Graphophone Company, which company claimed that their patent rights were violated by Walcutt & Leeds in making, using and selling duplicate sound records. The defendants were enjoined from making, using or selling such records made on machines not procured from the plaintiff or under the plaintiff 's patent. Subsequently the firm of Walcutt & Leeds went out of existence, but it appears the two members of the firm resumed and continued business in connection with others, having formed a corporation called "The Walcutt & Leeds Company, Ltd." The Judge holds that this new arrangement does not make the acts of Messrs. Walcutt & Leeds any the less a violation of the injunction, and therefore adjudges them guilty of contempt. To give the defendants full benefit of all possible doubt of intent arising from a misunderstanding of the former decree, they will not be punished beyond making good the injury to the plaintiff by paying over, upon ascertainment, the profits and damages of the violation, with costs of the proceeding in default thereof to stand committed. Under the order of Judge Wheeler the defendants are not permitted to combine the machines sold them by the American Graphophone Company with any other device so as to produce duplicate records.

THE N. E. L. A. CONVENTION.



THE official programme of the Chicago Convention of the National Electric Light Association:

Tuesday, June 7, 1898.—Meeting of the Executive Committee at 9 a. m., secretary's office, Auditorium Hotel. Morning session, 10.30 o'clock, Convention Hall, Auditorium Hotel. Address, President Insull. Paper, Calvin W. Rice, Brooklyn, N. Y., "Cost of the Generation and Distribution of a Unit of Electricity." Topic, "Prices and Discounts for Electric

C. R. Huntley, Ex-Pres. N. E. L. A.

C. O. Baker, Jr. Master of Transportation.

S. M. Hamill, V. Pres. Brush Elec. Co.

Elihu Thompson, Gen. Elec. Co.

Edwin J. Houston, Author and Expert.

H. H. Brooks, Am. Cir. Loom Co.

A. Kennelly, Author and Expert.

F. Nicholls, Ex-Pres. N. E. L. A.

W. L. Candee, Okonite Co.
J. P. McQuaide, Nat'l Conduit & Cable Co.

C. H. Wilmerding, Ex-Pres. N. E. L. A.
W. J. Godfrey, Habirshaw Wire.

Samuel Insull, Pres. N. E. L. A.
E. F. Peck, Ex. Committee.

Geo. F. Porter, Sec. N. E. L. A.
C. D. Shain, Siemens & Halske.

J. A. Seely, Chair. Ex. Com. N. E. L. A.
H. L. Shippy, Roebling Sons & Co.

POPULAR FACES AT THE N. E. L. A. CONVENTION.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

FIRST FLOOR, WORLD BUILDING.

NEW YORK.

NEW YORK, JUNE 4, 1898.

CONTENTS.

THE CHICAGO CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The last convention of the National Electric Light Association was held at Niagara Falls, June 8, 9, and 10, of last year. Business of considerable importance was transacted, and papers read relating to electric light and power. The Association has added to its prosperity year by year, and extended its membership list so as to include all electric light men of any consequence in the United States. The interest attached to meetings of this kind has increased year by year, until now wherever the Association holds its convention the citizens of that town regard it as a municipal event.

The papers read by the appointed members of the Association are written by men that have had an intimate experience with the subjects it is their privilege to discuss. The papers contained within the transactions of sister societies, that are supposedly of a more technical and scientific nature, will be found by comparison to be if anything only on a par with those delivered before the National Electric Light Association. The position the Associatien holds among the electrical fraternity is a most unique one. The members are well known to each other and in many respects have grown up together, so that the ties binding each to each are of the strongest character from a social standpoint. The diversity of experiences enjoyed by those constituting the active members of the Association enables them to exchange information highly valuable to those but partially initiated in the mysteries of electric lighting.

At the last convention at Niagara Falls the entire field of work was covered in so interesting a manner that many members awaited with impatience this next gathering. Aside from the instruction to be derived from these meetings, certain commercial relations are established, which possess considerable significance during the intervening year. Many supply men are on hand at the convention and other dealers in electrical apparatus.

The conclusions reached by those desiring to institute innovations in their central stations have enabled the supply dealers to develop a large and paying trade with many of the N. E. L. A. members, the convention work having in the end enough importance to influence many managers and presidents of electric light concerns to add to their equipment that which would be shown in the course of a discussion to be essential to the welfare and success of the plant. It is therefore seen that the N. E. L. A. conventions offer two great advantages to those attending it, increased opportunities for the transaction of business and a means of acquiring information of the highest practical value.

THE CLOSING DAYS OF THE ELECTRICAL EXHIBITION.

Those attending regularly to the exhibits at the Electrical Exhibition have noticed night by night an increasing interest on the part of the public in the various unique displays filling the great Garden. As a proof of this an observer will see many faces that seem to grow familiar as the nights roll on. It seems that many laymen whose occupations in life do not in any way run parallel with practical applications in electrical engineering repeat their visits frequently in order to gain sufficient acquaintance with the varied exhibits to be able to speak intelligently on such subjects. That at least seems to explain the frequency of their coming and going. The average New Yorker has no idea of the extent and variety of the apparatus utilized in the transmission of power, electric lighting, telegraphy and telephony and electric traction. The Electrical Exhibition gives the visitor an opportunity of gauging the extent of the development that has taken place in the different departments of electrical engineering within the last five years. It shows him that the closing days of the exhibition mark the dawn of a new era rich with its promises of multiplied inventions and bright with a future that will glorify it in the eyes of our twentieth century descendants.

TO THE TRADE.

The third annual convention of the fire and police telegraph superintendents and municipal electricians will be held at Elmira, N. Y., August 9th and 10th, 1898, at 10 A. M. All members are expected to be present. Bring your ladies; special arrangements are being made for their entertainment. Several papers will be read by well-known electricians. Will you be present? Fraternally, W. Y. Ellett, President; H. F. Blackwell, secretary. Take N. Y. C. R. R. & H. R. R.

Ottawa, Can.—The Canadian Electric Water & Power Co. has been incorporated by Hon. John Haggart, W. A. Allan, A. Charlebois, Sir Sandford Fleming and R. G. Code, for the purpose of manufacturing electric machinery and electricity for the purposes of light, heat and power in the cities and towns of Canada.

Pratt City, Ala.—Town Clerk may be addressed concerning construction of electric-light plant.

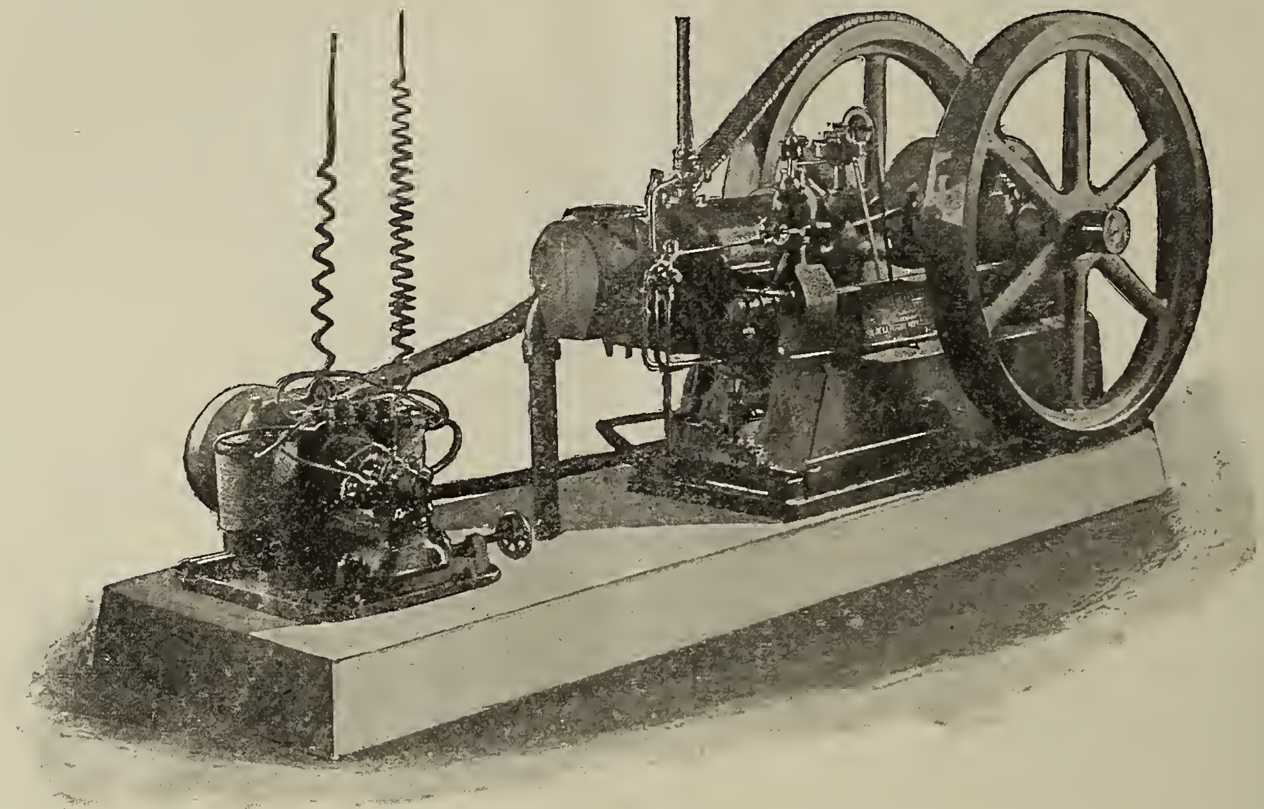
Arcadia, Fla.—J. L. Jones, Mayor, may be addressed concerning construction of electric-light plant.

Fitzgerald, Ga.—City Clerk may be addressed concerning construction of electric-light plant.

Lee, Mass.—The Lee Electric Co. will improve its plant and extend it to South Lee.

Current and Methods of Billing Current to Customers." Afternoon session, 2 o'clock.—Paper, Alex. Dow, Detroit, Mich., "Public Lighting with Relation to Public Ownership or Control." Topic, "Legislative Policy as to Public Service Corporations."

W. McLea Walbank, Montreal, Canada, "Cost of Producing Electric Power by Water Power from Lachine Rapids, Canada." Report, Committee on Standard Candle Power of Incandescent Lamps, Dr. Louis Bell, chairman. Questions and Answers. What Is It You Wish



"Hornsby-Akroyd" Oil Engine with Dynamo.

Wednesday, June 8, 1898.—Morning session, 10 o'clock.—Paper, Herbert A. Wagner, St. Louis, Mo., "General Distribution from Central Stations by Alternating Currents." Paper, Louis A. Ferguson, Chicago, Ill.,

to Know? Executive session. Evening session, 8 o'clock, Auditorium Hall.—Lecture, Joseph Wetzler, "Electricity Direct from Coal" (illustrated with stereopticon).

Thursday, June 9, 1898.—Morning session, 10 o'clock.

De La Vergne Exhibit at Madison Square Garden, May, 1898.

"General Distribution from Central Stations by Direct Currents." Topic, "Standardizing Apparatus for Central Station Use." Afternoon session, 2.30 o'clock.—Paper,

Paper, Prof. W. E. Goldsborough, "Transformer Economy." Report, Committee on Amendments to Freight Classification, James I. Ayer, chairman. Report, Committee on Legislation Concerning Theft of Current, James I. Ayer, Chairman. Afternoon session, 2.30 o'clock.—Topic, "Freight rates on Electrical Apparatus." Report, Committee on Finance, James A. Seely, chairman. Executive session. Election of officers.

DOMESTIC ELECTRIC LIGHTING.

A home is really incomplete unless supplied with every means on the premises for giving light and heat. What were at one time regarded as luxuries in the home are now considered necessities. It will not be very long in conseqence of this change of opinion for the ordinary citizen to regard electric lights as indispensable factors in home comfort.

Attempts have been made by manufacturers of primary batteries to run electric lights with economy and convenience, but their efforts have proved fruitless. Since the number of suburban residents has increased and country homes and summer resorts multiplied, the demand for private electric-light plants has grown to large proportions. They require an electric-light equipment which can be attended to by a janitor or layman and make no demand upon the skill or experience of those in charge. The cheapest, simplest and most practical combination of this kind is to be found in the use of an engine using oil, the mechanical energy of which is transformed by means of a dynamo into electricity.

At the Electrical Exhibition the De La Vergne Refrigerating Machine Company show in actual operation an oil-engine plant consisting of the Hornsby-Akrovd oil engine driving a dynamo, by means of which the entire booth is brilliantly illuminated. Two engines are to be seen, one of 32 H. P. running at 170 revolutions per minute, the other supplying light through the medium of the dynamo, of four H. P., driving by link belt a C. & C. dynamo. Kerosene oil is used of which one pound per horse-power is consumed. The excellence of this plant is proven by the absolute steadiness of the electric lights. The engine, by means of which this remarkable regulation is obtained, operates on the Otto cycle principle with a single-acting piston and an explosion every second revolution. The oil consumption naturally depends upon the load the machine is carrying, the regulation being effected by this means.

The oil utilized in this engine is by means of a special device vaporized, mixed with air and then exploded. The retort within which ignition occurs is heated by external means before the engine is started. When this chamber is sufficiently hot oil is allowed to enter into it, vaporized, air mixed with it and complete ignition brought about by the walls of the retort. The amount of air admitted is the same at all loads, the only variable quantity being the oil supply. About forty pounds to the square inch is the degree of compression to which the mixture is subjected before its potential energy is utilized.

The certainty of ignition and absolute and automatic control of the fuel supply makes the Hornsby-Akrovd oil engine a most reliable and economical machine. The tank at the bottom of each engine carries sufficient oil to run it for many days. They can be made of any size desired.

The U. S. Government uses the Hornsby-Akrovd engine in preference to all others for its special naval and marine work in the operation of lighthouses and the running of fortification searchlights. It has even been introduced for running fog-horns of special construction, by the U. S. Government.

Exhibit of Bullock Electric Co.

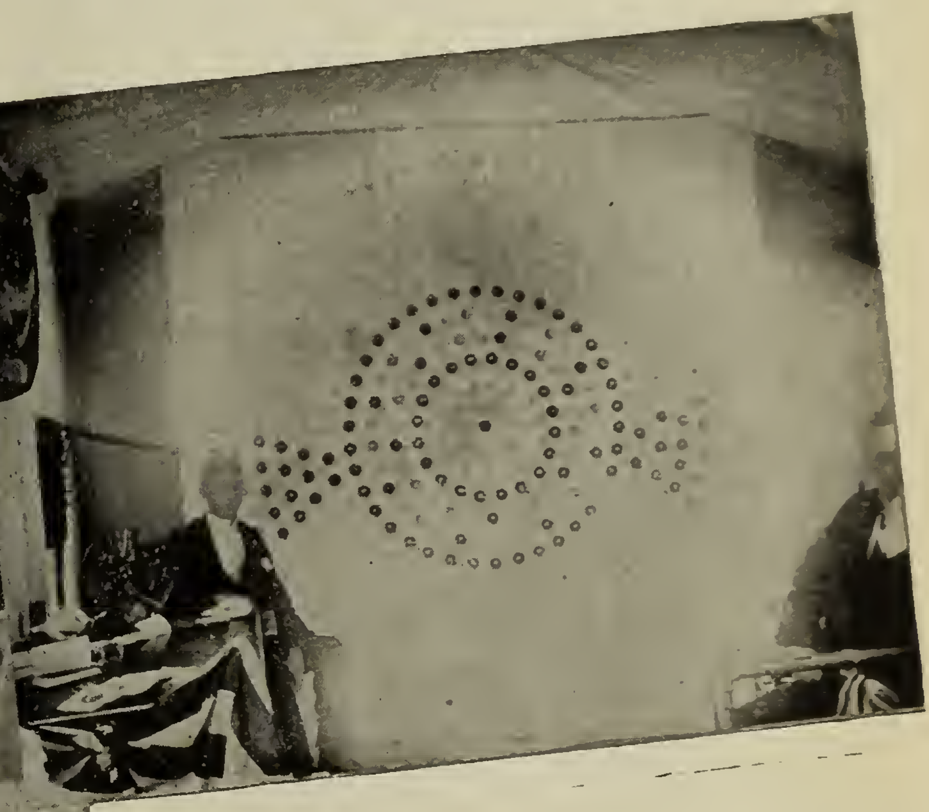


Exhibit of Thos. A. Edison, Jr.

The De La Vergne Refrigerating Machine Company have their offices at the foot of East 138th street, New York City. The absolute safety of this engine has been the cause of many thousands of plants having been installed. In public exhibitions it has taken the first prizes, particularly so before the Royal Agricultural Society of England. Costing one-half as much to run this oil engine has displaced a great many gas engines, due to its cheapness of operation and certainty of action.

THE BRILLIANT DISPLAY at the booth of Thomas A. Edison, Jr., was remarked upon by all the visitors to the Electrical Show. Thomas A. Edison, Jr. was frequently to be seen in attendence and he and his colleagues were kept busy explaining the qualities of the Edison Junior lamp.

THE BULLOCK ELECTRICAL MANUFACTURING COMPANY, of Cincinnati, O., showed a full line of machines for light and power. The reputation of the Bullock motors has spread all over the United States. The largest printing and publishing establishments in the country favor the Bullock motors, on account of its excellent finish and high efficiency.

Lewiston, Mont.—G. W. Cook, President Citizens' Electric Light Co., may be addressed concerning the construction of electric-light plant.

THE EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTROMOTIVE FORCE CURVES OF AN ATERNATOR.

(Continued from page 303.)

It is also interesting to note that between no load and full load, the crest of the induction curve moves through an angle of 30°, or over one-fourth of the width of the pole faces.

The fluctuations which take place in the armature inductance are due to the changes occurring in the reluctance of the path traversed by the flux induced by the armature current. The action of the armature current is to intensify the induction in the armature core between the 60° and 130° positions of coil 1. The initial ininduction in the core was over 24,000 gausses when the coils were between the pole tips. The armature current acting with the field excitation maintained this saturation during the first part of the revolution and prevented any great variation in the induction in the first quadrant.

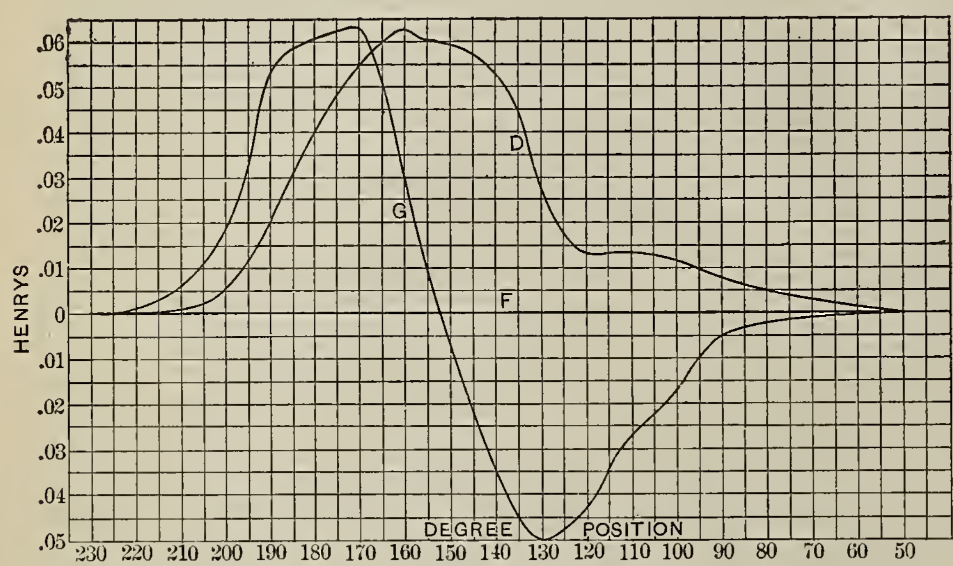


Fig. 4.

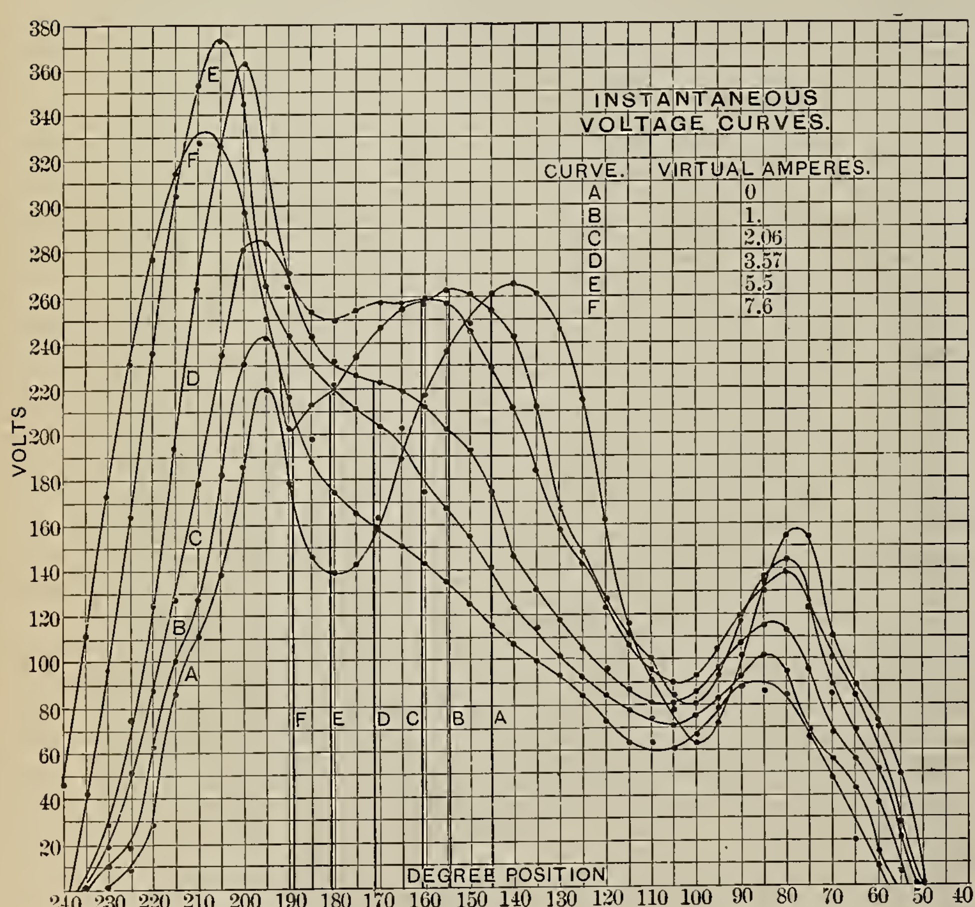


Plate 6.

But during the second and fourth quarters of each revolution, when the coils were between the 170° and 200° positions, the armature current was reacting against the field excitation, and thereby, by diminishing the flux density, was increasing the permeance of the iron and the inductance of the coils for these positions. The magnetizing power of the coils is considerable, as with 8 amperes flowing through them, they set up an induction of 18,000 gausses in the core when in the 160° position.

The great amplitude of the induction wave for 2.4 amperes in the coils is in the same way due to the fact that the permeance of the path is least when the magnetizing force is that due to this current. If we plot the values of the 140° curve of Plate 4 in terms of the armature cur-

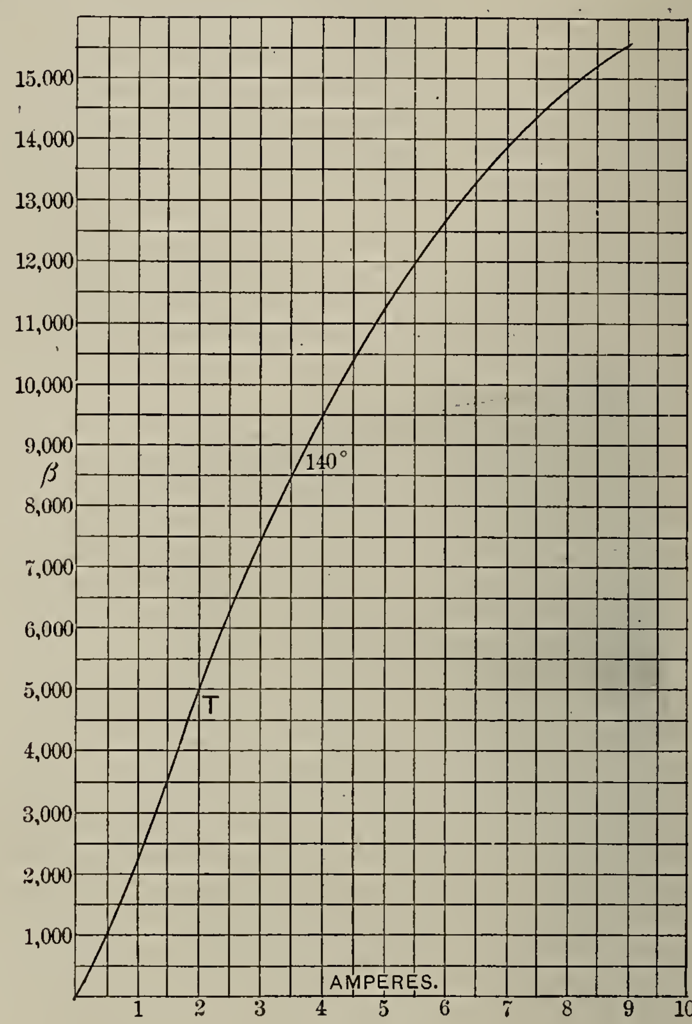


Fig. 5.

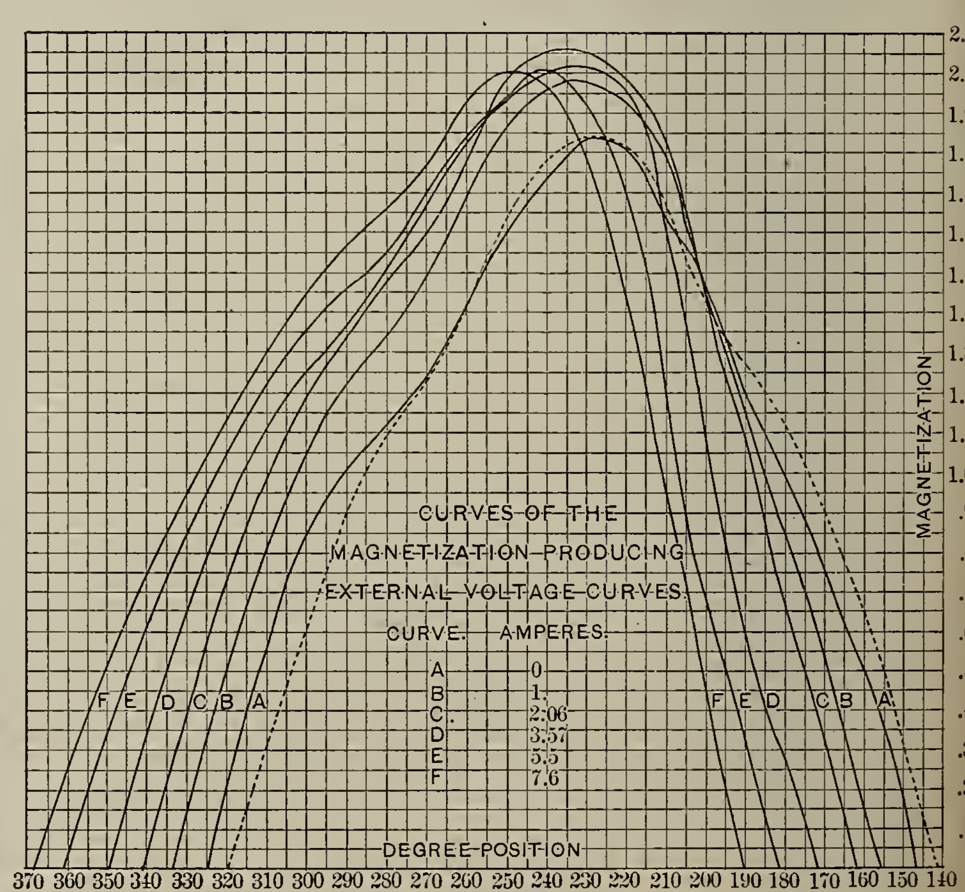


Plate 7.

rent and the induction set up in the core by the current, we obtain the curve shown in Fig. 5. This is "B and H" curve for the magnetic circuit through the armature core in this position, and the point T, which corresponds to the maximum ordinate of the 140° curve, is the point where a tangent to the curve makes the greatest angle with the base line.

The large teeth of the armature core do not seem to ıave the effect of causing any marked irregularities in he inductance curves. It is noticeable, however, that here is a slight hump in all of them at the 90° position. 'his is caused when the teeth immediately behind the oils pass the pole tips. The same effect is produced by he other teeth, but it is too slight to appreciably affect he readings.

Electromotive Force Curves.

A series of electromotive force curves taken from the ıachine are shown in Plate 6. These illustrate the gradal change in the wave form of the effective electromotive orce as the load increases. By the effective electromove force is meant the electromotive force that is in phase ith the current and overcomes the ohmic resistance.

There is quite an appreciable lag in the effective elecromotive force for the higher loads, owing to the armaıre inductance. This can hardly be regarded in the ght of a simple phase displacement, as the lag partakes ırgely of the nature of a transformation of the fundaıental wave A, that is due to the phase positions of the igher harmonics being shifted relatively to the fundaıental harmonic, and not to any material change in the hase position of the fundamental harmonic itself. The xtent of the shifting is best appreciated by noting the ositions of the ordinates A, B, C, D, E and F. These nes bisect the areas of the electromotive force curves esignated by corresponding letters, and indicate the oints at which the induction threading the coils passes ırough zero and changes sign.

The curves of Plate 7 have been determined from those f Plate 6 by integrating the areas of the latter. They lustrate the waves of magnetism producing the effective lectromotive force curves, and give a better idea of the xtent of the lag that takes place. The scale of ordinates f Plate 7 expresses the value of the integral,

$$\int e\,dt = -N,$$

s determined from the curves of Plate 6, and must be ıultiplied by the constant 12,206 to express the value of ıe induction per sq. cm. in the iron of the armature ore. The maximum induction occurring in the core is ıerefore a little over 25,000 gausses.* In determining ıe value of the constant, an allowance of 20 per cent. as made for the lamination of the iron, 80 per cent. of ıe gross area of the core being used as the equivalent of ıe iron.

Curve A of Plate 6 was obtained with zero current in ıe armature. This is the "fundamental" or internal lectromotive force wave of the machine. It will be oticed that it is not symmetrical about the 140° ordiate. It is an irregular curve having three prominent eaks; the right hand one slightly depressed, the left and one raised somewhat, and the central one practially symmetrical about the centre of the pole faces. The ır peaks are due to higher harmonics being superimposed pon the fundamental wave by the magnetic disturbances in ıe air-gap that are caused by the large teeth. Steinıetz† has noted this effect and treated the subject of the istorting influence of armature teeth in a masterly manet. His results indicate comparatively symmetrical waves or no-load conditions.

In the case under consideration, a marked shifting of ıe electromotive force curve in direction of rotation is ıused by the teeth immediately on each side of the coils. s the teeth approach the pole tips, the lines of force do ot appear to reach out to receive them to any extent. here is a sluggishness apparent. On the other hand, hen the teeth are leaving the trailing pole tips, the lines f force seem to hold on with tenacity, and when they do t go, fly back with a snap as would extended strands of astic. In the extreme cases, this action does not apear to occur until the tooth is over an inch away from the ole tips. The rapid cutting of the lines necessarily ıgments the potential at this point.

This explanation has its bearing upon the case, but the distortion is perhaps better explained by looking at it in the light of the part played by hysteresis and eddy currents. The eddy currents induced in the pole tips tend to oppose any change that takes place in the field distribution of the induction. They help to maintain a high induction in the trailing pole tips, and keep down the induction in the leading pole tips. The iron in the core of the armature is being carried through a complete hysteretic cycle at each revolution. The iron in the pole tips is carried through an hysteretic loop with the passage of each tooth across the pole face. At the leading pole tips the magnetism in the core iron is always working on the descending portion of the curve of hysteresis, and the reluctance of the magnetic circuit by the leading pole tips is increased accordingly. At the trailing pole tips the iron is worked on the ascending side of the hysteretic curve, and the reluctance of the path by the trailing pole tips is thereby reduced.

The same magnetizing force, therefore, acting upon the two paths, induces a distorted field when the armature is running, and a symmetrical field when the armature is at rest, as shown by curve A and the dotted curve of Plate 7. The latter curve was obtained by exploring the air-gap distribution of the flux by the ballistic method, using the exploring coil wound over coil 1, and breaking the field circuit.

(To be continued.)

INSULATION AND CONDUCTION.

(Continued from page 292.)

This paper is already so long that I cannot touch in detail on the question of cables. There are also other papers in existence written by men better equipped for the task. I had intended saying something about what Siemens has called the "absurd craze for high insulation resistance," but the fact is now generally recognized, except by inexperienced engineers, that the best cables are those of medium ohmic resistance. I will only mention two methods which have occurred to me as feasible for certain purposes. One is based on the fact that the dielectric strength of air, as shown by the experiments of J. J. Thomson and Peace, increases very rapidly with the pressure at 90 lbs. per square inch, being equal to that of a good quality of rubber. A similar plan, though not requiring a very large pressure, is due to Mr. Westinghouse, who thought of employing it four or five years ago in Philadelphia. The second occurred to the writer on reading Elihu Thomson's article on the use of liquid air as an insulator. It is this: Since ice at only 12° below freezing has a specific resistance of over 1000 meghoms, *i. e.*, as good as some brands of insulation, why not make the conductors hollow, lay them in a trench filled with wnter, pass cold brine through the pipes, use the brine for cooling houses, making ice, etc., and let the frozen water act as the insulator. A rough calculation shows that this is commercially feasible, even neglecting all sources of profit from the furnishing of the brine, (*i. e.*, if it were used only for cooling the pipes.) After making all allowance for friction of fluid, cost of power, etc., the balance comes at the right end, if the line is always fully loaded.

The question is sometimes raised, whether we can ever hope to have a non-inflammable substance which shall be elastic like India rubber. The probable cause of the elasticity of rubber is known,* and it would seem as if there was no reason why such a substance should not be prepared. All we have to do is to coagulate one substance in the midst of another. In fact we have at present in tetrametaphosphate of sodium such a substance, elastic as rubber, transparent and tough, and when pure a good insulator. It would be an admirable material if it were not for the fact that the elasticity is due to water, and when this dries out it becomes brittle.

As regards an organic artificial rubber, I have very little doubt but that it will be made as soon as it is understood by chemists that its properties are due to structural and not chemical causes.

Armature windings.—The present methods of using mica leave little to be desired. The writer might mention, however, one novel method he used in a case where very heavy currents were to be carried. Asbestos and silicate of soda, as is well known, form a good coating, but is, however, poor mechanically. The armature bars were wrapped with asbestos string and then coated with the silicate. This made when dry an extremely firm covering which could only be removed with a hammer. Though at first a bank of 100 lamps could be lit up through the insulation, after a little running it dried out to quite a high figure and the machine did good service, at one time running several hours, as I am informed on good authority, under such an overload that the carbon brushes were red hot.

In cases where cloth is to be treated we have a very different question. There are two ways of using cloth: 1st, as a backing merely, by coating it on the surface with some substance which is supported by it, as plaster on lathing. Many substances work well in this situation, but the fact that little tubes of cellulose are very apt to stick up through the coating, as was pointed out to me by Mr. F. R. Upton many years ago, and that if moisture gets in at the edge it spreads all over, renders it not the best kind of iusulation. Rubber is sometimes applied in this way to cotton tape, but though of very high resistance and insulation at first it rapidly deteriorates. In general it should be said, that where a permanent result is desired rubber should never be used unless kept in the dark and out of contact with air. If these precautions be neglected the life is very short. The othet method is to saturate the whole cloth with some substance which will penetrate every crevice, but when this impregnating substance has solidified it must continue to fill these crevices and capillary tubes. For this reason no substance which is dissolved in anything else can be used. If, for instance, we try a varnish dissolved in alcohol, it will be found that the strength of the solution in the capillary tubes is much smaller than outside, for the same reason that sea water filtered through sand becomes fresh.* Consequently, on drying, these capillary spaces are not filled up and let water in. Therefore, unless we adopt the first method and plaster the insulator on thickly and deep enough, so that it does not matter whether the support insulates or not, we must use melted solids or drying oils. Unfortunately but few solids which melt are elastic, since this elasticity is obtained by a structure which is destroyed by melting, and those solids which melt into thin liquids and remain flexible when solid do not preserve this property except within narrow limits of temperature, as can be easily tested by holding under a cold water tap and striking the specimen sharply. Soft paraffin can be used in some cases if the cellulose be well dried and thoroughly suturated. The asphalts cannot, as a rule be used, as they never get sufficiently fluid on melting. There is, however, one notable exception: uintaite, or, as it is commercially called, gilsonite. This substance I found many years ago had the peculiar property that, when melted, like paraffin oil, it will pass into the pores of cellulose or cloth. Having a very high melting point, nearly 300° if I remember, and mixing perfectly with paraffin in all proportions, it gives mixtures which are admirably adapted for induction coil work, as these compounds can be made to have high melting points and to penetrate a coil thoroughly.

I also some years later, in 1891, used this material in combination with linseed oil for transformers, the process at first proposed being boiling in vacuum, but it was found that, even without this, saturation was complete. I understand that this method is still used, though modified in form, by the company for which I first devised it. Of the drying oils, with the exception of some foreign oils as Chinese wood oil, and an African oil whose name I cannot recollect or ascertain, linseed and the drying nut oils are the best. Linseed oil has the remarkable property of expanding on drying. This enables it to fill up all pores. Its durability is evinced by the good condition of old oil paintings. The varnishes crack and go, but the oil remains.

Its insulation is not injured up to very high temperatures at which shellac, rubber, etc., would be worthless. This material was used a great deal by the Edison company in its early days, but it often broke down. The trouble was traced to the lead drier, and after many experiments Mr. Marshall, who had charge of this work, finally settled upon the use of pure raw oil. This gave excellent results and was long used but took some time to dry, and the writer finally, after many tests, found that borate of manganese drier got rid of the trouble, while, as is well known, it gives a very quick drying varnish. This was used by the United States Company in Newark on their machines, with the result that in 1890 after use for a year, the foreman reported only two armatures so treated as returned for repair (they were injured by lightning), and no fields. This material was also used by the Stanley Company for transformers.

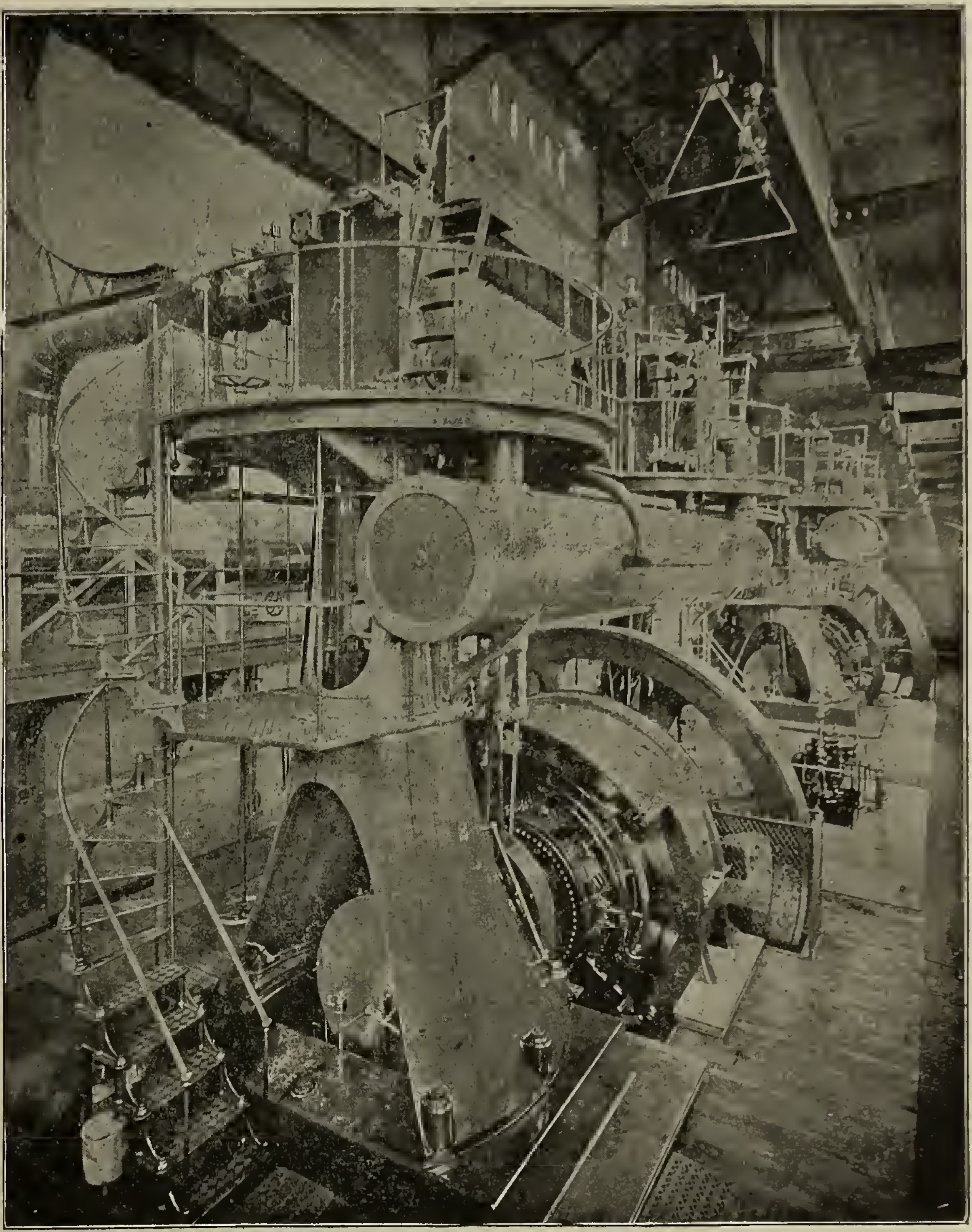
Another advantage of this borated oil is that it always retains a slight stickiness, and so gives a good joint when wrapping around wires, etc. Many substances so used are not sticky and let moisture in through the joints. Where a smooth surface is required, it is readily obtained by dusting on a little talc, a method first suggested, I believe, by Mr. Edison. It can also be given a coat of Japan on the outside. Varnish gums should never be used with linseed oil, as they are brittle, and the dried oil is only just flexible enough. Consequently when the oil has dried the resultant varnish is always very brittle. A temporary elasticity is given at first by the fact that when the solvent has dried off the oil is still fluid and undried, and as the varnish gum keeps the air from getting at it rapidly, it sometimes remains flexible for a year. Such mixtures also crack when cold.

(To be continued.)

MR. S. MARSH YOUNG, vice-president and general manager of the Manhattan General Construction Co., 11 Broadway, New York, will be at the Auditorium Hotel in Chicago during the convention of the National Light Association with a full line of the new Manhattan Enclosed Arc Lamps. These lamps are designed to burn in multiple on circuits of from 90 to 250 volts, and two or more in series on circuits of from 200 to 600 volts, and on alternating-current circuits of from 90 to 130 volts and any number of alternations.

The Electrical Age.

VOL. XXI—NO. 24 NEW YORK, JUNE 11, 1898 WHOLE NO. 578



Power Plant, Metropolitan West Side Elevated Railroad, Chicago.

THE METROPOLITAN ELEVATED RAILROAD OF CHICAGO.

The Metropolitan Elevated Railroad of Chicago was opened to the public on April 17th, 1895, although regular traffic did not begin until May 1st. Starting from the lake front and leaving the more densely populated business centre, the road branches off in every direction. The total length of the road, including branches and trunk line, is about twenty miles.

The main line starts on Franklin street. It has four elevated tracks, and is 1.81 miles in length. From Paulina street the Garfield Park and Logan Square branches diverge, and the Humboldt Park line is a branch of the Logan Square line. The Douglas Park line runs south from the Paulina street terminus of the main line westward for a distance of 3.7 miles. Each of the branches has two tracks.

The road runs through the centre of the blocks, thus only crossing streets instead of traversing their length. The company acquired the land by direct purchase, partly through condemnation proceedings, and much of the way was cleared by the destruction of buildings.

The stations are all built under the tracks, stairways leading to the track platforms.

One car of each train will be the traction car, and will take the current from a special rail laid on the deck of the road. The electric system is that of the General Electric Company.

A view of the generating station of the Metropolitan road is reproduced herewith from the "Scientific American." The generators, as will be seen, are of the multipolar type, and are driven direct.

One type of generator driven at 75 revolutions per minute maintains a voltage of 500 on no load and 600 loaded, with a current of 2,230 amperes. Another type at 100 revolutions gives 500 volts with no load and 550 volts with full load, and a current of 1,450 amperes. The armature winding consists of heavy bars of copper insulated by mica. They were wound when in place. There are twelve field magnets in the circle inclosing each armature. It was only after the winding of the armature and setting up of the field around it that the engines were assembled. The engines are Allis Corliss, and are compound inverted vertical, direct-acting, standing some 50 feet high, with 25-foot fly-wheels. There are five; two are of 2,500 horse-power each, the others of 1,000 horse power each. The dynamo comes between the high and low pressure sides, so as to be inclosed by the engine frames. It is claimed that the energy stored up by the fly-wheel at full speed is enough to run a train of cars from the power house into the city. A Morgan electric crane of 75 tons capacity, also shown in the illustration, spans the engine house, commanding the entire area.

The massive switches are mounted on a white marble base plate. The current from the power house goes to the car motors by the lateral contact rail and returns by the regular rails to the station. Each traction car will carry four motors, so that maximum efficiency will be given at three different speeds. On starting, the motors are thrown into series; at the next speed two are in parallel and two in series, and at the highest speed all are in parallel. Air brakes will be used, a small motor working the air pump on the motor car.

The steam is generated in 16 Babcock & Wilcox boilers, provided with automatic stokers. The plant is so designed as to admit of future enlargement without disturbing existing conditions. It is located on an alley back of Throop street, between Van Buren and Congress streets.

The motor cars were built expressly for this service by the Barney & Smith Car Company, Dayton, Ohio. Each car, without its electrical apparatus, weighs nearly 40,000 pounds, is 40 feet long in body, and 47 feet 3 inches over all. There is a motorman's cab at each end, which takes up a portion of the platform space.

The trains are lighted by electricity.

The Logan Square line is carried over the tracks of the Northwestern Railroad on a bridge with a 250-feet span. Besides this bridge there are other fine examples of engineering skill.

It seems likely that the success this road has already met with will induce the proprietors of the Manhattan Road of this city to instal a plant of a similar nature. The simplicity of the system, its economy of operation and low rate of depreciation will certainly assist in bringing about this desired result.

INSULATION AND CONDUCTION.

(Continued from page 320.)

Sample C is a specimen of borated oil saturated cloth, which is now between eight and nine years old. It will be noted that it is still fresh and flexible, and a recent dielectric strength test showed up very high, 7000 volts, if I recollect. The pure raw oil is boiled at about 200° with ½ per cent. of borate of manganese for several hours till it begins to be thick.

Non-inflammable materials can be made as I have pointed out elsewhere, by taking out the hydrogen atoms of hydrocarbons and substituting chlorine. Even paraffin can be thus treated if kept warm, and first turns to a fluid and then to a solid. At one time it seemed as if this process might be valuable, but the use of enclosed conduits has done away with the greatest source of danger from fire.

I will conclude by describing a couple of devices which I have found useful in preventing insulation from being spoiled. Soldering acid, as commonly used, is a solution of chloride of zinc. If this falls on cellulose it turns it to a paste. It never evaporates and always takes up moisture from the air, and will gradually eat its way through quite a thickness of insulation. Whether it is acid or neutral makes no difference so far as its action on the insulation is concerned, though the neutral solution does not corrode the wire. Rosin has the disadvantage that it is not a fluid and is clumsy to handle. I have found that by shaking up powdered rosin in very strong ammonia, an ammonia soap is produced which works well in most cases. The ammonia dissolves the copper oxide and evaporates afterwards, leaving the powdered rosin, which is an insulator.

Apparatus can be protected from overheating by putting in the apparatus a small glass tube filled with carnauba wax. This melts near the danger point, but remains quite hard up till then, so that by imbedding a spring and contact in the wax, when the apparatus gets too warm the wax gives, and the spring expanding causes a short circuit which blows the fuse.

The largeness of the subject must be my excuse for the fragmentary nature of this paper. After I had begun it I found I had made a mistake; what I should have undertaken was to write a book. I trust, however, that some of the points I have developed may prove of interest.

* Popularly known as the Tesla coil, on account of his having brought it into prominence through his use of it in his lectures; though it was invented and first described by Elihu Thomson.

† Elec. World, Aug. 8 and 22, 1891.

‡ Phil. Mag., Dec., 1892.

* Molecular Physics, Franklin Inst., Sept., 1896.

† J. J. Thomson, "App. on Dyn. to Phys. and Chem.," p 190.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. *

At a recent meeting of the Institute held at 12 West 31st street, New York, a paper was presented by Prof. R. A. Fessenden on "Insulation and Conduction," just concluded on this page. About seventy-five members and guests were present, with President Crocker in the chair.

In the absence of the author the paper was read by Mr. R. W. Ryan and discussed by Prof. Franklin and Dr. Pupin.

The secretary announced that at the meeting of the council in the afternoon the following nominees had been selected from the proposals submitted by the membership: For President, Arthur E. Kennelly. For Vice-Presidents, Robert B. Owens, William Stanley, Cary T. Hutchinson. For Managers, Herbert Lloyd, Samuel Sheldon, Geo. F. Sever, Chas. P. Steinmetz. For Treasurer, Geo. A. Hamilton. For Secretary, Ralph W. Pope.

The following officers continue their terms as provided in the constitution: Vice-Presidents A. E. Kennelly, Chas. S. Bradley, D. C. Jackson. Managers J. W. Lieb, Jr., F. A. Pickernell, W. L. Puffer, L. B. Stillwell, Alexander Macfarlane, W. F. C Hasson, Gano S. Dunn, Herbert Laws Webb.

The question of standardization of electrical machinery was referred to a special committee composed of Elihu Thomson, Francis B. Crocker, A. E. Kennelly, C. P. Steinmetz, C. T. Hutchinson, J. W. Lieb, Jr., L. B. Stillwell.

The following associate members were elected: Albert G. Davis, acting manager, patent dep't, General Electric Co., Schenectady, N. Y.

Albert R. Gallatin, student at Columbia University, residence 58 West 55th street, New York City.

Herbert Gaytes, electrical engineer, Realty Syndicate Railways, Piedmont Power House, Oakland, Cal.

Griffin Russell Agnew, purchasing agent, American Telephone & Telegraph Co., 15 Dey street, New York City.

Francis Valentine T. Lee, engineer (Pacific Coast Dep't), Stanley Electric M'f'g Co., 300 California street, San Francisco, Cal.

Max Loewenthal, associate editor, The Electrical Engineer; residence, 831 Park avenue, New York City.

Henry W. Pope, special agent, American Telephone & Telegraph Co., residence, 200 West 83d street, New York City.

Fritz Reichmann, instructor of Physics, The University of Texas, 309 East 11th street, Austin, Tex.

Theodore E. Theberath, Pacific Coast engineer, Stanley Electric M'f'g Co., 300 California street, San Francisco, Cal.

Robert Anton Fliess, student of electrical engineering,

* 26 Cortlandt street, New York City, March 24th, 1898.

Columbia University; residence, 201 West 55th street, New York City.

The opening date of the general meeting at Omaha was fixed for June 27th, and its continuation for either three or four days has been left with the Committee on Papers and Meetings for decision. Ralph W. Pope.

EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTRO-MOTIVE FORCE CURVES OF AN ALTERNATOR.

(Continued from page 319.)

The activity displayed by the eddy currents in heating up the pole tips is quite remarkable. The curves B and A of Plate 8 indicate the rise in temperature of the leading and trailing tips, respectively, throughout a two hours' run. The readings were taken from thermometers fastened directly to the pole pieces. The curve C is a curve of differences derived from curves A and B, and it indicates how very much more rapidly than the temperature of the leading pole tips the temperature of the trailing pole tips rises during the first twenty minutes of the run. Their difference in temperature after that time is practically constant. The curves plainly indicate that much greater magnetic disturbances occur in the leading pole tips than at other points in the pole faces. The thermometers had to be fastened to the back of the pole tips during the test; had it been possible to connect them in contact with the air-gap face, more rapid changes would doubtless have been recorded.

During the test the field coils were excited with a current of 10 amperes, and the armature was loaded to about 5 amperes. At the end of the run the temperature of the armature was 42° C.

As the armature core has sixteen teeth, or four per pole face, we may expect harmonics as high as the ninth to play a prominent part in the wave structure.‡ The general form of the internal electromotive force curve A is indicative of the fifth harmonic; the side peaks have been sharpened, however, by the upper harmonics, and the central one somewhat broadened by the third.

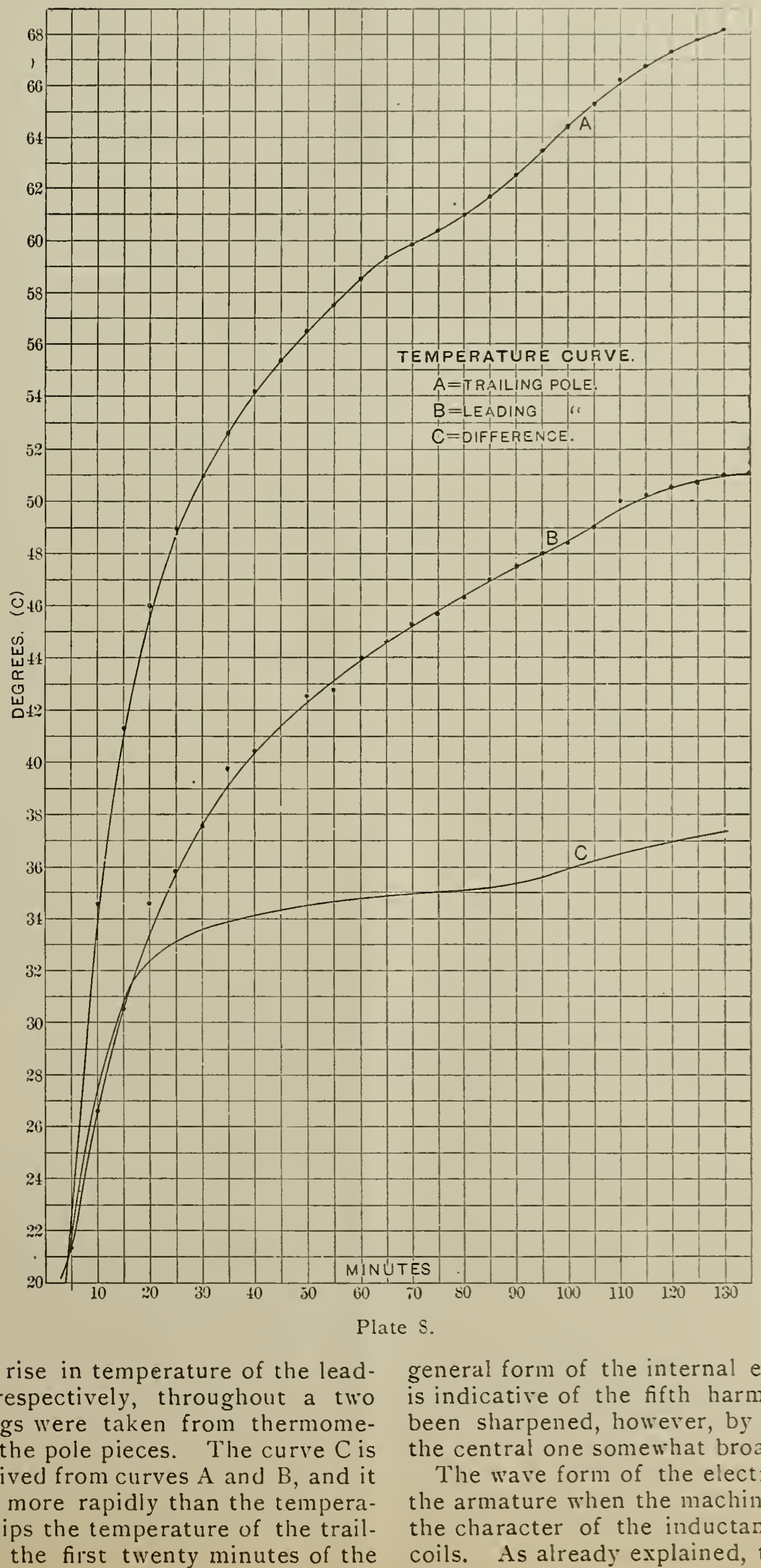


Plate 8.

The wave form of the electromotive force induced in the armature when the machine is loaded depends upon the character of the inductance curve of the armature coils. As already explained, the effect of the teeth upon the inductance curves is to introduce harmonics and cause irregularities in their contours. Practically the same number of harmonics are prominent in all the electromotive force curves, although the armature inductance has the effect of smoothing out the irregularities by giving the third harmonic greater prominence and diminishing the effect of the higher harmonics. As the current rises and the magnetizing power of the armature becomes apparent, the harmonics introduced into the circuit by the variable inductance grow in amplitude. They combine with the harmonics of like order of the fundamental wave, and an electromotive force curve results that is compounded of a series of harmonics that depend upon the value of the armature current for their amplitude and phase positions.

the electromotive force and current waves can be attributed to the cyclic variations in the inductance of the system, and when these are known within a fair degree of approximation the character of the wave modifications that will result can be determined.

In the development of the experimental results contained in this paper the dynamo was loaded by inserting sets of incandescent lamps in the external circuit. A special point was made of keeping the external circuit entirely free of any inductance. The current curves are therefore necessarily proportional to the electromotive force curves. However, to make their relative value and form more easy of appreciation, they have been plotted and are shown in Plate 9. The inductance curves of the coils that correspond to the alternating current curves

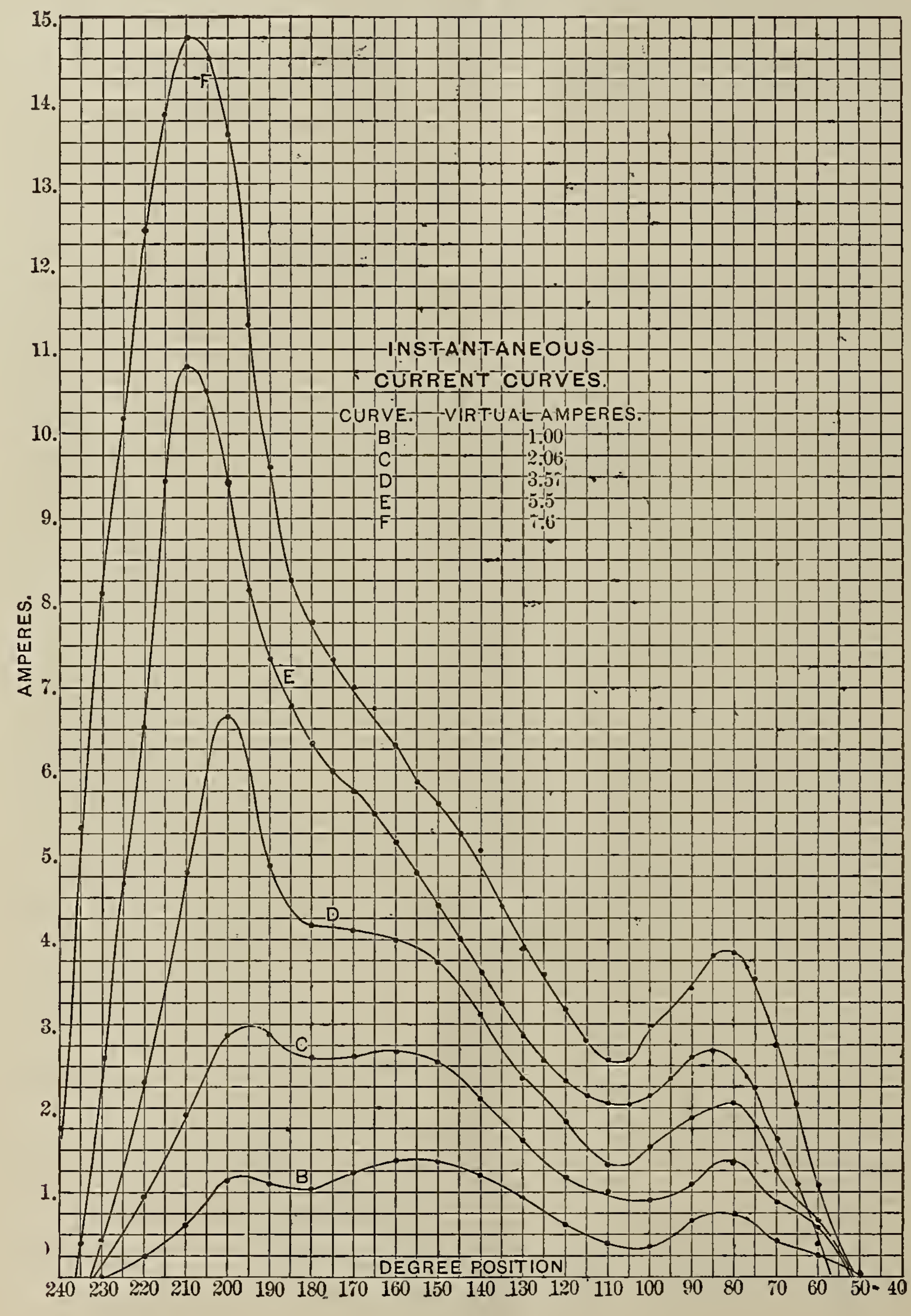


Plate 9.

A very small amount, if any, of the change in the form of the effective electromotive force waves is due to any departure of the original no-load wave of field flux from its initial wave form. In fact, to all practical intents and purposes the pulsations that occur in the magnetic reluctance of the field circuit are sensibly of the same intensity at full load as they are at no load. In other words, the changes that occur in the permeance of the core of the armature as the load varies do not appreciably alter the permeance of the field circuit. The fundamental wave of magnetism and of electromotive force may therefore be regarded as always being present, if not always tangible.

When alternating current generators are operated on circuits having a constant resistance for constant conditions of load, the disturbances that modify the form of

are given in Plate 10. These curves were determined by selecting from the curves of Plates 4 and 5 inductance values corresponding to the instantaneous values of the current curves and plotting them to same degree positions.

It is noticeable, owing to the different scales used in plotting the curves, that the current curves seem more even and smoother than the electromotive force curves. The inductance curves also are more nearly alike, both in phase and in amplitude, than the curves of Plate 3. This is owing to the fact that the alternating currents all start from and end at zero values when the coils are in positions of slight inductance, while they attain their maximum values at points of large inductance. For this reason the average inductance per cycle of the coils is greater with an alternating current flowing in them than with a direct current of the same effective value.

The alternating currents, for analogous reasons, force the induction curves up to the saturation limit marked by curve G of Plate 3 more rapidly than do the direct currents, and therefore for the same variation in effective current strength a less marked variation is caused in the inductance curves with these currents. The curves of Plate 3 certainly lead us to expect a greater variation, relatively to current intensity, in the armature inductance when the armature is in actual operation than that which is depicted in Plate 10.

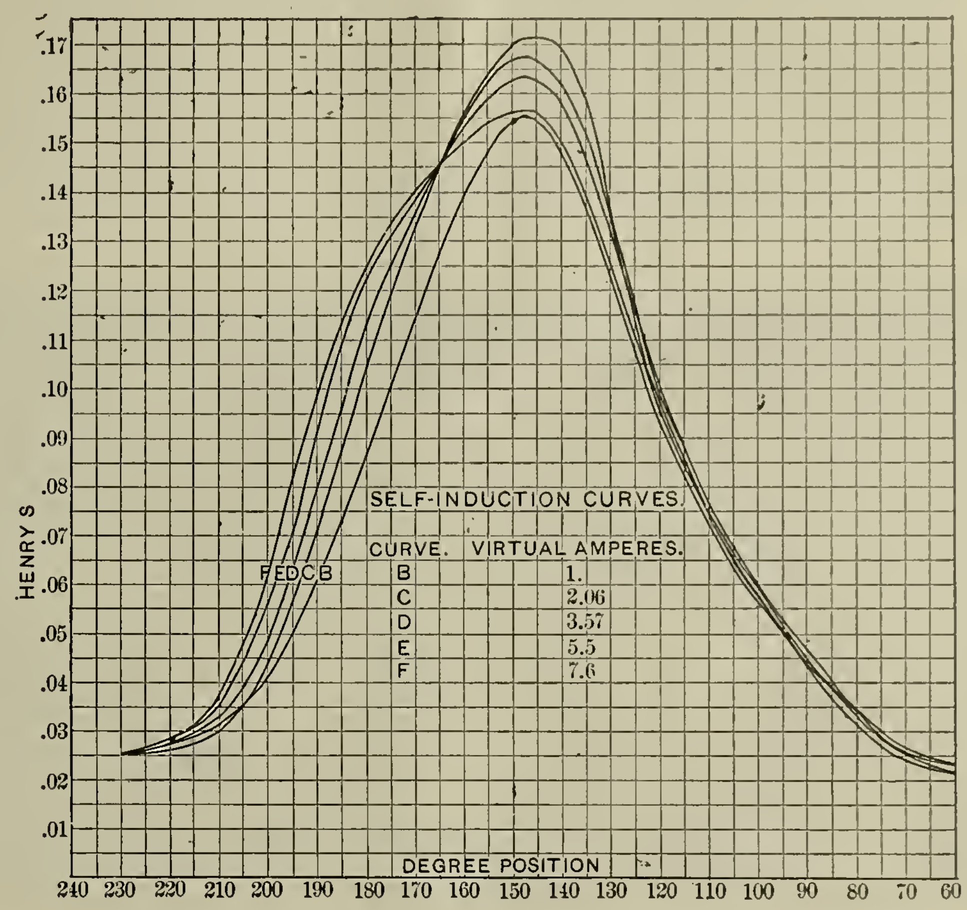


Plate 10.

It is a curious coincidence that the alternating current inductance curves all cross at a common point, namely, at the 164° position.

(To be continued.)

LIVE WIRES AT THIS WEDDING.

Charles Sanford Merten, of No. 343 Forest avenue, Bronx, and Miss Jennie S. Gilmour, of No. 38 India street, Brooklyn, were married by a minister in the Moore Chapel of the Electrical Show, Madison Square Garden.

Both bridal parties went to the wedding in electrical carriages. The little chapel, which was built to show the "daylight system" of lighting, was illuminated from tubes that curved over the ceilings. R. McFarland Moore, the inventor of the system, officiated.

The Mendelssohn and Lohengrin wedding marches were played on a pipe organ run by an electric motor.

JUDGE ADAM E. SCHATZ, of New York City, has recently received valuable Canadian patents on his system of canal hauling, described in the Christmas Number of the "Electrical Age." Extremely favorable comments have been made by European as well as American journals, as well as a technical nature. A full illustrated article appears in "Le Courrier de la Presse," of Paris.

* Some elaborate tests were made on Brush dynamos in 1889 by Mr. Murry. The values of B attained were about 4,800 gausses in the field and 27,000 in the armature cores. See S. P. Thompson's "Dynamo Electric Machinery," p. 464, 1892 edition.

† C. P. Steinmetz, Transactions, vol. xii., p. 470.

‡ C. P. Steinmetz, Transactions, vol. xii., p. 475.

NEW YORK ELECTRICAL SOCIETY.

The annual dinner of the New York Electrical Society was enjoyed by one hundred and fifty members and guests on Friday night, May 27th. The dinner was given at the St. Denis Hotel and proved to be a success from a gastronomic and social standpoint. The decorations were very pretty and the music charming. Speeches were made by the following gentlemen: New York Electrical Society, President Gano S. Dunn; the secretary, Mr. G. H. Guy, entertained the guests with some classical selections in music instead of expressing his feelings with a burst of rhetoric. The American Institute of Electrical Engineers was dilated upon by Prof. F. B. Crocker; the technical colleges by Mr. Joseph Wetzler; the Yankee Militant, Capt. F. L. Zalinski, U. S. A.; Sister Societies, Dr. W. McMuetrie; the Newspaper Man, Mr. S. L. Coles; Electrical Applications, Mr. F. W. Jones, the original president of the society in 1881; the Electrical Manufacturer, Mr. H. Ward Leonard; What We Think of Electrical Engineering, Messrs. C. O. Mailloux and H. B. Coho. Both spoke from different standpoints; one from that of the consulting engineer; the other that of the electrical contractor. The evening wound up with a great deal of good fellowship on all sides and a feeling that the New York Electrical Society occupied a place of great importance in the opinion of American electrical engineers.

At the recent election Thursday evening, held at the Electrical Exhibition, Gano S. Dunn was elected president; W. E. Case, H. B. Coho, Dr. C. A. Doremus, F. A. Patterson, E. E. Higgins and Chas. Blizard, vice presidents; Geo. H. Guy, secretary, and Henry A. Sinclair, treasurer.

A representative of the "Electrical Age" recently spoke over the wires a distance of twelve hundred miles by telephone. The conversation was held between New York City and Fort Wayne, Indiana. The speech was perfectly clear and distinct in every particular and shows how well perfected long distance telephony has become. This telephone line is made of pure copper. The line insulation is unusually high and the pole work has been completed in the most careful manner. It is hard to realize that more than a thousand miles separates you from your auditor, the syllables and annunciation are so perfect. Mr. Edward J. Hall is vice-president and general manager of the American Telephone and Telegraph Company, and is to be congratulated upon the success of his efforts in furthering long distance telephony. He and his staff of engineers have proven conclusively that telephoning is perfectly practical over long distances, and we would not be surprised to hear of the existence of a line that wedded the Atlantic with the Pacific Ocean, and brought into the closest communication the metroplis of the East and the far West.

THE EFFICIENT DISTRIBUTION OF LIGHT.

Light is produced today in a most expensive manner. Scientific tables will show that more than ninety-five per cent. of the fuel used for the production of electric, gas or oil light, is absolutely wasted. If this is the case and we then discover that in the process of distributing the light about twenty-five to fifty per cent. is again lost in the majority of cases, a necessity for the proper distribution of light is most pronounced. The use of globes and shades and other paraphernalia for surrounding a light-giving source received very little attention until Messrs. Blondel and Psaroudaki, making a scientific study of the problem, invented the famous "Holophane" globe. The Franklin Institute of the State of Pennsylvania, in their favorable criticism of the "Holophane" globe, state as their belief that it secures much better diffusion and more satisfactory distribution than any other globe known to its members. It is quite evident from these remarks that the diffusion and distribution of artificial light is most successfully secured by means of these most remarkable globes. On November 3, 1897, the Franklin Institute recommended the award of the John Scott Legacy Medal and Premium to the two inventors, Messrs. Blondel and Psaroudaki. The Holophane Glass Company, of 1 Broadway, New York City, manufacture and sell "Holophane" globes of the most efficient construction. Their samples are on hand for examination by all sufficiently interested to call.

Holophanes.

The second preliminary announcement of train service and through cars via "America's Greatest Railroad," New York Central & Hudson River R. R., has just been issued by Edgar Van Etten, General Superintendent, and George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Concord, Mass.—Work on the proposed electric-light plant is expected to commence shortly.

MEMBERS NEWLY ELECTED TO THE NEW YORK ELECTRICAL SOCIETY.

W. C. Broadhurst, 120 Broadway, 4th floor, Room 25, N. Y.
H. M. Lamont, 120 Broadway, 4th floor, Room 25, N. Y.
C. Morris Haskell, 27 Morris place, Bloomfield, N. J.
Edwin H. Daly, 1064 Madison avenue, N. Y.
Gustavo Lobo, 219 W. 44th street, N. Y.
Richard Lamb, 1 Broadway, N. Y.
J. B. Taltavall, 253 Broadway, N. Y.
Fred Catlin, 253 Broadway, N. Y.
Clarence W. Phillips, 1420 Fifth avenue, N. Y.
Marcus Nathan, 15 Cortlandt street, N. Y.
Harris I. Goldstein, 79 Clinton street, N. Y.
A. L. Saruya, Saruya Eng. Co., 32 Park place, N. Y.
Joseph Miller, 216 Madison street, N. Y.
Henry C. Mortimer, Jr., 54 W. 21st street, N. Y.
Earle Ovington, 39 W. 26th street, N. Y.
Dr. C. A. Doremus, 59 W. 51st street, N. Y.
Geo. F. Porter, 203 Broadway, N. Y.
A. L. Doremus, Crocker-Wheeler Elec. Co., 39 Cortlandt street, F. Y.
Horton Webster Haddock, 1 W. 129th street, N. Y.
Richard Koch, 47 E. 78th street, N. Y.
H. A. Strauss, 120 Liberty street, N. Y.
F. M. Hawkins, 39 Dey street, N. Y.
Conrad Watchter, 55 S. 4th avenue, Mt. Vernon, N. Y.
Elmer P. Morris, 15 Cortlandt street, N. Y.
John Maguire, 371 Fulton street, Brooklyn, N. Y.
John Joyce, 129 Huron street, Brooklyn, N. Y.
Jens Skougaard, The Dakota, 72nd street, N. Y.
E. Y. Porter, Iron Clad Rheostat Co., Westfield, N. J.
C. D. Warner, Newark, N. J.
S. Glover Way, 34 W. 35th street, N. Y.
Harold Briesen, Weehawken, N. J.
Christopher M. Lowther, 36 Riverside Drive, N. Y.
W. J. Clarke, 141 E. 25th street, N. Y.
R. E. Gallaher, 15 Cortlandt street, N. Y.
E. N. Stevenson, 15 Cortlandt street, N. Y.
Theo. B. Entz, Storage Battery Co., 20 Broad street, N. Y.
W. H. Palmer, Storage Battery Co., 20 Broad street, N. Y.
Wm. F. Crawford, Blackall & Baldwin, 39 Cortlandt street. N. Y.
C. N. Wheeler, Crocker-Wheeler Elec. Co., Newark, N. J.
C. W. MacMullen, 42 E. 23rd street, N. Y.
C. M. Clark, 42 E. 23rd street, N. Y.
Jos. C. Youenes, 100 W. 105th street, N. Y.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., PUBLISHER

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

FIRST FLOOR, WORLD BUILDING.

NEW YORK.

NEW YORK, JUNE 11, 1898.

CONTENTS.

THE DESTRUCTION OF LARGE BUILDINGS BY ELECTROLYSIS.

With each advancing stage of civilization there arise new complications so closely interwoven and so inimical in many cases to personal safety and happiness that it seems as though civilization were better off freed from such evils. Since the advent of the trolley certain cries have arisen from the municipality; bridge builders over whose structures the electric road passes; and, finally, from the architect and builder. It appears that the owners of those buildings constructed with a metal framework fear the dangers of electrolysis. They complain of the steady undermining going on in the very foundations, and believe with a palsied fear that the huge monoliths will some day weaken at their base to such an extent that the building will be unsafe and consequently untenantable. In the columns of "Architecture and Building," of New York, the subject has been discussed in relation to Chicago's skyscrapers with the conclusion, to quote the writer, as follows: "while this danger has been hinted at before the discussions that have appeared from time to time as to the dangers from rust and corrosion to the metal structures of the skyscrapers, little attention has been paid to electrolysis affecting foundations.

From the above it will be seen that engineers and architects have a serious problem to work out in protecting their buildings against this danger. Apparently the remedy is insulation or the adoption of other than metal for the underground work where dampness is certain to be present and render iron subject to electrolysis."

We are of the opinion that the dangers arising from electrolysis are not as great as depicted by the active pen of this writer. When considering the matter from a purely theoretical standpoint the idea that by continued electrolytic action iron foundations will be torn away piecemeal until the building rests upon uncertain and weakening supports is horrifying to contemplate, but from a practical standpoint the conclusion may be reached that the leakages of current have so great an area to affect that each building individually is subjected to but little of its deleterious influence, and consequently the dangers of electrolysis pass away as a delusion unfounded by experience and unsubstantiated in daily practice. It is unfortunate, however, to realize that when electrolysis does occur the blame must be laid at the door of the street-railroad corporation. The electrical energy sent through its lines and tracks will, unless the proper return is supplied, take whatever metal work is in the vicinity as a means of completing its circuit. It is therefore evident that a lack of feeders along the line of the trolley will inevitably give rise to the unfortunate conditions discussed so freely by the daily papers and some technical journals.

Can there be some inter-relation between electricity and magnetism? The first positive answer seems to have been given by Romagnesi in a work published in 1805, but little or no notice appears to have been taken of this. Certainly no progress was made in the subject till 1820, when Oersted made his famous experiment before his class. By that experiment he proved that a wire carrying an electric current will, when properly placed, deflect a magnetic needle. The subject was almost immediately taken up by Ampere, and in a few months many of the important consequences which Oersted's discovery involved were developed. Ampere's work on the action of currents on currents and on magnets is classical and is still treated as part of the fundamental basis for the theory of electrodynamics. An account of his work may, therefore, be found in almost any of the numerous text-books on electricity. The conclusions reached by Ampere were confirmed by Weber by a series of much more refined experiments. To Weber also we owe improvements in galvanometers. The same year marks the discovery by Arago that a current cannot not only deflect a magnet, but that it is capable of producing one by magnetizing steel needles.

The further discovery was made four years later by Sturgeon that soft iron, although incapable of making a strong permanent magnet, is yet much more susceptible to temporary magnetization by the electric current. Arago also made about this time the important discovery that if a needle be suspended above a copper disk and the disk rotated, the needle will be dragged round with the disk. This was not explained for some years, but seems to be the first discovery of induced currents.—Prof. Thomas Gray.

LITERARY NOTE.

One by one the magazines drift to New York. Now it is The Home Magazine which begins its metropolitan existence with the June number. New York is the literary centre of the country, so we suppose it is but natural that all the publishing interest should centre there.

The Trow Press will do the work on the Home Magazine. The editorial offices will be located in the St. James Building, Broadway and 26th street.

And by the way, the May issue, the last gotten out in Binghamton, is a splendid example of mechanical work. It is a most readable book, too; there are a number of timely illustrated articles, many short stories, special articles, etc., making it all in all a delightful number.

Greenwood, S. C.—Walton & Wagner, Rome, Ga., have received contract for establishing waterworks, and The General Electric Co. has received contract for installing electric-light plant.

Calvin Winsor Rice, P. O. Box 774, Brooklyn, N. Y.
L. B. Pearson, 82 Morningside avenue, N. Y.
Fenton S. Grant, 148 Ninth ave., N. Y.
Philip Menges, 451 W. 48th street, N. Y.
D. L. Collins, 50 Dey street, City.
Louis S. Levy, 687 E. 139th street, N. Y.
Samuel F. Butterworth, Edison Elec. Ill. Co., 117 W. 58th street, N. Y.
J. J. Bellman, Crocker-Wheeler Elec. Co., Newark, N. J.
Geo. Sanders Weston (2nd), 476 W. 143rd street, N. Y.

DEVELOPMENT OF ELECTRICAL SCIENCE.

(Continued from Page 298.)

The work of Planté and of Faure and others on secondary batteries has been of great value commercially. They gave rise to severe chemical problems, but the main difficulty here also has been of a mechanical kind, and they have not added much to the knowledge of electrical laws.

The transformation of alternating currents from high to low potential and vice versa, by means of what are commonly called transformers, has shown another remarkable development of Faraday's discovery of induced currents. The application of transformers has made it possible to distribute electrical energy over large areas in a moderately economical manner, and incidentally has led to a considerable increase in the knowledge of the magnetic properties of iron.

One of the most important of the applications of electricity is that of electro-chemistry. The chemical action of the electric spark was noticed by van Groest and Dieman in 1739 in the decomposition of water. Beccari, about the middle of the 18th century, obtained metals from oxides through which the spark had passed, and in 1778 Priestley noted the production of an acid gas when the electric spark was passed through air. Similar experiments were made by Cavendish and Van Marum on decomposed ammonia. It is not, however, until after the discovery of the voltaic cell that the subject of electrolysis really begins. I have already referred to the discovery of Nicholson and Carlisle in 1800, and the subsequent work of Davy and of Faraday. The peculiar phenomenon of the appearance of separated elements only at the end plates in the electrolytic cell led to considerable speculation, and was explained by Grothuss on the supposition that the molecules separated into two parts, one positively and the other negatively electrified, and that these parts formed a chain between the plates along which chemical action traveled by a continual interchange of mates, the end parts going to the plates. This theory was held for many years, and is still to be found in some text-books. Faraday's work is by far the most valuable of the early contributions to the subject. He gave the following laws:

The amount of chemical decomposition in electrolysis is proportional to the current and the time of its action.

The mass of an ion liberated by a definite quantity of electricity is directly proportional to its chemical equivalent weight.

The quantity of electricity which is required to decompose a certain amount of an electrolyte is equal to the quantity which would be produced by recombining the separated ions in a battery.

These laws are all of the greatest importance, and the last one clearly points out the reversibility of the electrical process. By forcing a current through an electrolyte it is decomposed and the mutual potential energy of the components consequently increased. By allowing the components to recombine in a battery the mutual potential energy is reduced and a current of electricity is the result. An excellent illustration of this action is exhibited by the secondary battery.

In 1857 Clausius gave a theory of electrolysis and at the same time reviewed the weaknesses of the hypotheses of Grothuss and others. Clausius assumes that the molecules of the liquid are in continual motion; that impacts frequently occur which produce temporary dissociation, leaving atomic groups charged with opposite electricities, and that during these separations any directive agency, such as an E. M. F., is able to cause a motion of these atoms in opposite directions. This is probably the first indication of the idea of the purely directive character of the applied electromotive force taking advantage of dissociation to produce chemical separation.

The energy side of the problem now began to attract attention, and the development of what may be called the thermo-dynamics of electro-chemistry began. Among the most prominent workers in this field have been Joule, Helmholtz, Gibbs, Kelvin, Boscha and Favre.

In 1853 Hittorf made quantitative determination of the change of concentration near the electrodes when a current is passed through a solution. This work is of historical interest because it formed practically the starting point for what may be called the modern view of electrolysis. Hittorf's experiments extended over several years and served practically to establish the theory of the migration of the ions in the solution. Hittorf communicated the following laws:

The change in concentration due to current is determined by the motion which the ions have in the unchanged solution.

The unlike ions must have different velocities to produce such change of concentration.

The numbers which express ionic velocities mean the relative distance through which the ions move between the salt molecules, or express their relative velocities in reference to the solution, the change in concentration being a function of the relative ionic velocities.

Hittorf's analyses enabled him to give numerical values to these relative velocities. The experiments of Nernst, Loeb and others have extended Hittorf's results, and have shown that in dilute solutions the relative velocities of the ions are independent of the difference of potential between the electrodes and are only slightly, if at all, influenced by temperature. Hittorf pointed out that a knowledge of the conductivity of electrolytes should give valuable information in reference to the nature of electrolytic action. A great deal of work has been done in this direction by Horsford, Wiedemann, Beetz, the Kohlrauschs and others. The most notable, perhaps, was the work of P. Kohlrausch, who devised a method of measurement, using alternating current, by which results of high accuracy were obtained. Kohlrausch's results give the sum of the ionic velocities, and thus, combined with the results of Hittorf on change of concentration, which gave the ratios, the absolute velocity can be obtained.

It appears from these results that the velocity of the ion in very dilute solutions depends only on its own nature and not upon the nature of the other ions with which it may be associated. For example, the velocity of the chlorine ion is the same when determined from solutions of KCl, NaCl or HCl. The important general law has also been found that the conductivities of neutral salts are additively made up of two values, one dependent on the positive, the other upon the negative ion. If, then, the velocities of the ions themselves be known, the conductivity of a salt may be calculated. The results of Kohlrausch received strong confirmation from some very ingenious experiments by Lodge and Wetham in which the migration of the ions was made to produce a change of color in the solution, and could thus be directly observed.

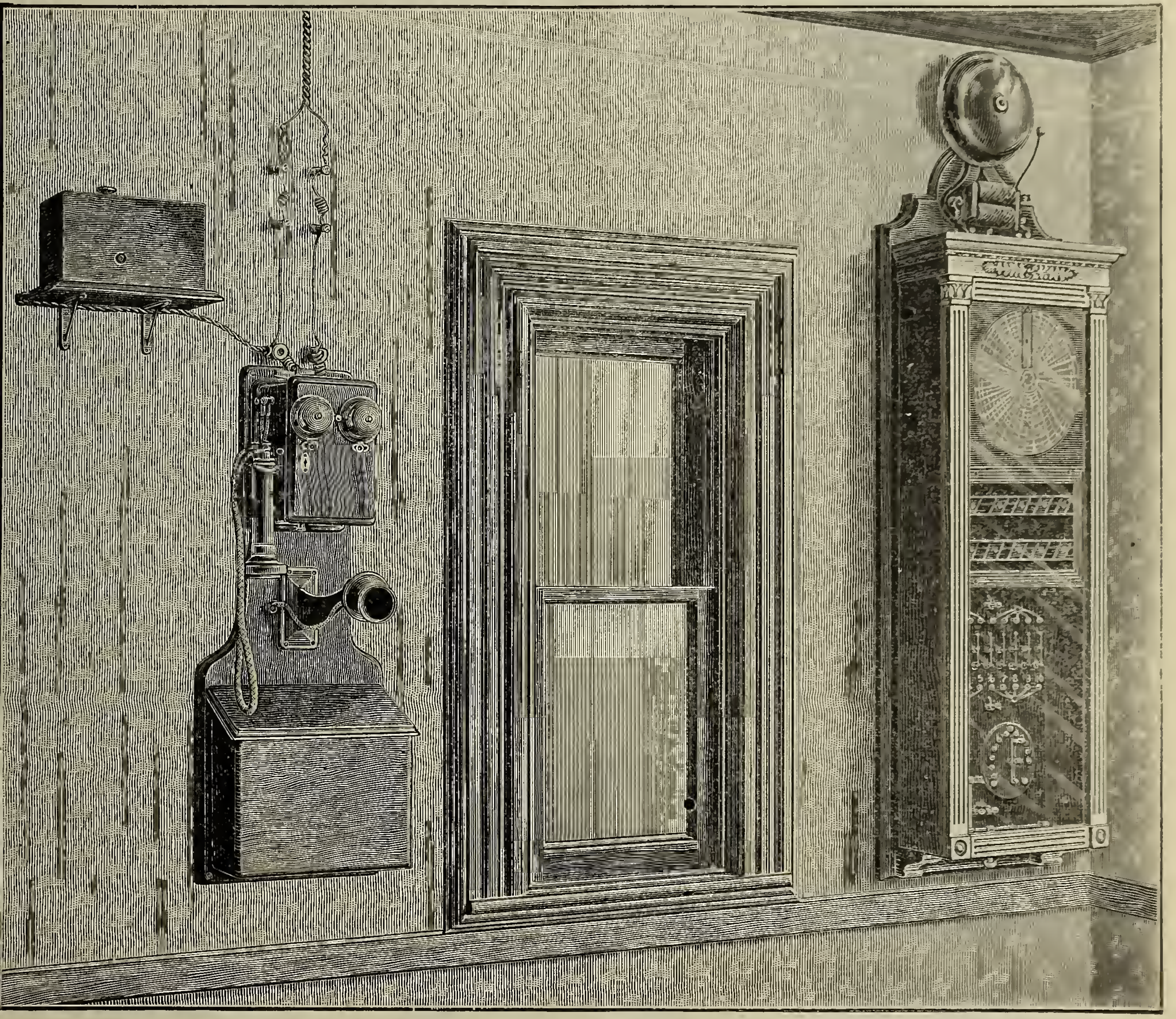
(To be continued.)

T. E. D. RITCHIE, 115 Broadway, New York City, has taken the Eastern agency for the Ft. Wayne Lamp Company.

Detroit, Mich.—Telephone Receiver Co. has been incorporated with a capital stock of $5,000.

INTERIOR THERMOSTATIC ELECTRIC CABLES.

The introduction of thermostatic electric cables into residences and business houses for their protection against fire and burglars have rendered them safer than Morro Castle. The Montauk Multiphase cable, by whose use so much good is accomplished, consists of a copper conductor around which is placed a fusible core ; then follow in consecutive layers a band of spirally wound tinned copper conductors, insulation covering them, copper conductors



The Multiphase Controller in Use.

partially tinned, all copper conductors and what is called divisional insulation. Over the whole of this is drawn a woven covering that protects the cable from external injury.

At the second Electrical and Kindred Industries Exhibition recently ended, the Montauk Multiphase Cable Company of 100 Broadway showed in their booth to thousands of visitors the great advantages of this cable in case of fire or burglary. A match held to it melts the fusible core and causes contact between the conductors otherwise insulated from each other. This fusing effect immediately rings a large gong and so notifies tenants that a dangerous heat has arisen along the line of the cable. The cable could be connected with a central station by means of the multiphase controller which, operating in conjunction with the cable, will send word to the central station regarding the nature of the trouble, specifying exactly what the cause may be. This addition makes the cable indispensable to a complete telephone, fire-alarm or district-service system.

In the illustration we show the multiphase controller as mounted in any home, hotel or business house. The ever watchful eye of this cable makes it so reliable in the performance of its functions that its universal use as a protection against fire is a foregone conclusion.

The Montauk Multiphase Cable Company control a series of patents that make infringement impossible. For further particulars write to the address given above.

DEVELOPMENT OF THE ENCLOSED ARC LAMP.

While the credit for the technical development of the enclosed arc lamp is due to Prof. Marks, it is well understood that the commercial development is largely the result of the work of the Manhattan General Construction Co.

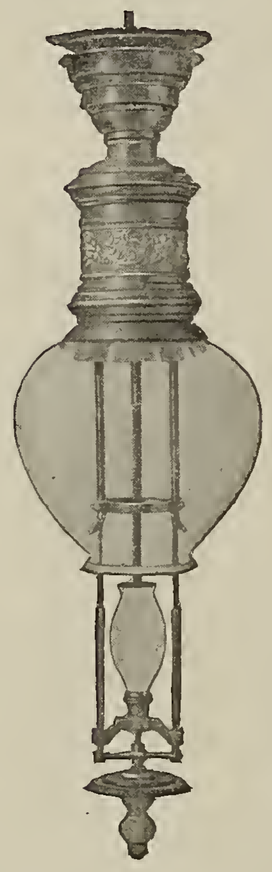
The first commercial successful enclosed arc was placed on the market by the Manhattan Co. in 1894, and since then the progress of such types of lamps has been so rapid that the enclosed arc has entirely superseded the old style of open-air arc lamps.

While the Manhattan Co. still furnish their old types of lamps, we give below a full description of their new improved types, which are designed to burn in multiple on direct-current circuits of from 90 to 250 volts, and in series on circuits of from 200 to 600 volts, and on alternating-current circuits of any frequency from 90 to 130 volts.

The principal defects which experience showed to exist in the old lamps were:

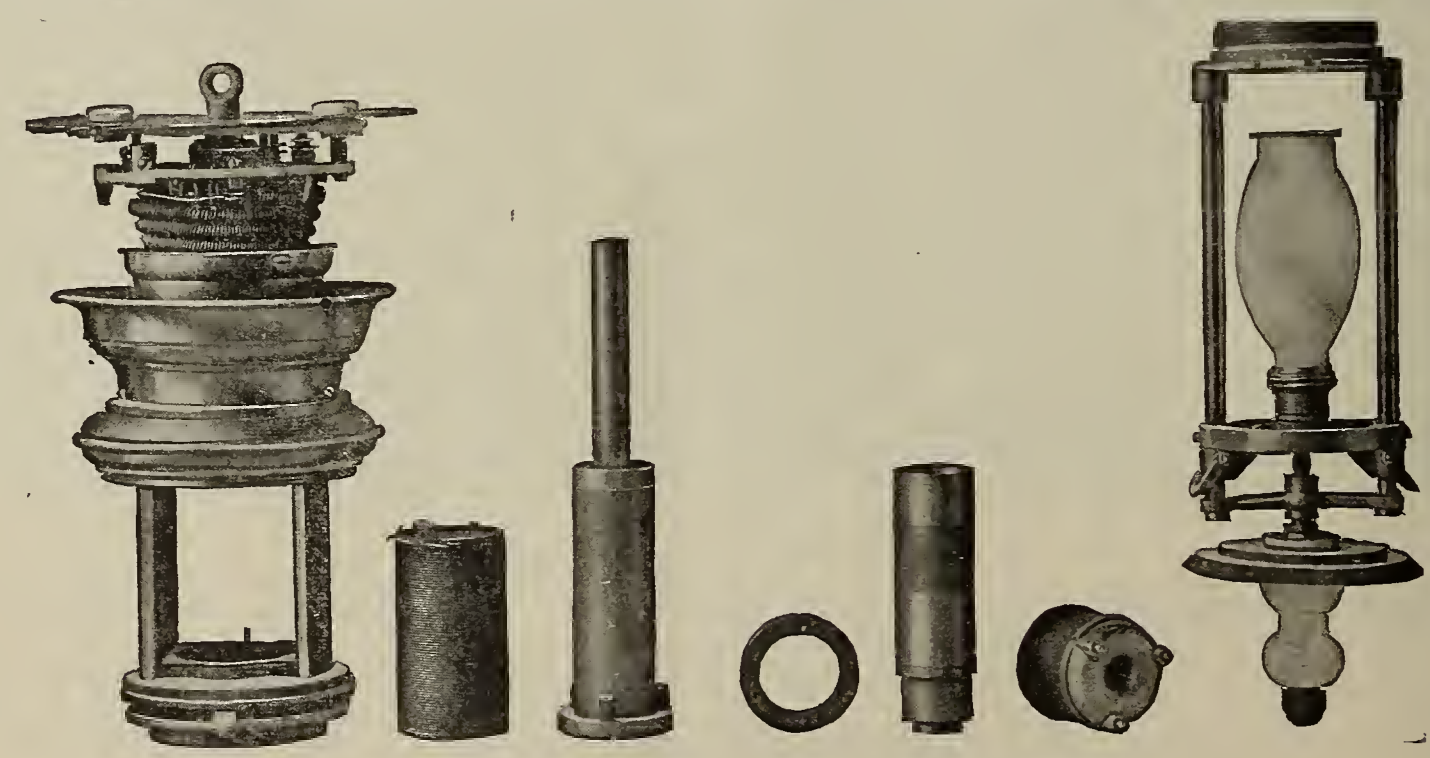
First—Length of 36 inches, which has been reduced to 29 inches.

Second—In the old lamp it was necessary in retrim-



Cut 3—The Lamp ready for Re-trimming, the Trimming Device being lowered.

ming to remove entirely from the lamp the spider holding the pan, the inner bulb, the gas check plug, the carbon and sheath, all of which either had to be held in the hand or laid down while replacing carbons and cleaning the bulb. In trimming, both hands had to be used, and



Cut 4—Mechanism in Detail of the D-C. Lamp.

when the lamp was hot this method became a hardship.

To provide, however, for cases where stations preferred to obtain entire uniformity of all parts required to be handled by trimmers, it has been arranged so that the new lamp may be furnished to take the old style of trim, or new style of trim may be furnished for old lamps now in service.

Trim is removed in shipment.

Third—In the old lamp the outer globe is stationary and a fixture on the body of the lamp. This saves handling, and many central stations claim that the saving thus made in breakage of outer globes nearly pays for renewal of inner bulbs, and this feature has been retained in the new lamp.

Fourth—In all other types of lamps the outer globe is lowered to give access to parts in trimming. In the new Manhattan lamp there has been introduced the novel

Cut 2—New Manhattan Lamp for both D.-C. and Alternating Current Circuits for Outside Service.

feature of lowering the bulb down through the opening in the bottom of the outer globe on double telescoping rods. The inner bulb and carbons are thus through in full view below the lamp, and, after retrimming, the device, on being raised automatically, locks in position. To lower the trimming device it is only necessary to press the knob on the bottom of the lamp. Carbon sheath is removed as heretofore, but the current is fed to upper carbon directly through the sheath in place of a separate brush box as formerly. Contact between sheath and inner tube is made through metal balls contained in the sheath. Magnetism automatically attracts these balls against the sides of the inner tube and assures perfect contact.

Fifth—It is perhaps not sufficiently well understood at one of the secrets of the life of the carbon is largely pendent on the style of closure of the top of the inner lb. The cap used in new Manhattan lamp is provided th a gas chamber, which materially lengthens the life. his cap is made under patents of L. B. Marks and oses S. Okun, covering every form of cap having a gas amber and lateral movement.

Sixth—In the old Manhattan lamp one of its great disvantages was that to adjust the current it was neces-ry to take out the pan and bulb, take off globe and ke, take the lamp down from its hanger, take off top ate, undo the wire connections, remove the rheostat, d take off shell from above. In the new Manhattan np the mechanism shell may be lowered while the lamp ngs in position by removing the trim and outer globe d giving the central cylinder a quarter turn, when the ell may be removed and current adjustment of the lamp anged.

The adjustment of the rheostat for voltage may be de by loosening set screws and lowering the split can-y at the top, as shown in Fig. –.

Seventh—While the great claim for the Manhattan lamp s always been its simplicity and the fact that it was de up entirely of heavy castings, it is very difficult to agine how the number of parts could have been much luced, but it will be found that all the mechanism be-v the armature has been dispensed with, and that the y moving part in the lamp is the armature, inside of ich, however, is a ball clutch. The clutch of the old np consists of four rings passing through slots in the nature, and the whole lamp had to be taken down and rt to reach the clutch. For this has been substituted r balls which ride between the inclined surface of the ide of the armature and openings in the central brass e. The armature and clutch may be removed from lamp while it hangs in position, by undoing one nut.

Eighth—In the old lamp the part requiring most fre-ent renewal and which was the most general cause for airs was the brush box, through which the current was to upper carbon. This has been entirely eliminated m the new lamp.

Ninth—One of the sources of danger to short arc lamps been that the arc is so close to the mechanism there likelihood of burning out of magnet. This has been vided against by the use of a ventilated magnet, and urrent of air is constantly passing between magnet and tral tube.

Tenth—The steady burning of the old lamp depended olutely upon perfection of the air chamber, which sed variation in burning of different lamps; also great ety of manufacture, and it was impossible to make ps altogether interchangeable. In the new lamp re is no such chamber, and a loose fit is maintained ween all of the parts. In addition to the air chamber which the armature works in the old lamp, a further mber was provided around the clutch, making it essary to take the shell off in a most inconvenient nner, and great care had to be used in replacing insu-on at this point, which made the old lamp most diffi-t to assemble. This has also been remedied in the v lamp.

Eleventh—In the old lamp the proper assembling was most important feature, and unless done with accuracy the lamp lined up exactly it would not burn properly, it was almost impossible for users of the lamp to take part and put together again without special tools. All the parts were assembled with driving fits, whereas in new lamp all of the parts are loose fits and may be noved with the fingers, and to entirely remove all of parts of the lamp it is only necessary to remove two s.

The rapid extension in this country and abroad of the of circuits of from 220 volts has caused a large de-nd for lamps to burn in multiple on such circuits. The v type Manhattan lamp has been designed for such service, and the mechanism of the lamp is exactly the same as the lamp above described, and the same lamp can be transferred from a 110 to a 220 volt circuit by the substitution of another coil and rheostat and a change of the nut holding the armature.

The same standard new type Manhattan lamp is also arranged to burn two or more in series on circuits of from 200 to 600 volts by a change of the magnet coil.

The development of the enclosed lamp for direct-current circuits has naturally caused much experimenting to be done with enclosed alternating lamps, and it seems as though the improvements in mechanisms brought about by enclosed lamps have enabled those experienced in lamp construction to produce lamps that would be acceptable both commercially and electrically.

Access to the mechanism may be had while the lamp hangs in position by removing the globe and trim and giving the mechanism shell a quarter turn.

The trimming device is removed in shipping, as in the D. C. lamp.

The Manhattan Co. state that they have been working on this lamp for nearly a year, and have put the same through continuous commercial tests, and do not hesitate to state that the lamp will maintain the high reputation of the company.

It is economical and reliable. It starts up quickly, and without chattering, will run without variation of current and quietly from 100 to 130 volts where such variation is found to exist, without readjustment.

The lamp will burn 100 hours with one 9½ inches × ½ inch upper, and one 6 inches × ½ inch lower carbon, and the unburned portion of the upper may be used as a lower for the next run. On circuits of 100 volts, six amperes, the lamp consumes 450 watts. The length of the lamp is 29 inches.

The lamp may be adjusted by a simple change of connections on the top plate for circuits of from 7,200 to 17,000 alternations, and has a range of adjustment for voltage of from 90 to 130 volts.

In designing these new types of Manhattan lamps there has been but one consideration in mind—Quality.

These Manhattan lamps are manufactured under Patents of Marks Enclosed Arc Light Co., Moses S. Okun, Max Harris and others.

The first company to recognize the validity of these patents and to protect themselves in taking out a license was the Manhattan Co., and since that time licenses have also been taken out by the General Incandescent Arc Light Co. and Electric Arc Light Co., and it hardly seems possible that three concerns such as these would, with their thorough knowledge of the situation, recognize the strength of basic enclosed arc patents unless the chances of their maintenance is considered to be more than a possibility.

Philadelphia, Pa. — Standard Traction Co. has been incorporated by Maynard L. Young, Edwin F. Morse, William S. Doran, J. Howard, Reber and William F. Sullivan. Capital stock, $1,000.

Portland, Me. — The Union Telegraph Co. has been incorporated with G. A. Beaton, treasurer, to acquire and operate telephone lines and handle apparatus. Capstock, $10,000,000.

St. Louis, Mo.—The Mississippi Valley Electrical & Manufacturing Co. has been incorporated by Edward Buden and others, with a capital stock of $100,000.

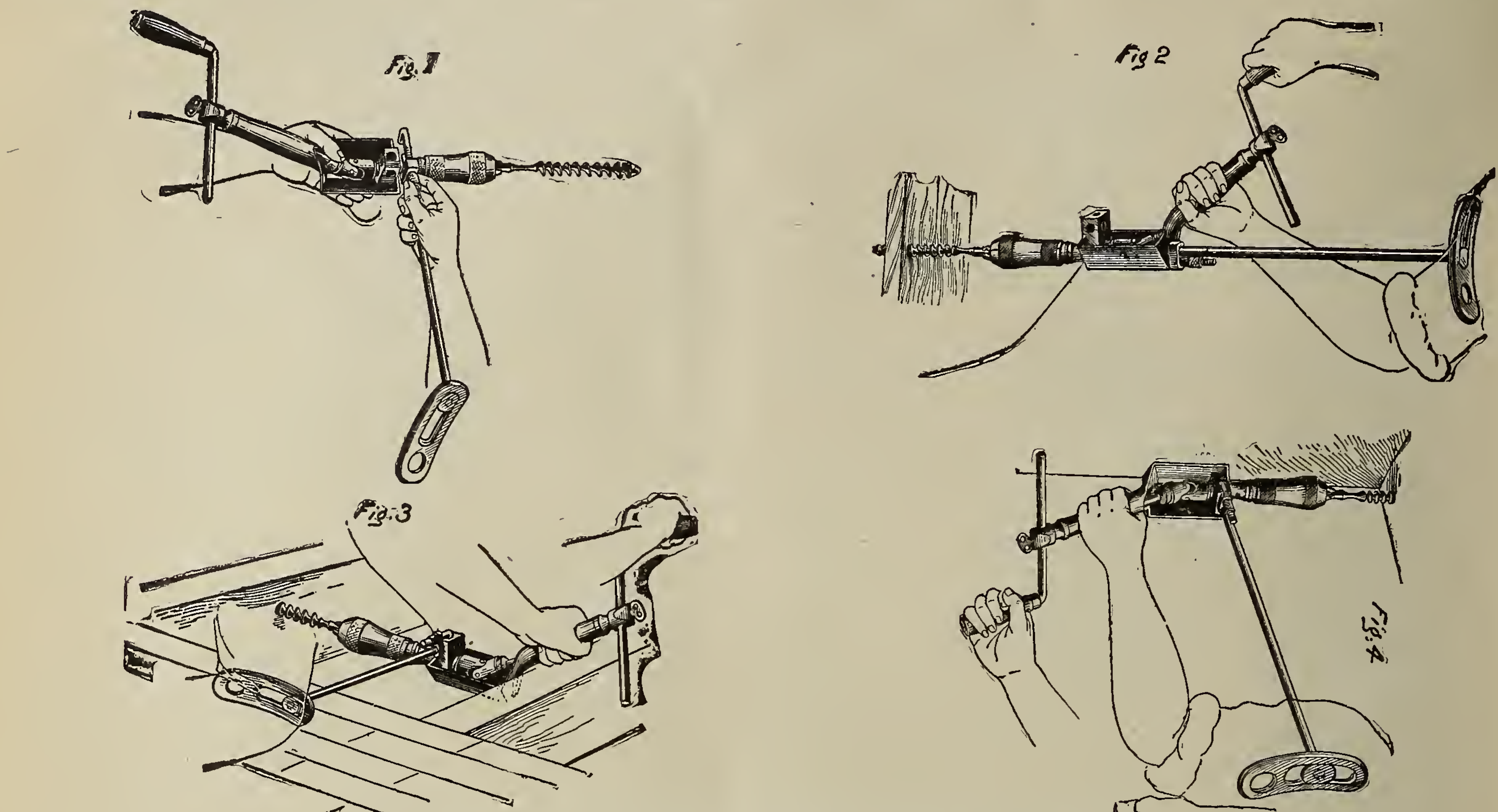
Athens, Tenn.—City Clerk may give information concerning light plant which will be established.

Harriman, Tenn.—A new incandescent light plant will be established.

Winchester, Tenn.—A local telephone exchange will be established at an early day.

A COMBINATION ANGLE AND BREAST BRACE.

The McClellan patent guide frame combination angle and breast brace, illustrated in this article, is used to the greatest advantage in cases where it would be impossible to bore a hole with any other tool. This advantage makes it the superior of all other breast braces. Its use for corner boring makes it unique, and the facilities with which holes can be bored in a limited space with accuracy and speed leaves nothing to be desired in this piece of apparatus. The breast brace can be readily taken apart, the breast rest can be detached and the handle so adjusted as to have a radial sweep of from four to thirteen inches. This article finished with a hardwood handle, either nickleplated or japanned, is for sale by Patterson Brothers, 27 Park Row, New York.



The McClellan Patent Guide Frame Combination Angle and Breast Brace.
Fig. 1 represents assembling the breast rest into one of the positions. Fig. 2 being used as an ordinary breast brace.
Fig. 3 in use boring between joist in floor. Fig. 4 overhead, in corner, or between upper celling joist.

CANADIAN LETTER.

ELECTRICAL NEWS.

Wallaceburg, Ont.—The Wallaceburg Electr ; Light Company contemplate putting in an incandescent plant, having agreed to do so within eight months.

Stanbridge, East Que.—Mr. S. Cornell will install an electric light plant next spring.

Thamesford, Ont.—Electric light is being agitated.

Quyon, Ont.—An agitation is on foot to have better fire protection.

Cambellton, N. B.—The ratepayers have voted in favor of electric light.

Annapolis, N. S.—The by-law authorizing the town to operate its own electric light plant and to borrow $12,000 for the purchase of a plant was defeated by the ratepayers.

ELECTRIC RAILWAYS.

Amherstburg, Ont.—A company in Detroit has made a proposition to build an electric railway between this place, Windsor and Harrow, and want a bonus of $15,000. Mr. Joseph De Curse, C. E., has made estimates for grading, bridges, culverts, etc. Several bridges will be required if the road is proceeded with.

St. Catherine's, Ont.—A company is said to have been formed and plans matured for building an electric railway between St. Catherine's and Port Dalhousie, ready for operating April next. H. D. Symmes, manager of the St. Catherine's and Thorold electric road, is at the head of the new company.

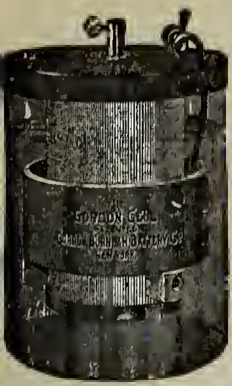
J. ALCIDE CHAUSSÉ.

Port Jervis, N. Y.—The Port Jervis Light & Power Co. will construct an electric plant to cost about $50,000.

Sault Ste. Marie, Mich.—The Edison-Sault Electric Co., president, H. Dunbar; manager, W. F. Kingan; will make improvements to its plant at cost of about $75,000.

Berlin Falls, N. H.—The Northern Electric Co., recently incorporated, will build an electric light plant.

Charlotte, N. Y.—George P. Goulding may give information concerning construction of electric-light plant at an estimated cost of $10,000.



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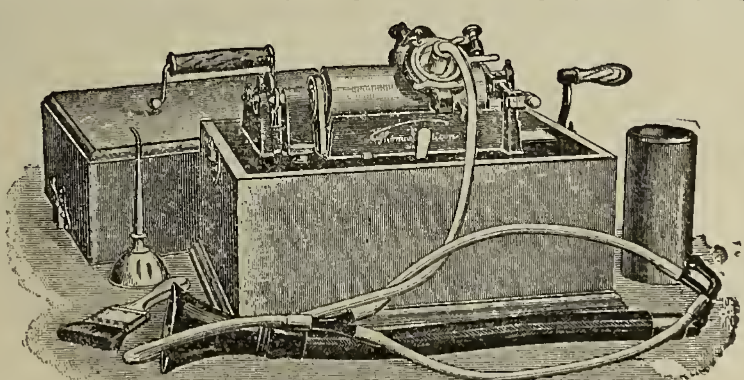

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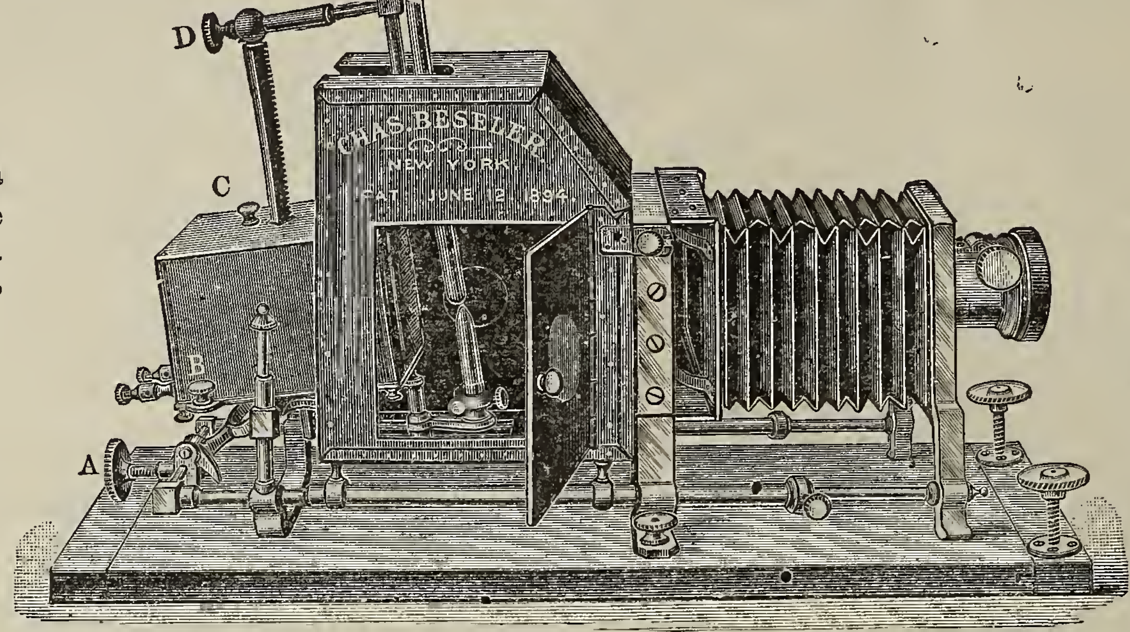
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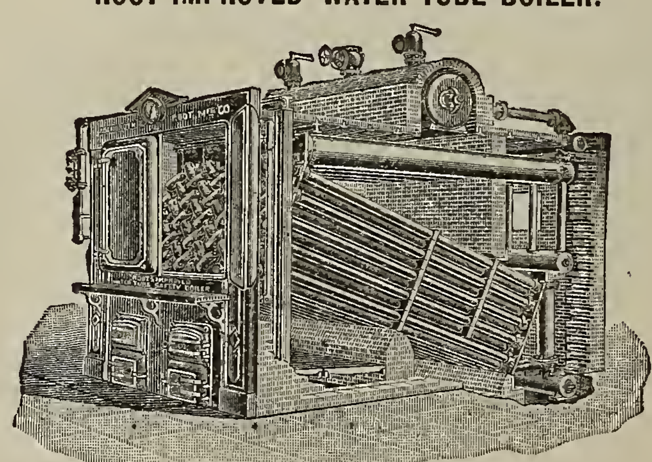
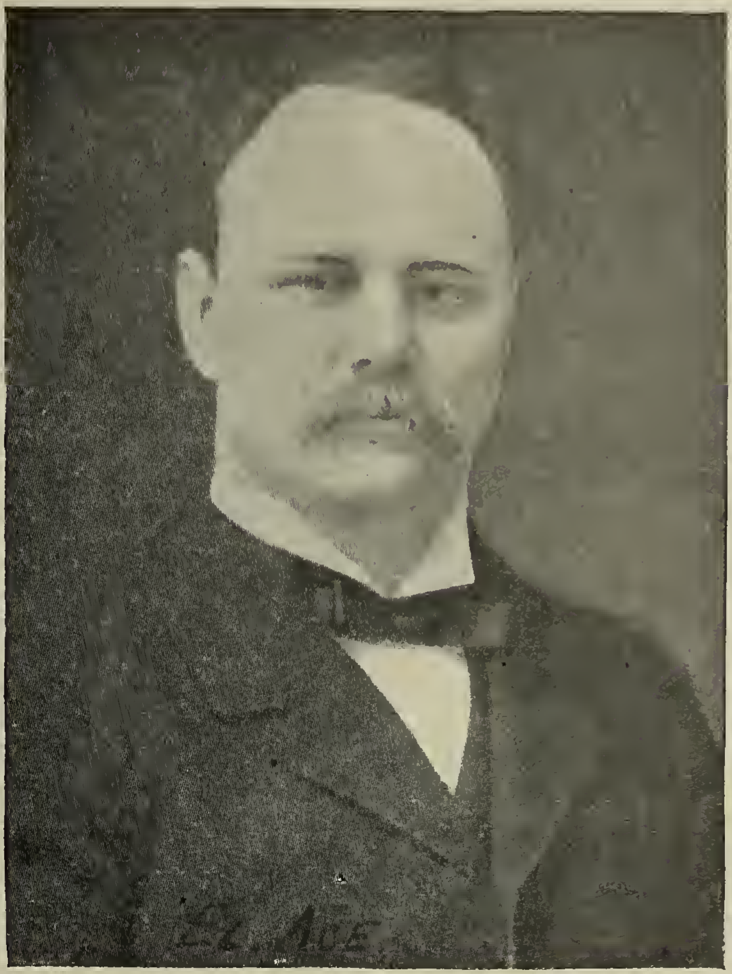


The Electrical Age.

VOL. XXI—No. 25 NEW YORK, JUNE 18, 1898 WHOLE No. 579



Mr. Alden M. Young, of Waterbury, Conn., President of the National Electric Light Association.

MR. ALDEN M. YOUNG, of Waterbury, Connecticut, was unanimously elected President of the National Electric Light Association at the last meeting, held in Chicago. He has been closely allied with the electric light, power and railway business for a number of years throughout New England. He is president of the New England Engineering Co., of Waterbury, Connecticut, whose interests are identified with a number of electric light and power plants throughout New England. Mr. Young was born at Hadley, N. Y., in 1853, being an old telegraph man, like a large majority of the successful men in the electric lighting business. He represented the old Atlantic & Pacific Telegraph Co. in a number of big cities in New York state. In 1878 he took up the telephone and organized a company in Waterbury, Conn., and it became a valuable property. Spreading out into the lighting and street railway lines, everything he undertook became successful. As president of the New England Engineering Co., he is engaged in the building of complete electric light, power and railway plants, steam and gas plants, and construction work of all kinds; secretary of the Waterbury Traction Company; president of the Central Railway & Electric Company, New Britain, Conn.; secretary of the Norwich Gas & Electric Company, of Norwich, Conn., and an officer in a dozen or more electric companies in the states of Connecticut, New York and New Jersey.

Probably the most important and interesting venture originated by Mr. Young is an undertaking now being developed in the Borough of Brooklyn, New York City. In May, 1897, he purchased the franchise of the Kings County Electric Light and Power Company of that city, and immediately started to financiering same, which he successfully accomplished, interesting some of the best-known men of New York and Brooklyn. The capital of this company is two and a half million dollars. The plant is nearly completed and will be one of the best equipped in the country, Mr. Young having given it his personal attention.

The interests with which he is personally identified represent investments running up into millions of dollars, and all paying good dividends. Mr. Young's knowledge of building successful lighting plants will become a big factor in the Association, and the members can congratulate themselves on their choice for presiding officer.

REPORT OF THE PROCEEDINGS OF THE TWENTY-FIRST CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION,

HELD AT THE AUDITORIUM HOTEL, CHICAGO, ILL., JUNE 7–9, 1898.

President Insull, of Chicago, called the meeting to order at 11 o'clock on Tuesday morning. There was the largest attendance ever present at an opening session of a meeting of the association, and the attendance and interest in the proceedings was sustained throughout the convention. There were four hundred delegates and visitors present.

Letters of regret at their inability to attend the meeting were read from First Vice-President A. M. Young, Waterbury, Conn.; Thomas A. Edison and Nikola Tesla, New York; Prof. Bovey, Montreal, and Elihu Thomson, Lynn, Mass.

Invitations to accept hospitalities were read from the

Metropolitan West Side Elevated Railroad, South Side Elevated Railroad, Northern Steamship Co. and the American Telephone and Telegraph Co.

The first paper was on the "Cost of the Generation and Distribution of a Unit of Electricity," by Calvin W. Rice, of Brooklyn, N. Y.

In the discussion on this paper a question arose as to the comparison of the losses between gas and electricity. Mr. Barker, of Boston, said that the occasion for loss in the gas distribution was largely leakage in the pipes; the matter of condensation loss was reduced to a low percentage, with the improved appliances in the production of gas. Mr. Coggshall, of Fitchburg, stated that the loss of output by alternating current from the 1st of January to the 1st of April was 53 per cent.; the loss existed largely in the transformers. Mr. Wagner, of St. Louis, thought the meters might not have registered the full amount of current used. Mr. Coggshall agreed with him; they had put in meters which required twenty lamps to make them register at all. President Insull then exhibited a chart illustrating the operating expenses of the Edison Chicago station, in which he showed that the most important point is the interest cost; you might have all your operating expenses, outside of interest, presented to you, and then you could lose money; it would be possible to do such a thing, if your selling price is not on the right basis. He said that it was generally supposed that the best business is the power business; that you could afford to sell power at one-half the price, if your current was not going to be used for light; it was found that the power curve and the light curve cross each other for sixty days during the winter, and the claim that was made for the power business proved a great fallacy.

Mr. Dow, of Detroit, gave an interesting account of the operation of the Wright demand meter. The Wright demand meter is so far the most satisfactory method of recording the maximum that a customer takes at any time; the principle is the same as that which governs the registering thermometer, the style of thermometer which not only shows the present temperature, but which, at the highest point it reaches, leaves a little globule of the colored alcohol, so that any one on inspeting the thermometer can tell, not merely the present temperature as he can by looking at any other thermometer, but he can tell to what point the alcoholic column has risen since the thermometer was last set. The setting is accomplished by shaking down the retained globule, and the process of resetting in the Wright meter is the same. The metre has a fluid which is expanded by the electric current, and it leaves an indication showing that some time since you last set the meter the cnstomer has used current to a certain extent, not that he has used so many watt hours, but that at one time for several minutes he called for so many amperes and used it simultaneously. That indicates the largest amount of machinery you have to install to take care of the customer.

Mr. Ferguson, of Chicago, said that their business had largely improved by the use of the meter, and they cannot get instruments fast enough; he thought that any company could well afford to buy the meters, even if they had to borrow the money. Mr. Weeks, of Kansas City, stated that in the cost of our product the relative value of the interest factor has been forcibly and clearly shown, and the necessity for revision of rates or discounts has been ably demonstrated. He thought it was somewhat inequitable to make a lower rate for transient summer service, such as that of the customer who operates a fan but a few weeks or months at most in the year, while his rate on account of the interest factor should be higher rather than lower than that for most other classes of service. Mr. Ferguson being asked as to the effect of the Wright meter system on municipal service, said that it would not get as low as it is being sold now. It could be readily seen that if the rate is twenty cents the first hour, and ten cents for everything after that, the maximum discount will not reach 50 per cent.; it is something higher than that now. It is the same as if you make the rate ten cents per kilowatt hour. You will have to make the second rate low enough so as to figure out the same kilowatt hour as you are now charging for the arc-light service; that must be arranged for in each individual city.

At the Tuesday afternoon session, the paper by Mr. Alexander Dow, of Detroit, on "Public Lighting, with Relation to Public Ownership and Control," was read, followed by papers on the same topic by Samuel Scovil, of Cleveland, and H. M. Atkinson, of Atlanta. At the conclusion of the reading of these papers the convention adjourned to executive session.

The first business of the Wednesday morning's session was the reading of two papers—"General Distribution from Central Stations by Alternating Currents," by Herbert A. Wagner, of St. Louis, and "General Distribution from Central Stations by Direct Currents," by Louis A. Ferguson, of Chicago.

The discussion on these papers was opened by Prof. Fujioka, of Japan, who gave an interesting account of the electric lighting installation in the city of Tokyo, Japan, where they used the Edison three-wire system. Their cost of production was high, as coal there costs six dollars a ton.

In answer to a question, Mr. Wagner said that by making the transformer practically an integral part of the feeder, they eliminate all the effects of transformer dropping, just as they do the feeder drop by regulating the pressure wires from the feeder terminal, which become the secondary terminals of the transformer, so that they can sacrifice the regulation of the transformer to secure a very low iron loss; a poorly regulated transformer is very much better for use in a system where transformers are connected in multiple, provided the pressure for each transformer can be regulated independently; the transformers of very close regulation, one per cent. or under, are connected in multiple, with two or three hundred feet of mains in between, and unless the resistance of the mains is extremely low, the transformer will not handle the load, unless it is uniformly distributed along the main. Prof. Goldsborough, of Purdue, Ind., said that if a system of sub-stations could be devised and a number of transformers placed together, and a set of feeders could run from the central station to the sub-station and some of the transformers could be cut out, that there would be a gain there, and a certain number of the feeders would be used in common with a certain number of transformers. In that arrangement you would have less core losses, and consequently you would have improved efficiency in the lower loads. Mr. Rice, of Brooklyn, mentioned that he had visited the stations at Salt Lake City and Sacramento, and spent several days with the designing engineers of both cities, and they both claimed superior efficacy and elasticity for the Edison three-wire system. They have the three-phase four-wire distribution. He thought that Mr. Wagner's example of the alternating plant was unfortunate, in that it does not represent an alternating plant of the latest design. It was now past discussion, he said, that alternators may be thrown in parallel, the same as the continuous current generators. The use of motors is a feature which is coming into prominence, but the alternating motors have not been developed and applied the same as continuous current motors, because they had not lived long enough; in time he expected to see alternating current motors distributed as widely and as universally as continuous current motors. The same idea applies to the arc lamp; we have had arc lamps for a great many years on the continuous current system, but only recently have they been developed and made acceptable on the alternating current system.

(To be continued.)

HEAVY ELECTRIC RAILROADING PROPOSED IN FRANCE.

An enterprise involving the expenditure of not less than forty million francs, or eight million dollar,s, and the creation of a road, about 2½ miles long, partly underground, to be operated exclusively by electricity, is about to be undertaken in the city of Paris by the Orleans Railroad. The main terminal of this railroad, which operates about 4,300 miles of track in the West and Southwest of France, is at the Place Valhubert, near the Pont d'Austerlitz and the Jardin des Plantes, in the extreme east of Paris.

The travelling population of Paris does not live in the eastern part of the city but in the western, in which direction the city is steadily growing, and access to the present Orleans station in most cases involves carriage transportation. The Orleans Company has, therefore, decided to prolong its line into the very heart of Paris, and for this purpose has secured a right of way underground to a point on the left bank of the Seine opposite the Garden of the Tuilleries, where it will erect a terminal station. Visitors to Paris, since the year 1872, have had the ruins of the Cour des Comptes pointed out to them as an example of the ferocity of the Commune ; it is on this spot that the new Quai d' Orsay station of the Orleans Railroad is to be erected.

The new road will have two tracks and will drop from the Valhubert station on a grade of 1.1 per cent. towards the Seine. Here the river banks are in two stories—an upper quay or roadway, and a lower quay used as a dock or wharf for canal boats. A belt nine meters wide has been secured on this lower quay, and the line will follow this in the open for 650 meters. It will be an underground road beneath the upper quay for the remainder of the distance until it reaches the terminus under the Cour des Comptes. Openings in the wall side of the quay facing the river will afford light and ventilation. The rail level is about that of the normal height of the water; any seepage water in times of flood will be gathered in a sump and drained out.

The road follows the line of the Quai's St. Bernard de la Tournelle, de Montebello, St. Michel, des Grands Augustins, de Conti, Malaquais and Voltaire to the Quai d'Orsay, passing the bridges Austerlitz, Sully, de la Tournelle de l'Archeveche, au Double, St. Michel, Neuf, des Arts, du Carrousel, Royal and Solferino. From the Pont Sully to the Petit Pont the underground construction will be a masonry arch of nine meters span for a length of about 900 metres. From this point, for another 500 metres, the upper roadway will be caried by a metallic arch, and for the balance of the distance the masonry arch construction will be resumed with a span of about eight metres.

About half way between the Place Valhubert and the Quai d'Orsay, between the Petit Pont and the Pont St. Michel, a station will be built, known as the station du Pont St. Michel. The Quai d'Orsay station, the terminal station, will lie between the buildings of the Caisse des Depots at Consignations and the Palais de la Legion d' Honneur and between the Pont Royal and the Pont de Solferino. It has been designed by M. Sabouret, Chief Engineer of the Central Service. The Orsay station will have fifteen tracks, any one of which can be used for arriving or departing trains. According to the present plans, the three tracks nearest the river will be used for side tracks, the next four tracks for long distance departing trains, the next two for arriving and departing suburban trains, the next two for arriving long distance trains, the next two for arriving and departing suburban trains, and the last two stations for station service.

The platforms of the Pont St. Michel station will be 230 metres long. Those of the Quai d'Orsay station 185 to 240 metres long and six to seven metres wide. They are, of course, raised to the height of the footboard of the cars, so that these may be entered directly from the platform. The arriving traffic will come in from the Rue de Bellechasse and the Rue de Lille, and the departing traffic will be concentrated on the Quai d' Orsay. A number of elevators will be installed to facilitate movement of passengers and baggage.

The rail level is 25 feet below the street level. The company has not been obliged to purchase the title to the surface, the structure overhead being carried by a

Test Train at General Electric Co.'s Works, Schenectady, N. Y.

metal roof construction guaranteed by the company. The building above the station will probably be occupied by a large hotel and will, of course, be in harmony with the buildings in its vicinity. The design of M. Laloux have been selected and approved by the Minister of Public Works.

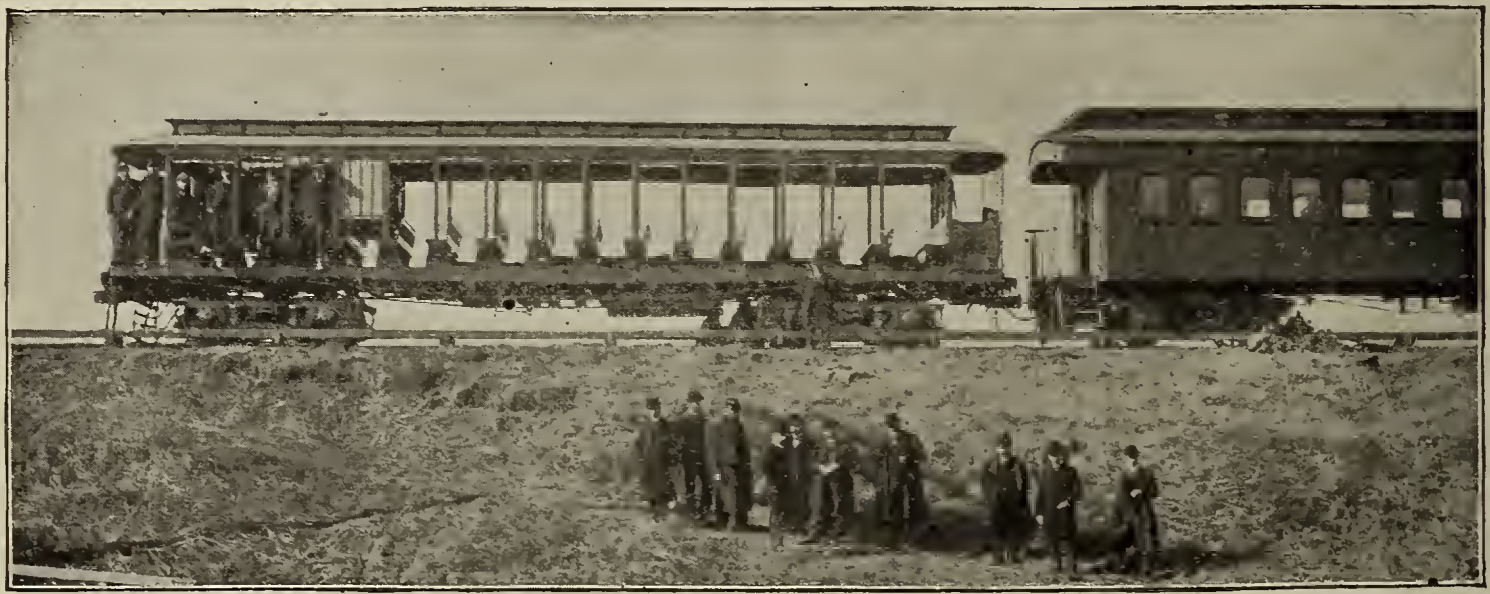
A short distance west of this station is the terminal station of the Ouest Railroad at the Invalides, and still further west is the small station of the Champ de Mars, the former a part of the main line of the Ouest Railroad, the latter an off-shoot from the Ceinture or Belt Line which encircles Paris. These stations will probably eventually be joined to the Quai d'Orsay station of the Orleans road, thus uniting the Ouest, Ceinture and Orleans systems.

In driving the underground tunnel, the Orleans Railroad will operate without interference whatsoever with the street traffic. The earth overhead will be supported by a metal shield pushed forward by hydraulic presses and followed closely by the masonry. The method is similar to that employed in building the great sewer recently laid down in Paris.

The operation of this underground road, as at present contemplated, is to be carried on by means of electric locomotives driven by continuous current at a pressure of between 500 and 700 volts, using the third-rail system of contact. In asking for estimates, however, the company has requested bidders to submit plans also for the use of systems of generation and distribution other than that just mentioned. The locomotives are to be eight in number, all alike, and able to haul a train of 250 French tons in seven minutes between the stations of the Quai d'Orsay and the Pont d'Austerlitz without stopping at the intermediate station of the Pont St. Michel. This means a speed of 45 k. m. an hour. The locomotives should not only be able to haul a train of the weight mentioned on a grade of 11 m. m. and on curves of 200 metres radius, but should also be able to haul trains as heavy as 300 tons at a slower speed. The locomotives must be built to move in either directions at the same speed, and be of a length to allow them to be turned on turn-tables six m. 20 c. m. in diameter. They are to be equipped with motor-driven air pump for air brakes.

The electric generating station will be placed at the western end of the Valhubert station departing platform, taking the place of certain waiting rooms. The equipment is to be of sufficient capacity to allow of the simultaneous movement of four 200-ton trains, exclusive of the locomotive, upon the line—one starting from Austerlitz station, one from the Quai d'Orsay station, the third climbing the grade of 11 m. m. and the fourth running between the Pont St. Michel and the present main station. Furthermore, the generating plant must include sufficient lighting capacity for three stations already mentioned and the tunnel as well as for the station and shops at Ivry. The current is to be taken by the locomotives from an insulated third rail at the side of the track in the stations and between the tracks over the rest of the line, due provision being made for all switches and crossovers.

In order that a better knowledge of the operation of electricity in heavy traction service might be gained than was possible in Europe, the Orleans Company recently sent over to America a corps of engineers to investigate the different electric railway installations of this type in this country. The party was headed by M. E. Solacroup, assistant chief engineer of material and traction, and M. Sabouret, already mentioned, the other members being Messrs. Hiberty, Fremenville and Walton. Their inquiries were conducted very quietly, but during their short stay they were able to visit almost every installation of special interest to them in the United States. The investigation was begun at Hoboken, where an electric locomotive is hauling all the freight service between the transatlantic docks there and the West Shore and Erie Railroads. From there they visited Baltimore, to inspect the great electric locomotives which operate the entire traffic of the B. & O. Railroad through the Belt Line tunnel in that city. From Baltimore they went to Chicago, for the purpose of observing the operation of the electric elevated railroads, and, returning East, passed through Cleveland, Niagara Falls and Buffalo, where they had an opportunity of studying the employment of the electric car in high-speed interurban service.



Group of French Engineers and the Test Train.

From Buffalo they travelled to Boston where they were met by C. P. Clark, President of the New York, New Haven and Hartford R. R. and Colonel N. H. Heft, Chief Electrician of the same road. They travelled on the Nantasket Branch of the New Haven system between East Weymouth and Hull, and inspected the power-house. Returning they visited the third-rail electric system between Berlin and Hartford, Conn., opened for traffic last summer, and rode on the 30-ton electric locomotive operating between factories at New Haven and the Cedar Hill Junction.

A special test was arranged for their benefit at Schenectady on the experimental two-mile track of the General Electric Company, the conditions of the track and load being, as far as possible, similar to those which will obtain on the line in Paris. A length of track was marked off 1.11 of a mile long, by two white flags, corresponding to the distance between the Quai d'Orsay and the Pont St. Michel stations, the most difficult portion of the proposed Orleans extension. According to the time schedule arranged for the operation of the road, this distance should be covered in three minutes and fifty seconds. A train was made up of a motor car of the Nantasket Beach pattern, equipped with four G. E. 55–175 H. P. motors as locomotives, several New York Central coaches and seven flat cars loaded with pig iron, making a total train load of 320 tons including the motor car, which weighed 45 tons. The run between the flags, including starting and stopping, was made easily in three minutes and twenty-five seconds, giving a margin of not less than twenty-five seconds to the good. The diagram on this page shows the acceleration curves of this run.

The question of rendering the third rail innocuous after the passage of the train having been brought up, the General Electric Company arranged an exhibition of its method of effecting this result. A section of the third rail was measured off and divided into sections in lengths varying from 30 ft. to 500 ft. Connections were made between these and a system of automatic switches, and the conditions of the General Electric system of surface contact, almost exactly reproduced. By this system, the arrangement of circuits is such that the sections into which the rail is divided may be of any length from that of a few feet to any number of miles, that is, any section of the conductor rail will be alive only when the train itself is running over that section. The instant the train passes to the succeeding section, that which it has just left becomes dead and absolutely innocuous. The use of this system also renders it possible to "section" the conducting rail at stations, leaving it continuously alive at all intermediate points. The switch cutting the dead section into circuit is closed as the contact shoe of the train comes into contact with the conductor, energizing it, and is automatically opened as the train passes to the next dead section.

The motor car was run over that part of the track beside which the third rail was sectioned, and as a visual means of indicating that the third rail was alive a number of incandescent lamps on top of the boxes containing the switches were connected to the conductor. As the car reached the sections and rendered them alive, the lamps lighted up, being extingushed as the contact shoes passed over the dividing lines between the different sections.

These tests formed the subject of the concluding investigations of the French engineers in this country. A few days before their departure a dinner was tendered to them at Delmonico's, at which many prominent railroad engineers and electricians were present to meet them. They admitted having received many new ideas during their stay; and return to France convinced of the use and possibilities of electricity as a motive power, especially in the field of heavy traction.

OPENING ADDRESS BY SAMUEL INSULL, PRESIDENT. *

MEMBERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Ladies and Gentlemen:

In calling to order the annual convention of your Association my dual capacity presents somewhat of an embarrassment to me. I am in doubt whether as president to enlarge upon the great growth of this Association since its formation in this city on February 25, 1885, or whether as a resident here to dwell at length upon the marvelous growth of the city in which we meet. Chicago and the industry with which we are identified have a somewhat close connection. The growth of the former, if measured from the point of view of the rapidity with which history is made, is, so to speak, the product of yesterday. The electrical industry, or rather that portion of it with which we are associated, is but little more than the product of to-day. If the growth of this city and that of our own industry is as great during the next thirteen years as the progress that they have achieved since the date of your first meeting here, I am sure that both the citizens of Chicago and the members of your Association will have every reason to congratulate themselves. Speaking for those of my friends connected with the electrical industry in Chicago, and also for myself, I can assure you that it affords us very great pleasure to welcome you at this convention, and the fact of your meeting in this, my home city, enhances not a little my high appreciation of the privilege of presiding on this occasion.

The officers of your Association have had in mind in preparing a programme for this convention the importance of bringing before you subjects of interest in connection with central station management, and the papers to be read at our various sessions and the topics mentioned for discussion cover such a wide range that it would seem undesirable for me to occupy much of your attention by way of introduction. The various gentlemen who have so kindly consented to read papers will deal with such important questions as the cost of generating and distributing the product which we manufacture, transformer economy, and the rival claims of alternating currents and direct currents as means of distribution. The many problems which you have to solve in connection with the question of public lighting and the cost of producing electrical energy by water power will also be discussed.

Standard vs. Special Machinery.

A matter which has called forth during the last year considerable discussion is the question of the use of standard apparatus and the tendency towards the specification of special machinery on the part of electrical engineers. This course is not by any means confined to large work, but is followed by some engineers whether they are designing a small isolated plant or are projecting a large modern central station. It would seem to me to be of paramount importance to the manufacturer and user that both should co-operate in eliminating as far as possible from the business the necessity of building and using special types of machinery. This can only be done by the adoption of standard specifications for various standard types of apparatus. A committee of the American Institute of Electrical Engineers has already taken this subject under consideration, and I believe that we will be serving alike the interests of the manufacturers and users of electrical apparatus if we will take some action with a view to co-operating with the institute and other bodies in this matter. In drawing attention to this subject, I speak with an appreciation of the position of both manufacturer and user, having had more or less connection with the manufacture of electric apparatus and the manufacture of electric current. Constant duplication of parts resulting in constant duplication of a given piece of machinery means, as any manufacturer will tell you, constant reduction in cost. Variation from a given type means increased cost and even the wiping out of an apparent profit.

In the last year or so there has been a great deal of discussion in England prompted by the success of American manufacturers in obtaining large contracts for electric traction work in Great Britain, and the inquiry has often been made, how is it possible for American electrical manufacturers, with high wages against them, to compete with English builders, whose scale of pay to their workmen is on a very much lower basis. If you will examine into the amount of electric traction machinery manufactured in this conntry under a system of constant duplication and the use of special tools, and then visit the electrical establishments on the other side of the water and note the tendency there towards specializing each particular job, you will soon recognize that the reason for low cost and consequently low selling price on

(Continued on page 344.)

* Delivered before the National Electric Light Association at its twenty-first Convention, held at Chicago, Illinois, June 7th, 8th and 9th, 1898.

N. E. L. A. CONVENTION EXHIBITS AND ATTENDANTS.

The National Carbon Company was represented by Richard O'Connor, with a neat line of samples.

Chas. A. Schieren & Company were represented by A. W. Watriss, with all styles of belts in his pockets.

Wallace Electric Company had a nice exhibit, and the guests and friends were well attended to by Messrs. Hine and Barr.

Messrs. Varney & McOuat, electrical novelty men of Indianapolis, were represented by G. E. Varney.

L. H. Rogers told the people how much better Fort Wayne lamps would burn than any other competitor.

The Culter-Hammer Manufacturing Company showed their most excellent circuit breakers and motor starters, and had the same explained by Mr. Culter, of the company.

Mr. S. M. Hamill, of the Brush Electric Company, disappointed his many friends by his absence.

The Zamell Arc Light Meter Company, of 266 Blue Island avenue, Chicago, Ill., was represented by A. G. Zamell.

President Marsh and Western Manager Hill made their presence known by presenting the great merits of the Bryan-Marsh lamp.

The National Conduit & Cable Company, of New York, was well represented by G. J. Jackson, the original paper cable man.

An array of talent was seen at the convention in the representatives of the Triumph Electric Company, of Cincinnati. They triumphed in every way.

The Washington Carbon Company, the well-known makers of pencil and battery carbons, were represented by J. S. Crider, the secretary of the company.

Mica was never shown to better advantage than at this convention. Mr. John Child, the western representative of A. O. Shoonmaker, of New York, exhibited a beautiful specimen, 32 inches by 14½ inches, which attracted considerable attention.

Messrs. Partridge & Speer, of the Partridge Carbon Company, were missed at this convention. Many inquiries were made for them.

The Fort Wayne Electric Corporation was never better represented than at this convention, by Mr. F. A. Wunder.

The delegates and friends at this convention were well looked after by Mr. Chas. Holmes, manager of the supply department of the Chicago Edison Company.

All the gentlemen attending the convention, members and guests alike, expressed great pleasure for their kind treatment by the management of the Auditorium Hotel.

The American Carbon Company, Noblesville, Ind., was represented by Edmund Dickey.

The Royal Electric Company, Peoria, Ill., were represented by Mr. G. Luthy and Electrical Engineer Scheefer.

Hart switches were well displayed by Geo. S. Searing.

Chas D. Shain was on deck as usual, so that we did not misprint his face even if we misprinted his title. He was received by the usual delegation of friends.

Messrs. F. H. Smith, manager, of Pittsburg, and C. A. Ross, of Chicago, attended to the beautiful exhibit of incandescent lamps of the Sawyer-Man Electric Company.

The Northern Electric Manufacturing Company, of Madison, Wis., were there in the person of Edward Kohler.

The Standard Underground Cable Company, of Pittsburgh, Pa., is well looked after by Mr. J. R. Wiley, manager of the western sales department. He was assisted by Mrs. Paterson and Miss Wiley, his two favorite sisters.

The American Electric Heating Corporation, of Cambridgeport, Mass., was looked after by General Manager J. I. Ayer.

The Westinghouse Electric & Manufacturing Company's interests were well looked after by Mr. Arthur Warren, the new manager of the advertising department. We wish him success in his new position.

The Munson Belting Company was never better looked after than by the favorite among the boys, Col. Shay. Electric light men like him for his suave manner.

Henry C. Adams, Jr., the secretary of the Phillipps Insulated Wire Company, was on deck.

President John C. Boss, of the Lakon Company, of Elkhart, Ind., manufacturers of transformers, was kept busy answering the inquiries of possible buyers.

J. C. Shainwaldt, of P. & B. paint popularity, was on hand and well received.

Mr. Frank DeRonde, manager of the Standard Paint Company, makers of the famous P. & B. brand, is greatly missed at this convention. He is now captaining his Jersey Company at Tampa, Fla., ready for a Cuban invasion.

President H. B. Cutter, of the Cutter Electric & Manufacturing Company, of Philadelphia, was on hand and kept busy throughout the meeting.

Capt. Willard L. Candee and Geo. T. Manson, the two famous Okonite wire men, had their usual new souvenir in the shape of a beautiful miniature girl. Of course, everybody wanted one. Who wouldn't? Messrs. Candee and Manson were never in greater demand.

The Walker Company were represented by J. H. Gates, G. B. Foster and C. H. Philbrook. These three popular gentlemen found it necessary to keep open house, as they had a constant stream of guests during the convention.

The Mica Insulator Company, of New York, was represented by Chas. E. Coleman, of Chicago office.

The Northwestern Electrical Association was honored throughout the convention by Thos. R. Mercine. He kept the N. E. L. A. people thoroughly aroused to the fact that he was looking out for the interests of his association and their trip to Duluth.

H. H. Brooks, of the American Circular Loom Company, of Boston, was on hand as usual, and had no time for anything except business. We would like very much to receive one of those smoking outfits he presented to his many friends as a souvenir of the convention.

Col. S. G. Booker, of the Phœnix Carbon Company, St. Louis, was there during the convention.

Mr. N. E. Baird, of the Eddy Electric Manufacturing Company, was largely in evidence at this convention.

Manager Gilmer, of the Warren Electrical Specialty Company, Warren, O., was well pleased with the convention.

The Crouse-Tremaine Carbon Company and the Fostoria Incandescent Lamp Company were well represented by J. B. Crouse, the president.

The Sterling Arc Lamp Company, of New York, was well represented by R. J. Randolph, the manager. Mr. Randolph exhibited a fine line of enclosed arc lamps. He was right at home in Chicago.

The Armorite Interior Conduit Company was represented by the king of good fellows, Mr. James F. Cummings. Mr. Cummings also represented the Cummings Conduit Company, of Detroit, makers of a new tube, for which he makes great claims.

Edward H. Johnson, one of the most popular electrical men in this country and vice-president and general manager of the Sprague Electric Company, of New York, was a welcome member and exhibitor at this convention. He was assisted by Mr. Chas. A. Benton, of New York, and E. B. Kittle, western agent. Mr. Johnson and his assistants took all the members of the convention and their friends on a trip over the Alley "L" road to show them the new Sprague multiple-unit system. Mr. Johnson never enjoyed himself more than at this convention and was highly elated over his visit.

The Electrical Age.

Established 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

First Floor, World Building.

NEW YORK.

NEW YORK, JUNE 18, 1898.

CONTENTS.

ELECTRIC TRACTION ON TRUNK LINES.

At a lecture delivered some time ago before the American Institute of Electrical Engineers, the possibilities of electric traction at high speed were discussed by several eminent electricians. The conclusions reached were valuable, inasmuch as the immediate application of electric power to trunk lines was considered practical at so great a speed as one hundred miles an hour. Messrs. Crosby and Bell, the builders of an experimental line on which they had reached the velocity of one hundred and twenty miles an hour, mentioned, as the results of their own experience, that the road-bed, shape of locomotive, diameter of driving-wheel and several less important factors had an immense influence over the rate of speed attained and power consumed.

To quote from the paper treating of high-speed railroading, we find the following statement of great importance, "for the mechanical construction of the locomotive * * * . One had a twelve-foot rigid wheel base and no pilot wheels; the other had a seven-foot wheel base and a pony axle in front, free to move laterally over a certain distance, dragging the drivers in the same direction.

"This is the general principle of pilot wheels so largely used on high-speed engines. The second arrangement is preferred, for in it nearly all the weight goes on the drivers." In a volume written by Crosby and Bell, entitled "The Electric Railway," the fullest details of their work are given, which to even the casual reader will be of the greatest interest as marking a departure from the beaten path and an effort to increase the speed of electric railroading in a manner extremely practical. Mr. Crosby's opinion in relation to high-speed railroading is to the effect that the chances of derailing a train increase with the speed, but if the centre of gravity of the cars is very low it would be very difficult to cause an accident where the track is perfectly straight.

Another statement by Mr. Crosby is a very important one, as it regards track construction in a rather new light. The weight of the train and the state of perfection of the road will have everything to do with the speed which may be obtained under the circumstances. With a road built with rails of heavy steel, rigid enough to support the weight passing over them without bending, etc., a speed of one hundred and twenty miles an hour would be well within the limits of safety. Mr. Carl Zipernowski has offered plans for the construction of a road, the cars on which would move at a speed of one hundred and twenty-five miles an hour, between Buda-Pesth and Vienna. This road is to be devoted entirely to passenger service and would be built according to the latest scientific principles.

One of the difficulties, however, in high-speed railroad work would be the pressure used. About six thousand volts is not thought too great for the purpose; but this and other details would naturally adjust themselves when a road of this kind is under immediate contemplation. The great trunk lines of the United States are at present the fastest and most comfortable of any in the world, but they are objectionable because the speed is limited to an average of fifty miles an hour, and the coal dust thrown out by the locomotive is a great discomfort to travellers. The proposition to equip these lines with electric power has already come from two great corporations, not, however, with the intention on their part of operating at a higher rate of speed than at present. That is the objection.

Although the efforts of Mr. Crosby and others have been recognized as tending towards a solution of the important problem of high-speed train service on trunk lines, sufficient confidence in their work has not been established to make the present steam railroad corporations feel encouraged enough to make an investment of any amount. Consequently, it will be absolutely necessary for the promoters of high-speed railroad work to offer, as absolute proof of the success of any such undertaking, a comparatively short stretch of road upon which all sorts of tests may be made of a scientific, technical and general nature.

Certain tangible rumors have been afloat in the past to the effect that a line stretching from St. Louis to Chicago would be built at a speed running at one hundred and fifty miles an hour. While no value is placed upon these rumors by practical men, they at least show that the matter was under some consideration by capitalists, which might in the future develop into a serious undertaking. Although propositions of this kind may be built upon the flimsiest foundations, we thoroughly believe in the immediate possibility of establishing electric trunk lines upon which trains would fly back and forth at twice the speed of our proudest example of steam railroading, the "Empire State Express." The great corporations merely seem to be holding back at present before increasing their investment, or in any way transforming their road, simply because they require for their own individual satisfaction an electric road upon whose operation and construction they will be enabled to calculate the expenses and income incurred by any further development of that system.

The time for that transformation is at hand, and the attention of the civilized world is focused upon the builders and promulgators of electric railway enterprises.

Serial articles will be continued next week.

Spanish Mills.—The Massey Station Telephone Company propose to build a telephone line from Spanish Station to Spanish Mills. H. L. Glover and R. H. Harvey are interested.

this side of the ocean is brought about by the fact that in America this class of work is largely designed by the manufacturer, and as a natural result is the duplicate of something already produced, whilst on the other side of the Atlantic the builder of the machinery works from the plans of the electrical engineer, which necessitates his producing something different to fill each different contract. In one case the machinery is really manufactured; in the other case the builder runs a jobbing shop. Unfortunately, during the last few years American users of electrical apparatus have somewhat departed from the pursuance of what is really a fundamental principle of American manufacture, namely, the use of existing types which are turned out in large quantities with special tools with a view to the lowest possible cost of production. The electrical engineer for the purchaser has been permitted to draw up specifications which have tended towards the specializing of apparatus, necessarily interfering with rapid manufacture and low cost of the product. The disadvantage to the manufacturer is apparent. It is turning our large electrical works from manufacturing establishments into jobbing shops, cutting down their capacity, increasing their labor cost, and lengthening the time that it takes to produce a given article. Looking at it, therefore, from the point of view of the manufacturer, the capacity of his plant is reduced and consequently his interest and general expense cost is higher; his labor cost is increased; and if he finds himself unable to increase his selling price, his shop must be run at a loss instead of at a profit.

The user is necessarily interested in low cost of production on the part of the manufacturer, as he cannot expect to purchase apparatus except at prices which yield a return to the maker. From this point of view alone it would seem to me to the interest of the user that he should co-operate with the manufacturer with a view to standardizing apparatus, eliminating unnecessary variations from a given type, and providing specifications for machinery calling for a given capacity at a given efficiency. Such a course would lead to low cost of manufacture and consequently low selling price, coupled with rapid production.

Another objection to special apparatus is the expense and delay in obtaining duplicate parts in case of breakdown. The fear of delay under such circumstances often necessitates the user carrying the duplication of his plant to a point entirely unnecessary when standard apparatus is used. Capital investment and consequently interest cost is thus increased, not only by the purchase of apparatus which of itself is expensive to build, but also by the duplication of investment which I have pointed out must of necessity follow.

A further point which should be borne in mind in connection with the lack of standard specifications is the opportunity that it gives to the unprincipled manufacturer to dispose of his second-rate apparatus to the uninitiated. We talk of a machine having a given capacity; but under what conditions should it operate to develop this capacity and how often does it occur that a dynamo machine is rated entirely too high and at the cost of its efficiency? How much miscellaneous material used in connection with the industry is absolutely unfitted for the purposes for which it is sold? Surely all of us, manufacturers and users, are interested in maintaining the highest possible standard of work and eliminating alike from our central station systems and the installations for our customers worthless appliances whose only recommendation is their apparent cheapness, whereas, as a matter of fact, they are really the most expensive that can be bought, because they are unfitted for the purposes for which they are intended. A proper consideration of this subject would not embrace alone the apparatus we are ourselves in the habit of buying for use in connection with our plants, but also the appliances used in connection with customers' house wiring. It should be borne in mind that faulty apparatus from one cause or another resulting in the stoppage of the service of one or more customers is, in the mind of the user of the current, set down to the unreliability of the system as a whole. A central station customer seldom discriminates between a contractor who supplies a worthless device and a company supplying him with current. Standard specifications should therefore cover not alone the machinery used, but also the devices and material forming part of a customer's installation. This association has addressed itself at various times to the consideration of questions in connection with house wiring and has co-operated with the National Board of Fire Underwriters and other bodies with a view to establishing rules to be followed by contractors. I strongly recommend that this matter be taken up on a broader basis than heretofore, and that in conjunction with the technical societies we invite the co-operation of the electrical manufacturers with a view to standardizing apparatus and the specifications therefor, whether for use in the central station itself or in connection with the distributing system.

I do not want my remarks on this subject to be taken as in any way censuring the many electrical engineers who have by their special training and natural ability done so much to develop the industry with which we are connected. From my experience I am satisfied, however, that, from the point of view of the user, the designing engineer who adapts his requirements to the standard apparatus of a first-class manufacturer, is able to produce a plant of more satisfactory character and more economical to operate than that designed by those engineers whom I regret to say are sometimes influenced by the desire to use machinery which they can claim as their own handiwork, rather than use something that would be quite as satisfactory and has the advantage of being the regular product of an established manufacturer.

The consideration of the subject of standard specifications would naturally include the preparation of specifications with relation to the manufacture of incandescent lamps. For several years past a committee of this Association has had the subject under consideration. It has been found practicable by a number of large central station companies connected with another association and buying from one manufacturer, to purchase their lamps under specifications which provide for the testing of samples of the product of the factory, the payment for lamps supplied being based on the results of the tests. It seems to me that it would be possible to adopt standard specifications under which our members could purchase their lamps from any reputable lamp manufacturer. The importance of this matter will be appreciated when it is remembered that the cost of lamp renewals per unit of output exceeds $1.00 per ton of the cost of fuel in operating a central station, with the most modern steam plant.

(To be continued.)

Sheffield, Ala.—The Kitson Hydrocarbon Heating & Incandescent System Co. has been incorporated by W. R. Brown, A. B. Cook, Jr., B. B. Cohen and J. H. Nathan; to erect an electric light and heating plant. Capital stock, $5,000.

Fayetteville, N. C.—George A. Holderness and W. J. McDiarmid contemplate the establishment of a telephone system.

West Point, Miss.—C. L. Jordan, Mayor, may give information concerning proposed electric light plant.

New York, N. Y.—Bell Electric Co., manufacturers of electric bicycle lamps, 46 East Fourteenth street, attached by Deputy Sheriff Strauss for $300.

Buffalo, N. Y.—The La Salle Electrical Co. has been incorporated by Charles A. Pooley, Maurice C. Spratt and R. C. Palmer. Capital stock, $50,000.

EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTRO-MOTIVE FORCE CURVES OF AN ALTERNATOR.

(Continued from page 327.)

Counter Electromotive* Force Curves.

Having the instantaneous current and inductance curves corresponding to a series of loads on the machine, it was a comparatively easy matter to determine the curves of the counter electromotive forces developed in the armature. To obtain a curve showing the cyclic variation of the induction set up in the coils by the armature current, it is only necessary to plot the products of the ordinates of corresponding points on corresponding currents and inductance curves. Such a set of curves ob-

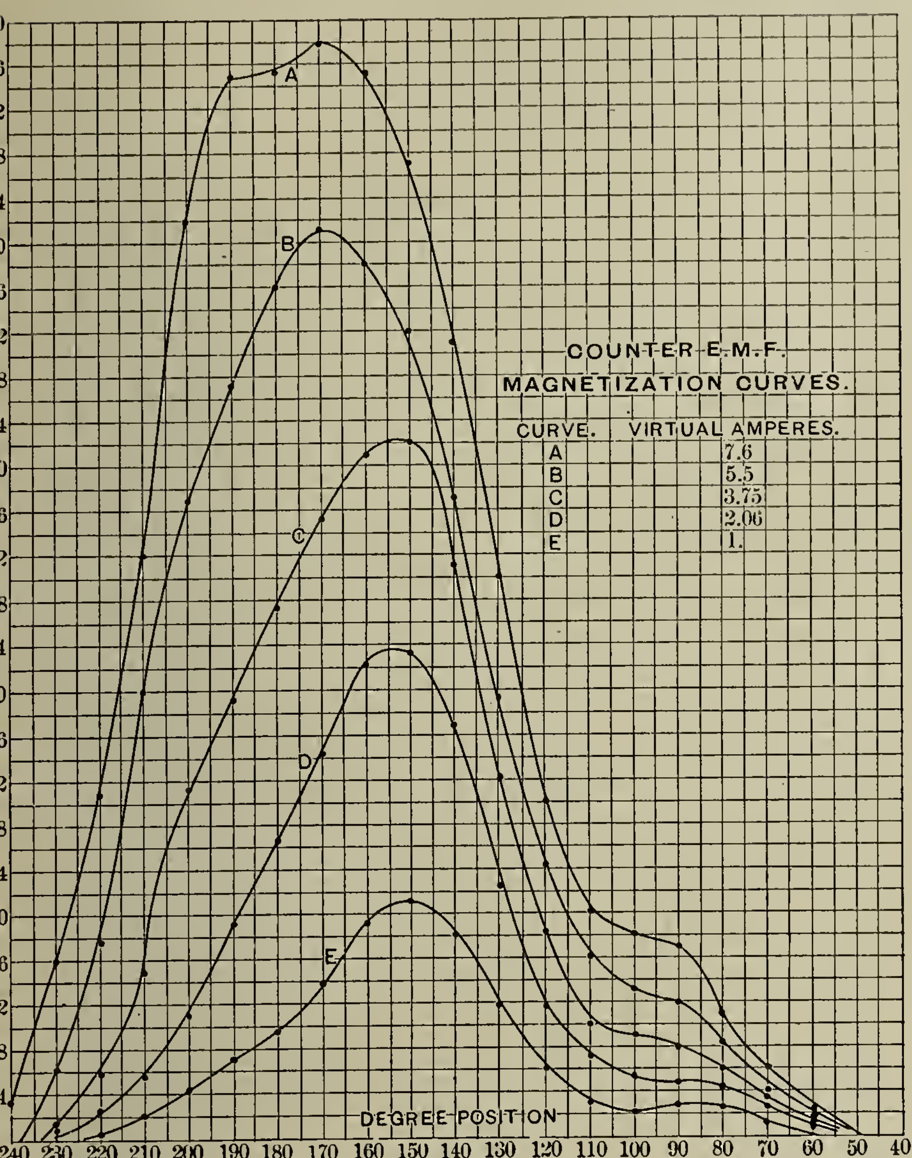


Plate 11.

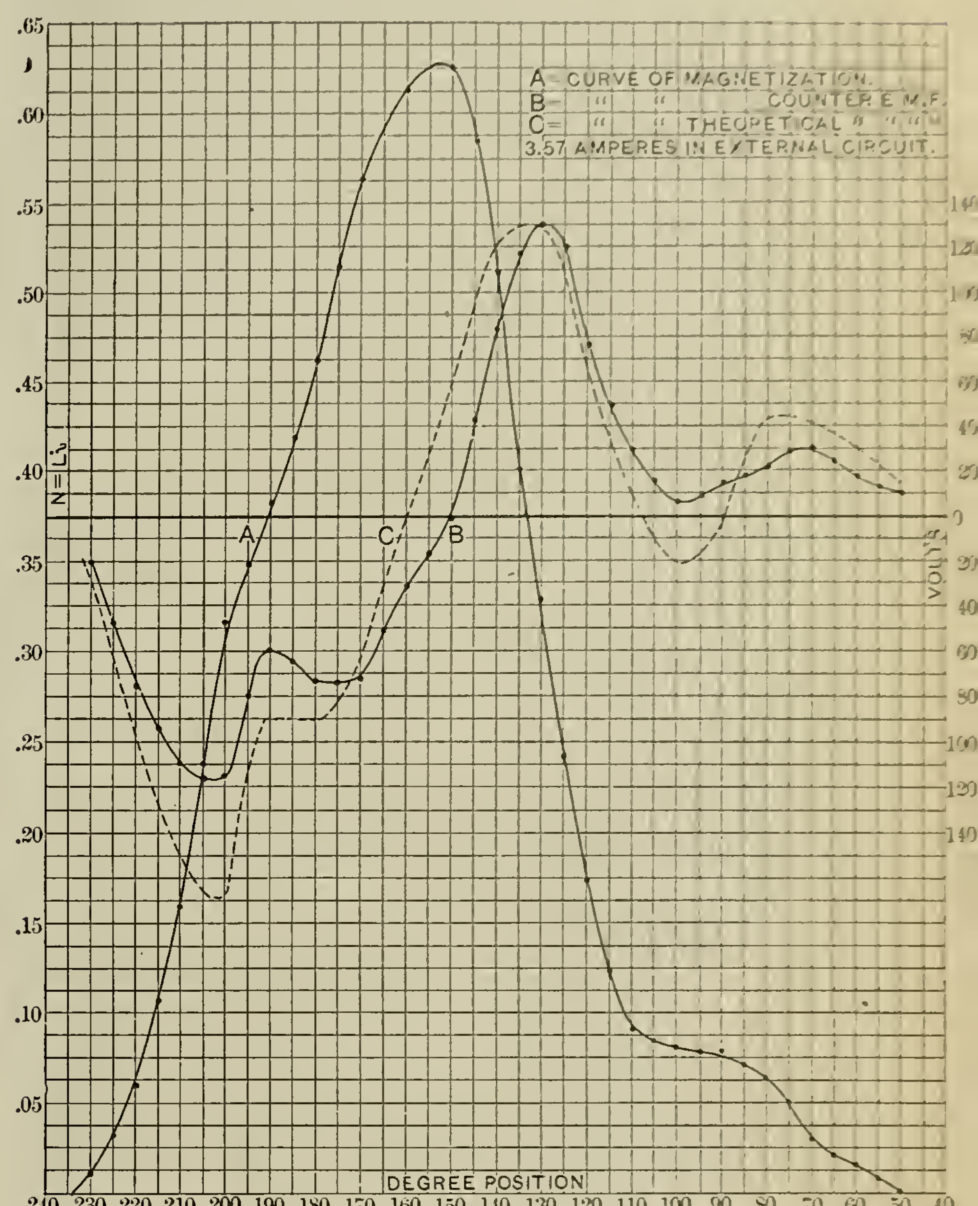
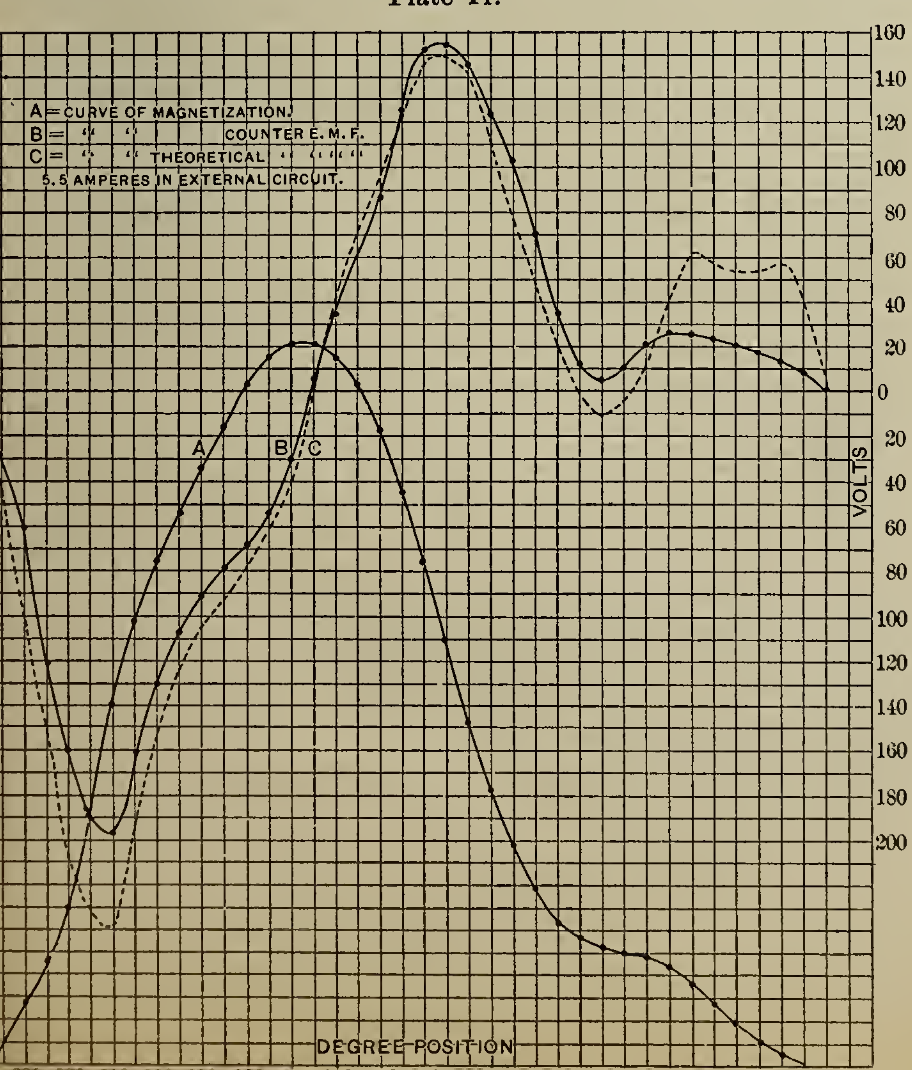
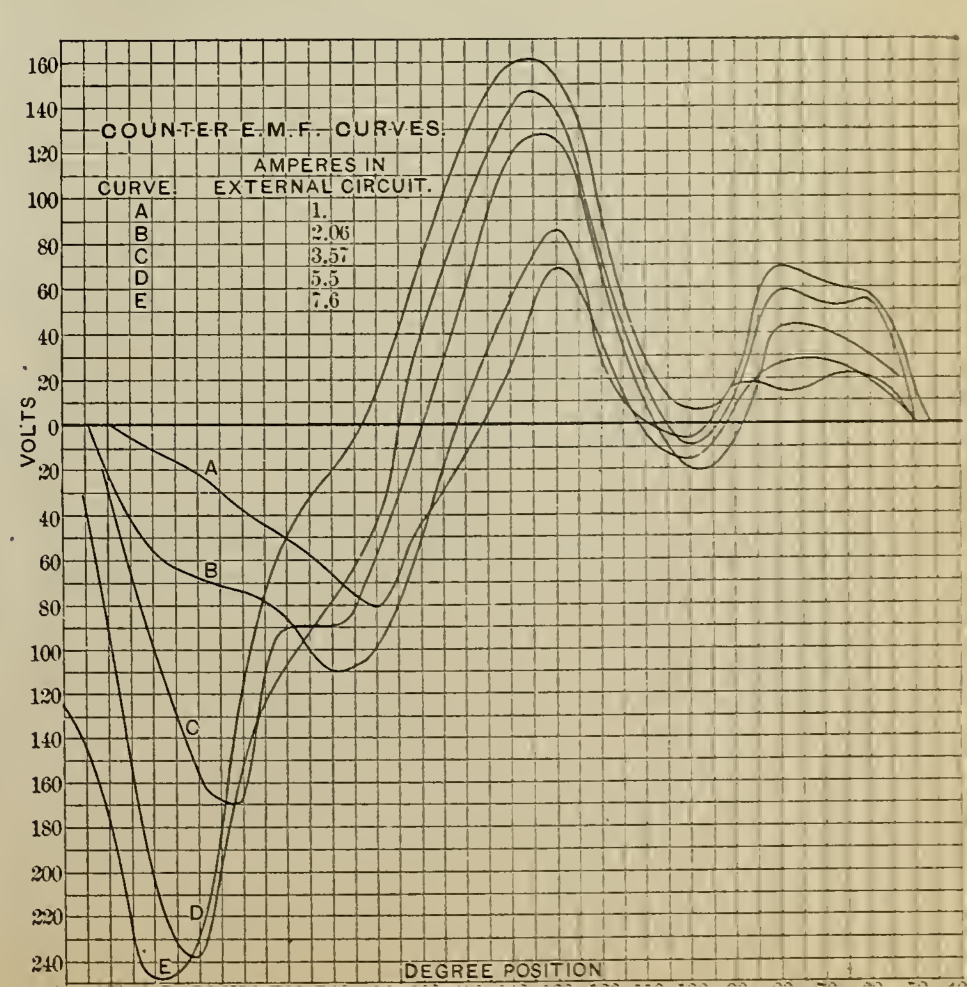


Plate 12.





tained from a combination of the curves of Plates 9 and 10 are given in Plate 11.

If N represents the total flux that is induced in both coils by the armature current, divided by 10^8; L represents the inductance of the coils connected in series in henrys; S represents the total number of turns (572) of wire in both armature coils; and A represents 80 per cent. of the gross area of the armature core inside the coils, or 11 sq. cms.

Then the induction per sq. cm. in the coils due to the armature current will equal,

$$B = \frac{N \times 10^8}{S\,A} = 15892 \times N. \qquad (2)$$

In Plates 9, 10 and 11 we have the necessary curves for determining the instantaneous values of the counter electromotive force corresponding to any degree position by applying the principles underlying either of the above expressions. Both methods were used and were found to check within narrow limits. In Plates 12 and 13 the curves marked A have been taken from Plate 11. The ordinates of the curves marked B are equal to the tangents of the angles made with the horizontal axis by lines drawn tangent to the A curves at the extremities of corresponding ordinates. The B curves are the calculated curves of counter electromotive force developed in the armature. The dotted curves were obtained by subtracting curves D and E of Plate 6 from curve A of Plate 6. On the assumption that the fundamental electromotive force wave of the machine does not change with the load, the dotted curve should also represent the counter electromotive force curve of the armature, and, in fact, the two curves should coincide.

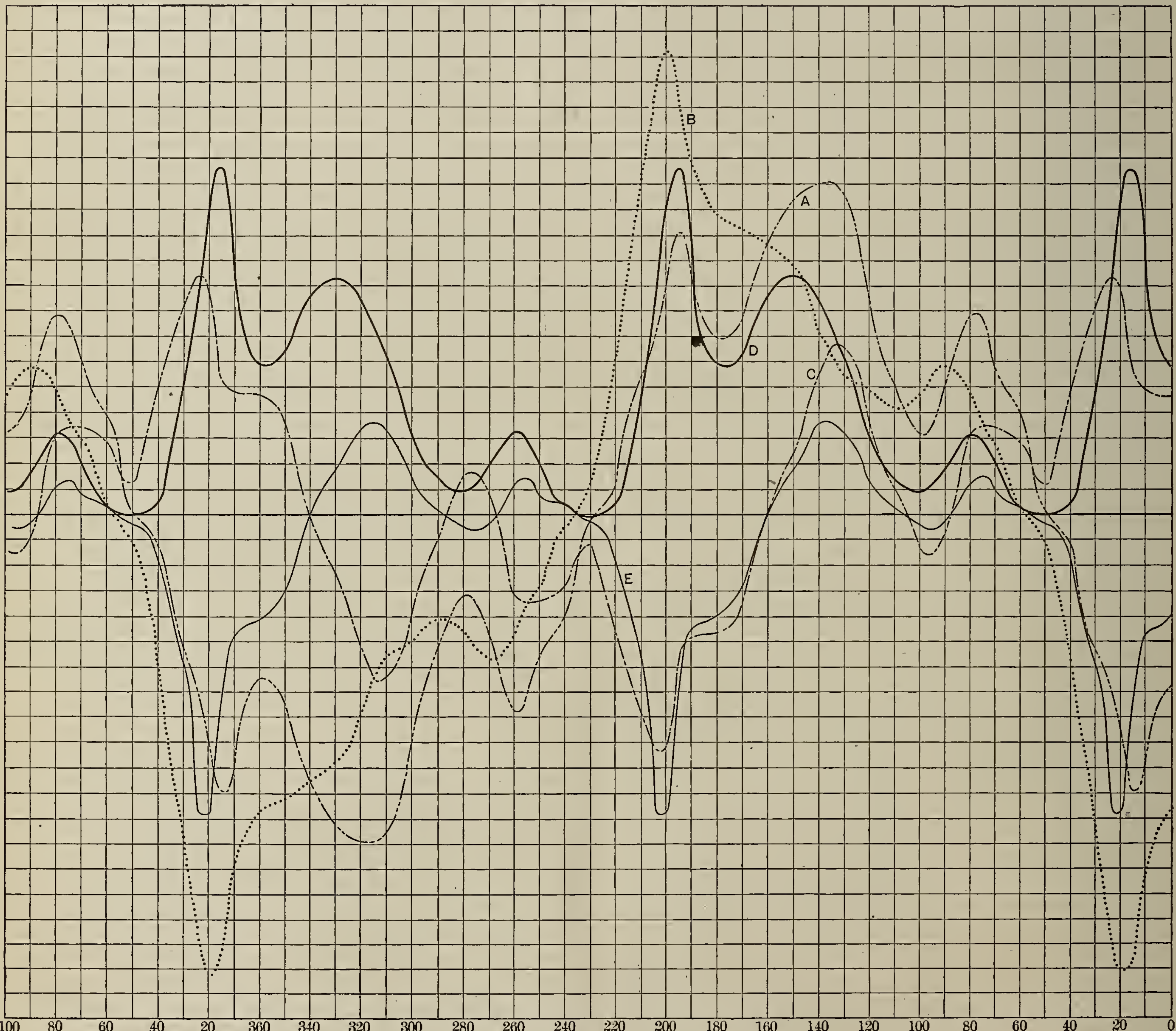


Plate 18.

This equation gives the constant (15892) that must be applied to the scale of ordinates in Plates 11, 12 and 13 to determine the actual core densities induced by the armature currents.

Again, if i represents the instantaneous value of the armature current,

$$N = L\,i \qquad (3)$$

and $$d\,N = L \times d\,i + i \times d\,L, \qquad (4)$$

since L is a variable. Therefore, the counter electromotive force developed in the coils equals

$$e = -\left(-\frac{d\,N}{d\,t}\right) = \left(L\frac{d\,i}{d\,t} + i\frac{d\,L}{d\,t}\right). \qquad (5)$$

Plate 12 represents the poorest, and Plate 13 one of the best, results obtained from the application of this construction to each of the five sets of curves taken from the dynamo. When the fact is taken into account that the inductance of the coils was determined when the armature was at rest, the likeness between the dotted and the full curves is quite remarkable, and apparently justifies

(Continued on page 347.)

MEMBERS AND GUESTS AT N. E. L. A. CONVENTION.

Badger, F. H., Jr., Montmorency Electric Power Company, Quebec, Canada; Badt, F. B., Meysenburg & Badt, Chicago; Baird, M. E., Eddy Electric Manufacturing Company, Windsor, Conn.; Baker, C. O., Anchor Electric Company, Chicago; Baker, C. O., Jr., Baker & Co., New York; Barker, F. E., Massachusetts Gas and Electric Light Commission, Boston; Barr, Edward L., W. R. Brixey, Chicago; Barron, A. M., Home Electric Light and Power Company, Elkhart, Ind.; Bean, W. Worth, Jr., St. Joseph and Benton Harbor Electric Railway and Light Company, St. Joseph, Mich.; Beetle, George L., Western Electric Company, Chicago; Bement, A., Bement & Co., Chicago; Benton, C. A., Sprague Electric Company, New York; Blum, A. J., American Carbon Company, Fremont, O.; Boettcher, C., Imperial Electric Light Company, St. Louis; Booker, S. G., Phœnix Carbon Manufacturing Company, St. Louis; Bowen, G. S., Elgin, Ill.; Bradley, J. M., Birmingham Consolidated Electric Company, Birmingham, Ala.; Brinckman, E. S., Imperial Electric Light Company, St. Louis; Brooke, W. M., Electric Appliance Company, New Orleans, La.; Brooks, A., Charleston T.-H. Electric Company; Charleston; Brooks, H. H., American Circular Loom Company, Boston; Brooks, J. W., Brooks Follis Electrical Corporation, San Francisco; Brown, C. E., Central Electric Company, Chicago; Burleigh, J. J., and wife, Atlantic Electric Light and Power Company, Camden, N. J.; Burns, P. C., American Electric Telephone Company, Chicago; Butler, W. W. S., Milton Electric Light and Power Company, Milton, Pa.

Candee, Willard L., Okonite Company, New York; Carnes, S. T., Memphis Light and Power Company, Memphis, Tenn.; Carr, R. F., Dearborn Drug and Chemical Works, Chicago; Cate, George W., Edison Illuminating Company, Detroit, Mich.; Channon, H. O., Quincy, Ill.; Clark, Frank H., Electric Storage Battery Company, Chicago; Clisdell, Percy A., General Electric Company, Minneapolis, Minn.; Coggshall, H. F., Fitchburg Gas and Electric Light Company, Fitchburg, Mass.; Coleman, Chas. , Eugene Munsell & Co., Chicago; Collins, L. W., Leecol Storage Battery Company, Chicago; Comstock, C. G., Smith-Hill Elevator Company, Quincy, Ill.; Comstock, L. ., Western Electric Company, Chicago; Condit, Sears B., A. Chase & Co., Boston; Cooke, J. H., Buckeye Electric Company, Chicago; Cooper, Thomas, Pekin Electric Light and Power Company, Pekin, Ill.; Copeland, F. A., Edison Light and Power Company, La Crosse, Wis.; Crandall, C. ., Western Electric Company, Chicago; Cravath, J. R., Chicago; Crawford, Ronald, Stamford Gas and Electric Company, Stamford, Conn.; Creden, T. H., Chicago Edison Company, Chicago; Crider, J. S., Washington Carbon Company, Pittsburg, Pa.; Crossman, T. E., official stenographer, New York; Crouse, J. B., Crouse-Tremaine Carbon Company, Fostoria, O.; Crowell, H. H., General Electric Company, Syracuse, N. Y.; Culver, J. H., Culver Electric Company, Decatur, Ill.; Cummings, James F., Arborite Interior Conduit Company, Pittsburg, Pa.; Cunningham, J. W., Capital Electric Light, Motor and Gas Company, Boise, Idaho; Cushing, L. K., Illinois Electric Company, Chicago; Cutler, Harry H., Cutler-Hammer Manufacturing Company, Chicago; Cutter, Henry B., and wife, Cutter Electrical and Manufacturing Company, Philadelphia.

Dale, John H., Dale Company, New York; Daniels, A. ., the H. B. Camp Company, North East, Pa.; Davis, Ernest H., Lycoming Electric Company, Williamsport, Pa.; De Camp, A. J., Brush Electric Light Company, Philadelphia; Dee, A V., Philadelphia; Dee, James R., Peninsula Electric Light and Power Company, Houghton, Mich.; Dickey, Edmund, American Carbon Company, Noblesville, Ind.; Doan, J. P., Jacksonville Gas Light and Coke Company, Jacksonvllle, Ill.; Doherty, H. L., Madison Gas and Electric Company, Madison, Wis.; Donohoe, E., American Electrical Works, Chicago; Dow, Alex., Mutual Electric Light Company, Detroit, Mich.; Downes, W., D. & W. Fuse Company, Providence, R. I.; Downs, B., Electric Appliance Company, Minneapolis; Drake, C. F., Fort Scott Electric Light and Power Company, Fort Scott, Kan.; Dull, P., Milledgeville, Ill.; Dysterud, E., Electric Light Company, Monterey, Mex.

Ebert, J. W., Western Electric Company, Chicago; Eddy, Charles M., Dearborn Drug and Chemical Works, Chicago; Edgar, H. T., Jandus Electric Company, Boston; Ely, J. H., Georgia Electric Light Company, Atlanta, Ga.; Engel, W. T., Charlotte Electric Company, Charlotte, N. C.

Fakes, J. G., Oklahoma City, O. T.; Ferguson, Louis A., Chicago Edison Company, Chicago; Ferguson, James, Municipal Electric Light Company, Brooklyn, N. Y.; Ferris, Thomas, General Electric Company, Milwaukee, Wis.; Field, C. J., Port Jervis Electric Railway and Light Company, New York; Field, A. W., Columbus Edison Electric Company, Columbus, O.; Finney, W. E., Chicago Edison Company, Chicago; Floy, Henry, Westinghouse Electric and Manufacturing Company, Minneapolis, Minn.; Foster, George B., Walker Company, Chicago; Frank, Jacob, Cosmopolitan Electric Company, Chicago; Fraser, R. H., Des Moines Edison Light Company, Des Moines, Ia.; Frith, Harry J., Watseka Electric Light Company, Watseka, Ill.; Fujioka, I., Japan Electric Light Association, Tokyo, Japan.

Gage, Channing T., Washburn & Moen Manufacturing Company, St. Paul, Minn.; Gardner, J. W., Stirling Company, Chicago; Garrison, A. C., Columbia Incandescent Lamp Company, St. Louis; Garton, W R., Chicago; Gates, J. Holt, Walker Company, Chicago; Gilbert, L. H., Jonesville Electric Light and Power Company, Jonesville, Mich.; Gille, H. J., Edison Electric Light and Power Company, St. Paul, Minn.; Gilmer, Elmer W., Warren Electric and Specialty Company, Warren, O.; Goldsborough, W. E., professor in Purdue University, Lafayette, Ind.; Greenwood, C. H., Edison Light and Power Company, La Crosse, Wis.; Gregory, John M., City Electric Light, Bellefontaine, O.; Grier, Edward R., Bryant Electric Company, Chicago.

NEW ELECTRICAL INCORPORATIONS AND BUSINESS CHANGES.

Galva, Ill.—Galva Telephone Co. has been incorporated by Geo. D. Palmer, L. H. Johnson and W. A. Wigen; to conduct a telephone business. Capital stock, $2,000.

Decatur, Ill.—Electric Supply and Fixture Co. has been incorporated by C. E. Gibson, G. B. Marshall and R. H. Coleman; to manufacture electric supplies. Capital stock, $2,500.

(Continued from page 346.)

the assumptions that have been made. The counter electromotive force curves are highly irregular in form. They oscillate from the positive to the negative value twice in a period instead of once, and are generally useful in filling up gaps. As shown, the curves represent the halves of one of the positive and one of the negative loops; in other words, the half period of the curves lies between the 350° and 170° positions, and not between the 50° and 230° positions. This will be made more evident by a reference to curve C of Plate 18.

The whole series of inductance curves, as obtained by the subtraction method, are plotted in Plate 14. This assemblage shows that the curves follow one another in regular order in spite of their lack of symmetry, and it is interesting to note the receding of one and the building up of another "hump" in these curves, as illustrated at the lower left-hand edge of the sheet.

(To be Continued.)

*In this paper the term "counter E. M. F." is used to indicate the E. M. F., which, added to the effective E. M. F., will equal the fundamental E. M. F. The counter E. M. F. is therefore equal and opposite to the inductance E. M. F., or the E. M. F. of self-induction.

Carrollton, Ohio.—The Carroll County Telephone Co. has been incorporated by Union C. De Ford, H. J. McGranahan, J. C. Patterson, A. L. Iden and Simeon Ashbrook. Capital stock, $10,000.

Anderson, Ind.—Postal Telegraph Co. has been incorporated by Leander B. Parker, Ed. J. Wally, W. I. Chapin, Frank W. Samuels, Ed. Wallardt and John F. Looney. Capital stock, $5,000.

Conneautville, Pa.—Conneautville Telephone Co., of Crawford County, has been incorporated by R. F. Wilcox, L. D. Carey, J. H. Smith, I. T. Snodgrass, W. J. Darby, D. E. Hewitt. Capital stock, $4,500.

Victoria, Tex.—The Mayor may be addressed concerning proposed electric light plant, etc.

Thibodaux, La.—The Cumberland Telephone Co. has obtained franchise to construct and operate a telephone system.

Brenham, Tex.—The Brenham & Shelby Telephone Co. has been incorporated by T. A. Low, Sr., Robert Strickert, A. D. Wilroy, Ben Schmidt and B. E. Witte; for the purpose of constructing and operating a telephone system between Brenham and Shelby. Capital stock, $1,000.

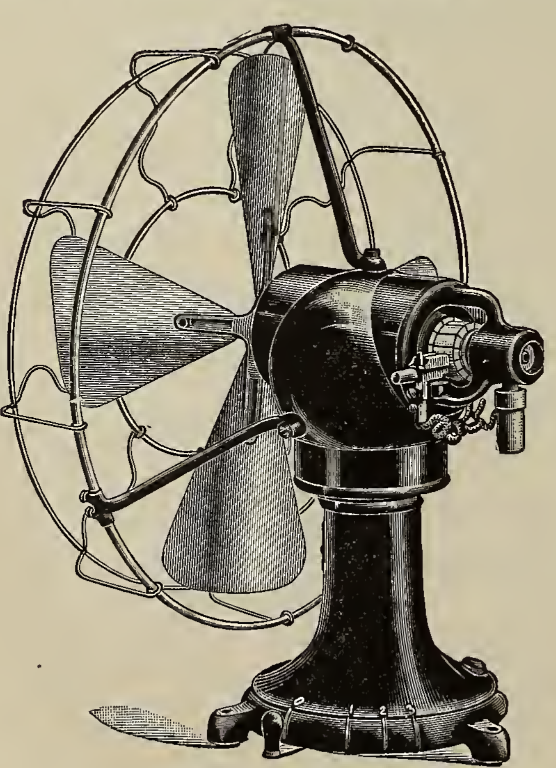
Uvalde, Tex.—The Uvalde Water, Ice & Electric Co. will shortly commence work on proposed electric light plant. Plant is to have one arc and 350 incandescent lamps.

St. Marys, W. Va.—The McKin Telephone Co. has been organized with R. H. Browse, President; L. A. Ellis, Secretary, and Arlando Eddy, Treasurer.

Manor, Tex.—The Manor Artesian Well Co. will establish an electric-light plant.

1898 "HURRICANE" FAN MOTOR.

The direct-current fan motors manufactured by C. A. Eck have been well introduced by the firm of Goldmark & Wallace, 221 Worth street, New York. These motors are very compact and operate noiselessly. They are of



1898 "Hurricane" Fan Motor.

the consequent pole type, the self-aligning phosphor bronze bearings, exposed and easily adjusted brushes, and a commutator of substantial construction and ample cross section to each segment. The bearings are provided with an oil-box to prevent spraying. The armature is toothed and runs cool at full speed. The efficiency of this motor is very high, as its magnetic and electric design is excellent.

A switch throws in three speeds and the current required for the twelve-inch, 110-volt is thirty-five hundredths of an ampere; for the sixteen inch 110-volt, is fifty-five hundredths of an ampere. The speed of the one-eighth horse-power is 900, 1400 and 1800 revolutions per minute; of the one-sixth horse-power, 800, 1200 and 1600 revolutions per minute. These fans produce a uniform and powerful breeze without vibration of any description and serve the purpose for which they were intended with high economy and perfect satisfaction.

To supply the Army and Navy of the United States, now expanded to a war footing, very large demands are being made on the American Bible Society for pocket Testaments. Tens of thousands of copies have been called for by the chaplains of regiments, Young Men's Christian Association officers and other responsible parties who are at work in the camps all over the country and at the front. Care is used to insure the wisest distribution, accompanied by a friendly word with each man. Deprived as they are of reading matter, they gladly accept the books and will treasure them as a souvenir of the war.

Our brave boys in blue who are exposing their lives for country and humanity are exposed also to the passions and demoralizing influences of war. It is a sacred and potriotic duty to equip them with "the sword of the Spirit which is the Word of God."

In order that the American Bible Society may be able to grant these great and unexpected requests, gifts large and small from individuals and churches should be sent at once direct to

WILLIAM FOULKE, Treasurer,
Bible House, New York City.

SOME ELECTRIC SHOW NOTES.

The Partridge Carbon Co. exhibited under the supervision of Wood, Shaw & Co. the various kinds of self-lubricating carbon and pure plumbago dynamo and motor brushes, in addition to their new arc light carbons, which are said to be equal to the imported.

Among the various exhibits at the Electrical Show that of J. JONES & SON, 64 Cortlandt street, New York, dealers in electrical supplies of all descriptions, was one of the most popular and attractive.

MR. DANIELS exhibited H. B. CAMP & COMPANY'S cement electrical ducts or conduits. The writer saw a lot of this duct being installed in Brooklyn last week. They say they have millions of feet in use in Greater New York.

The Electrical Age.

VOL. XXI—NO. 26 NEW YORK, JUNE 25, 1898 WHOLE NO. 580

General Electric Box Car Locomotive, Arlington Mills.

G. E. Platform Locomotive Hauling a Train, Arlington Mills.

ELECTRICITY VERSUS STEAM.

A striking instance of economy in actual money and elimination of trouble and delay induced by supplanting a steam haulage service with electric traction is offered by the installation recently made by the General Electric Company for the Arlington Mills, Lawrence, Mass. These mills have about two miles of track running from the main line of the Boston and Maine Railroad into the yards and throwing off spurs into the alleys between the different buildings. Previous to the change to electrical service, the haulage of the entire output of the mills to the main line, the haulage of the material from building to building, as well as the necessary switching about the yards, was done by a steam locomotive rented from the railroad. For this service the Arlington Mills paid an annual rental of several thousand dollars, and were, moreover, frequently put to great inconvenience and delay on account of the unavailability at times of any locomotive.

The successful results obtained with electric factory locomotives by other mills in New England, notably at Whitinsville, Mass., and Taftville, Conn., attracted the attention of the managers of the Arlington Mills to the question of electric haulage, which they took into serious consideration. As every case in which electric traction has been adopted in factories showed an improved service, as well as an actual money economy, electricity as a motive power was decided upon.

The electrical installation consists of a small generating plant and two electric locomotives, one of the box type and the other a platform car. The generating plant consists of a standard G. E. 75 k.w. 500-volt railway generator driven by belt from an Armington & Sims high-speed engine. The generator readily answers all calls upon it, with absolutely no heating or sparking, although it is occasionally subjected to very heavy overloads when both cars are handling a train of more than the usual number of loaded cars.

The box-car locomotive used for hauling material about the yards is shown in Fig. 1, and is equipped with two G. E. 800-27 H. P. motors and series parallel controllers. The platform locomotive is used to haul trains of loaded cars from the yards to the main line, and empties from the line to the mill tracks, and to do all the drilling in the yards. The equipment of this locomotive consists of two 50 H. P. G. E. 1200 motors with the necessary series parallel controllers. In hauling heavy trains it is assisted by the box-car locomotive. Together they are able to handle trains of 30 to 40 empties, or 12 to 14 loaded cars, with comparative ease and celerity. To give the necessary adhesion to the more powerful locomotive to enable it to handle heavy loads, about six tons extra weight is placed on the platform.

Perhaps the most interesting feature is the comparison between the cost of the electric plant and the expense formerly entailed by the use of the superseded steam locomotive. The cost of the entire electric plant was very little in excess of one year's rental of the steam locomotive. No more men are employed about the electric locomotive, the labor and cost has not risen, and the consumption of coal is scarcely felt on the main plant. Furthermore, the plant being always ready, cars may be shifted at any time during the day or night.

The new system is thus both economical and advantageous, and the appreciation of the Arlington Mills is, perhaps, best shown by the fact that a second platform locomotive is shortly to be added to this haulage plant.

DEVELOPMENT OF ELECTRICAL SCIENCE.

(Concluded.)

In 1887 the theory was advanced by Arrhenius and Ostwald that dissociation is directly effected by solution or fusion and that in very dilute solutions the dissociation is practically complete. Arrhenius holds that the ions carry charges of electricity, positive or negative, dependent upon their nature, but of equal quantity in every ion. The remaining part of the theory is similar to that of Clausius and others. According to this theory, the ratio of electric conductivities for different densities of solution gives a measure of the relative dissociation or ionization. If the act of solution effects the dissociation necessary to admit of electrolysis, chemically pure substances ought not to be decomposed by the electric current, and this is found to be the case. It is curious that two substances like hydrochloric acid and water, which, separately, are insulators, should, when mixed, conduct readily, and that practically only one of them should be decomposed. This, however, is only one of the many problems still to be solved. Another question is, how do the ions obtain their electric charge? Still another, what is the nature of the force which causes ionization? There are many more.

When we turn to the commercial application of electrochemistry we are met with astonishing evidence of activity. Only twenty years ago there was comparatively little evidence of the importance of this branch of applied electricity. At the electrical exhibition in 1881 electrochemistry was apparently of comparatively little prominence. A factory which could produce a few hundred tons of copper electrolytically was considered a wonder. The production of thousands of tons a month is beginning to be looked upon as commonplace. There is scarcely a metal which cannot be deposited electrolytically with comparative ease, and the prices of some of the rarer metals are going down rapidly. Zinc used to be considered a difficult metal to deposit successfully. It is now produced in some of the Australian mines in almost a pure state from refractory ores at the rate of thousands of tons per annum. Similarly the old method of galvanizing is rapidly disappearing and electro-deposition is taking its place, and this metal is now so deposited on the hulls of ships, on anchors and other smaller articles cheaply and perfectly. A new industry has practically sprung up, and there is every indication that the technical chemist of the near future will have to take an inferior place unless he be also well-versed in electricity and electrical appliances. This branch of applied science is revolutionizing many things. It has within a few years produced an enormous improvement in our magazine illustrations, and has, at the same time, reduced the cost of this kind of literature and of atlases and charts enormously.

Electro-chemistry is now used on a large scale for the production of chlorate of potash, bleaching materials, alkalies, coloring matters, antiseptics, like iodoform, anæsthetics, like chloroform, etc. In fact, it is getting to be difficult even to enumerate the manufactures in which it is used. It has revolutionized the extraction of gold, and plants of enormous capacity are now in use in some of the gold fields, the poorest ores and tailings being made to yield up almost the last trace of the precious metal. The production of ozone by the ton, the purification of sewage and the sterilization of water are all accomplished facts.

Some progress has even been made in the introduction of chemicals through animal tissues by electrolysis or cataphoresis, and Rœntgen has shown us how to see through the body.

Then, again, we have got the electric furnace, and with it the power to fuse almost the most refractory substances. In this way aluminum is now produced at a few cents a pound, whereas most of us remember when its price had to be reckoned in hundreds of dollars. In a similar way phosphorus is now produced on a large scale, as are also various carbides, carborundum, acetylene, etc.

It is impossible to look back over the history of electricity and its applications and notice the apparent geometric ratio in which advances are being made, and not to speculate on what a giant this science is going to become in another quarter of a century. Undoubtedly no one can study this one branch of science without being persuaded of the great value of scientific work for the advancement of human enterprise.

Thomas Gray.

Rose Polytechnic Institute.

CANADIAN ELECTRICAL ASSOCIATION.

The eighth annual convention of the Canadian Electrical Association will be held in the Windsor Hotel, Montreal, on June 28th, 29th and 30th, 1898; and the annual banquet at the Windsor Hotel, Wednesday evening, June 29th, 1898, at 9 o'clock. John Yule, President; C. H. Mortimer, Secretary.

Business Programme.

Tuesday, June 28th.

9:30 a. m.	Meeting of the Executive Committee.
10:00 a. m.	Opening of first session in Convention Hall, Windsor Hotel.
	President's Address.
	Reading Minutes of last Meeting.
	Secretary-Treasurer's Report.
	Reports of Committees and General Business.
2:00 p. m.	General Business.
	Presentation of Papers.
	Discussion.

Wednesday, June 29th.

9:00 a. m.	Consideration of Reports of Committees.
	Election of Standing Committees.
	Selection of Place and Time of next Meeting.
	General Business.
	Presentation of Papers.
	Discussion.

Thursday, June 30th.

9:30 a. m.	Election of Officers.

List of Papers.

"How to Overcome Some of the Difficulties Encountered by Central Station Men."

A. A. Wright, Renfrew, Ont.

(1) "The Unconscious Ownership of an Important Key"—(A Plea for the Introduction of Goods Traffic on Our Suburban Tramways).

(2) "The Quimby Screw Pump."

W. T. Bonner, Montreal.

"Experiences of an Inspector."
Dr. J. K. Johnstone, Inspector of Electric Light, Toronto.

"The Electric Current in the Rainy River Gold Mines."
M. W. Hopkins, B. Sc., C. E., etc.

"The Importance of Proper Methods of Illumination."
F. A. Bowman, M. A., B. E., New Glasgow, N. S.

"Electric Utilization of Water Powers."
Louis DeWitt Magie, Montreal.

"Economies in the Boiler Room."
James Milne, Toronto.

Social Features.

Tuesday, June 28th.

7:30 p. m.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

Wednesday, June 29th.

1:00 p. m.—Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7:30 p. m.

9:00 p. m.—Annual Association Banquet at Windsor Hotel.

Thursday, June 30th.

11:00 a. m.—Visit to McGill University.

1:30 p. m.—Visit to Royal Electric Company's lighting station and factory; then by special G. T. train to visit the works of the Chambly Manufacturing Company at Chambly.

Canadian Electrical Association Convention,

Montreal, 1898.

Reception Committee—Wm. Thompson, Chairman.

J. R. Thibadeau, S. T. Willet, H. H. Holt, C. R. Hosmer, Wm. Mann, F. L. Wanklyn, L. A. Herdt, A. Hadrill, P. W. St. George, W. H. Browne, John Carroll, O. Higman, R. E. T. Pringle, W. B. Powell, J. A. Baylis, W. S. Weldon, A. Aubin, Jules Bourbonniere, Donald S. Barton, E. Craig, H. O. Edwards, Robert Dobie, H. H. Henshaw, L. D. W. Magie, N. W. McLaren, Fred. Thomson, George Rough, W. H. Winter, J. E. Scott, F. W. Fairman, D. Ross Ross, George B. Burland, L. J. Forget, C. F. Sise, W. Dale Harris, W. G. Turner, D. McDonald, J. P. Mullarkey, A. Brunet, F. H. Badger, Sr.; L. B. McFarlane, G. W. Sadler, A. B. Smith, W. T. Bonner, F. H. Badger, Jr.; D. W. McLaren, W. McLea Walbank, F. W. Atkinson, Edward Butler, John Cunningham, P. J. Darlington, W. F. Dean, P. G. Gossler, W. E. Gower, R. A. Ross, F. J. E. Schwartz, Clarence Thomson, R. S. Kelsch, W. F. McLaren, C. E. A. Carr, J. J. York.

EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTROMOTIVE FORCE CURVES OF AN ALTERNATOR.

(Continued from page 347.)

Plate 15 represents another phase of the subject. The curves traced in the fine black lines are the results of adding the calculated electromotive force curves determined by the means illustrated in Plates 12 and 13* to the corresponding effective or external electromotive force curves of Plate 6. They show the result of an attempt to work back from the effective electromotive force curves, or from the wave form of electromotive force appearing at the collector rings when the machine is loaded, to the fundamental electromotive force wave or the electromotive force wave appearing at the collector rings when the machine is running on open circuit.

The curve A, reproduced on this plate for comparison with the curves just mentioned, is the same as curve A of Plate 6. The agreement between the curves is marked. The derived curves show the greatest departure from the fundamental curve early in the cycle, between the 70° and the 110° positions. This is due to the fact that the initial "hump" at the 90° position of the induction curves was not developed with sufficient care. A very slight change in the contour of the induction curves at this point makes a great difference in the form of the counter-electromotive force curves, owing to its effect in altering the direction of the tangents drawn to the magnetization curves on Plate 11. On the whole, the likeness between the curves is well within the limits of the errors of observation.

Derivation of Current Curves.

Another interesting set of curves is shown in Plate 16. The success attained in working out the counter-electromotive force curves led to a series of calculations to determine to what extent the form of the current curves was influenced by the shifting of the phase of the inductance curves with the load. To this end an average of the inductance waves A, B, C, D, and E of Plate 3 was taken to represent the average inductance wave of the armature for all loads. This curve is shown as curve B of Plate 16. With this curve and the fundamental electromotive force wave A, forming a basis for calculation, the current that will flow with any given resistance in the circuit can be readily determined, provided that the curve B is taken to represent all of the variations that occur in the armature inductance.* The relation existing between the impressed electromotive force, the current and inductance in any alternating current circuit similar to the one under discussion is expressed by the equation

$$e = R\,i + \frac{d\,N}{d\,t}, \tag{6}$$

There e, i and $\left(\frac{2\,N \times 10^8}{S}\right)$ are, respectively, the instantaneous values of the impressed potential, current, and the magnetic flux induced by the current, and R is the resistance of the circuit.

Since $N = L\,i$, as above (see equation 1), in the present case we have:

$$e = R\,i + L\frac{d\,i}{d\,t} + i\frac{d\,L}{d\,t}. \tag{7}$$

Then,

$$i\left(R + \frac{d\,L}{d\,t}\right) = e - L\frac{d\,i}{d\,t}, \tag{8}$$

and

$$i = \frac{e}{\left(R + \frac{d\,L}{d\,t}\right)} - \frac{L}{\left(R + \frac{d\,L}{d\,t}\right)} \times \frac{d\,i}{d\,t}. \tag{9}$$

By applying this formula to the curves of Plate 16, and following out a graphical construction, the successive instantaneous values of the current were finally determined, although in accomplishing this result the current curve E, which was the outcome of the process, had to be carried through successive cycles until it repeated itself.

The values of $\left(\frac{d\,L}{d\,t}\right)$ were taken from curve B.

The ordinates of the curve A were then divided by the corresponding values of $R + \frac{dL}{dt}$, and these quotients, when plotted, gave the curve E.

Next, referring still to Plate 16, a point, as, for instance, p, was taken, that was thought to lie near the current curve, and the line $(p' r')$ was drawn. From (r') the line

$$(r' s') = \frac{L}{R + \frac{dL}{dt}} \qquad (10)$$

was laid off and $(s' p')$ drawn. Now from the assumed position of p',

$$\frac{p' r}{r' s'} + \frac{p' r'}{\left(\frac{L}{R + \frac{dL}{dt}}\right)} = \frac{di}{dt}, \qquad (11)$$

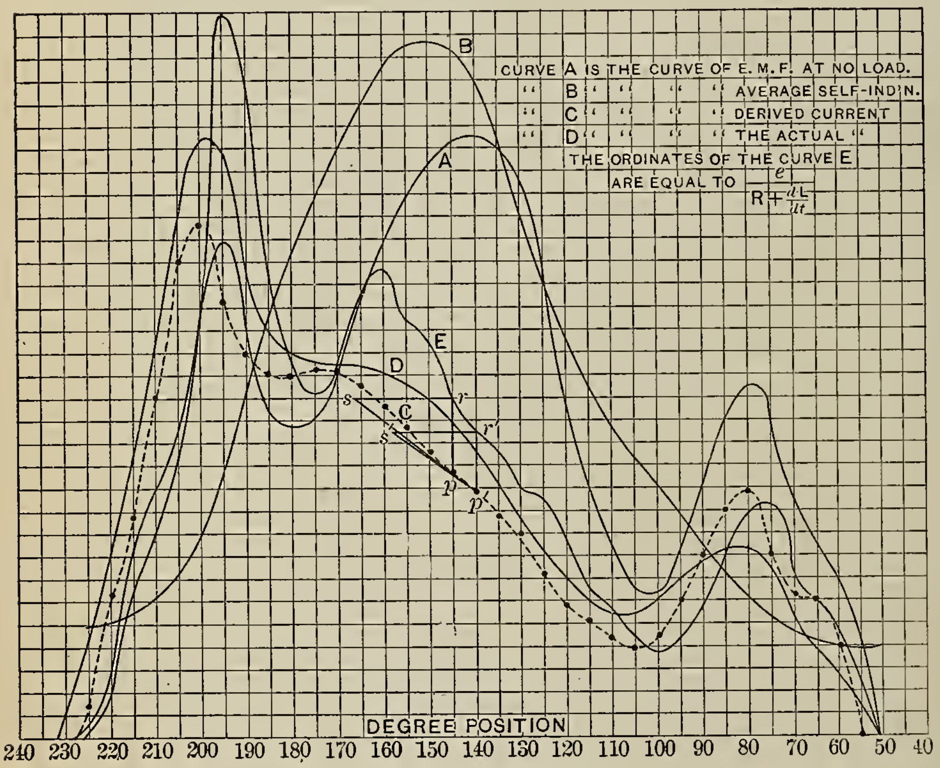


Plate XVI.

* Cuts were published in previous articles.

and $(p' s')$ established the direction of the current curve, since from equation (9),

$$\left(\frac{L}{R + \frac{dL}{dt}}\right) \frac{di}{dt} = \frac{e}{R + \frac{dL}{dt}} - i, \qquad (12)$$

and

$$\frac{di}{dt} = \frac{\frac{e}{R + \frac{dL}{dt}} - e - i}{\left(\frac{L}{R + \frac{dL}{dt}}\right)} \qquad (13)$$

and therefore, $(p' r')$ approximated the value of

$$\frac{e}{R + \frac{dL}{dt}} - i. \qquad (14)$$

By taking another point p on $p' s'$, and continuing the construction, a chain made up of short lengths $p' p$ was obtained which ultimately developed into the periodic wave C, for which the values of

$$p' r' = \frac{e}{R + \frac{dL}{dt}} - i. \qquad (15)$$

The graphical construction used is not new. It is an adaptation of one of Dr. Sumpner's† unique methods of treating alternating current problems, and I have developed it here simply as a matter of interest in connection with the discussion.

Returning to the curves, it is noticeable that the dotted curve C resembles the current curves of Plate 9 very closely. Comparing it with curve D, which is a current curve taken from the machine, with 55 ohms resistance in the complete circuit, the chief difference noticed is that the right hand peak of the dotted curve is a little

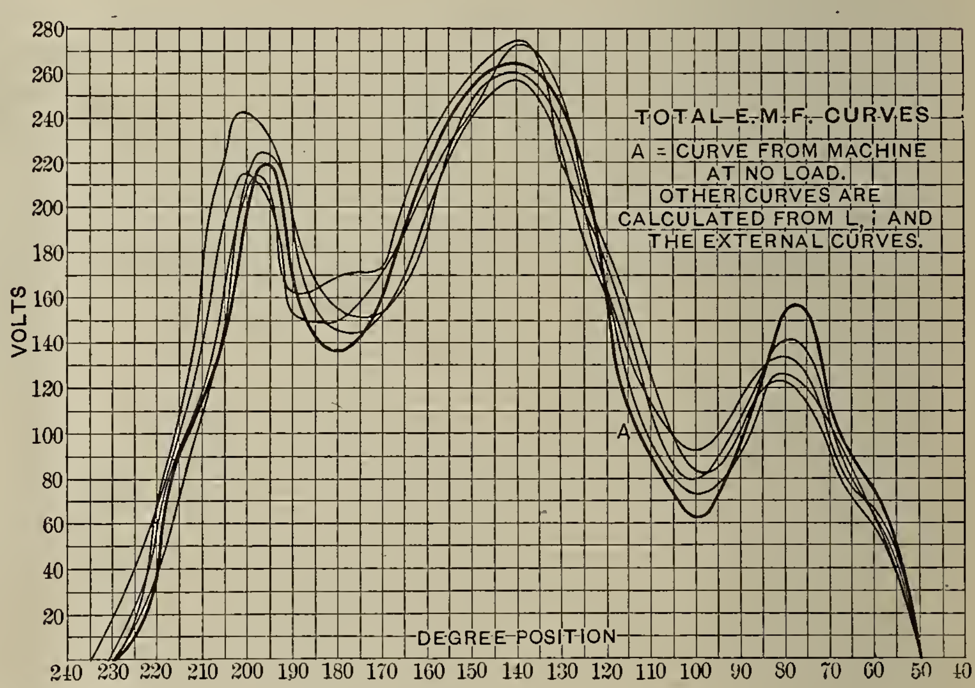


Plate XV.

high, and the left hand peak a little low, and that the curve as a whole is somewhat depressed below the curve D. The differences between the curves are, however, not very marked. They result largely from the curve B having a less amplitude and smaller slope than the alternating current inductance curves of Plate 8, since it is derived from the direct current inductance curves of Plate 3.

The construction indicates a method that can be employed with success in determining, before the machines are built, the wave forms that will be developed by alternators. It is possible to predetermine the fundamental electromotive force and inductance waves of an alternator, by the application of modern methods of design, and from these the load curves and armature reactions can be ascertained by processes analogous to those shown here.

*Steinmetz, "On the Law of Hysteresis." Transactions, vol. xi., p. 574. In this article the author calls attention to the solution of a problem that is analogous to this one, differing from it only to the extent that he works from an assumed sinusoidal inductance-electromotive force and a circuit of negligible resistance.

†Dr. W. E. Sumpner, "Philosophical Magazine," June, 1887, p. 470.

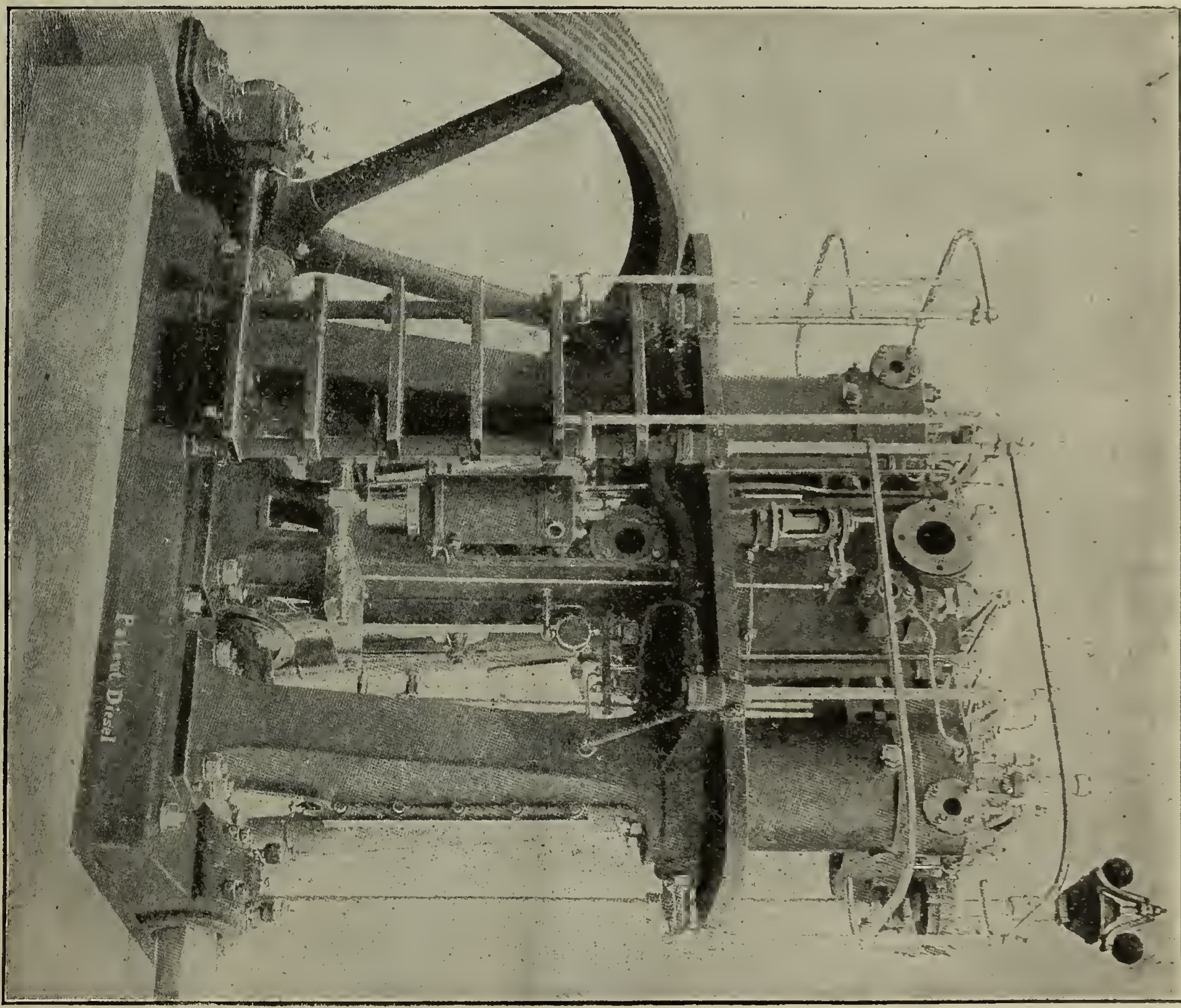
If in the present case it had been desired to calculate the actual current curve with great exactness, an extension of the method used could have been employed. This elaboration necessitates taking the inductance values from Plates 4 and 5, as each point on the current curve is fixed. The process represents a refinement, however, that is hardly warranted in view of the good approximations resulting from the use of the less tedious plan.

(To be continued.)

THE DIESEL MOTOR.

The low efficiency of heat engines has discouraged a great many inventors and prevented them from any further endeavor to improve or otherwise modify their present construction. High-class steam-engines of the very finest mechanical design never exceed eight per cent. efficiency, and the most marvellously constructed triple or quadruple expansion engines, part of whose equipment consists of a condenser and steam-saving cut-off, does not exceed fourteen per cent. in its efficiency, and so on in other cases where heat is used as a means of obtaining mechanical motion, the losses are greater and greater, increasing rapidly unless the utmost precautions are taken by the exercise of great mechanical ingenuity to prevent them. Then again, in addition to the fuel which passes away in the form of heat, is the smoke nuisance, which in certain large cities will not be endured by the municipality. The inventor of the Diesel motor, in order to avoid the above losses and difficulties, followed this plan. "Pure air is compressed in the cylinder of the motor, thus generating a temperature of about six hundred degrees, centigrade. The fuel to be used, such as gas, petroleum or powdered coal, is thereafter injected into the compressed air, where it is gradually burned up at a much lower temperature than ever before accomplished. During combustion and during the succeeding expansion it is entirely turned into work. The injection and combustion of the fuel takes place as the piston in the cylinder begins its return stroke. It ceases when it has reached about one-eighth or one-sixteenth of its way back, and it is so regulated that the increase in the temperature created by the compression of the air and subsequent combustion of the fuel is reduced by the cooling off due to the work done during the succeeding expansion; thus practically there is no increase in sensible heat, since the heat caused by the combustion of the fuel is immediately turned into power and the motive power thus gained is only reduced by the small amount required for the compression of the air."

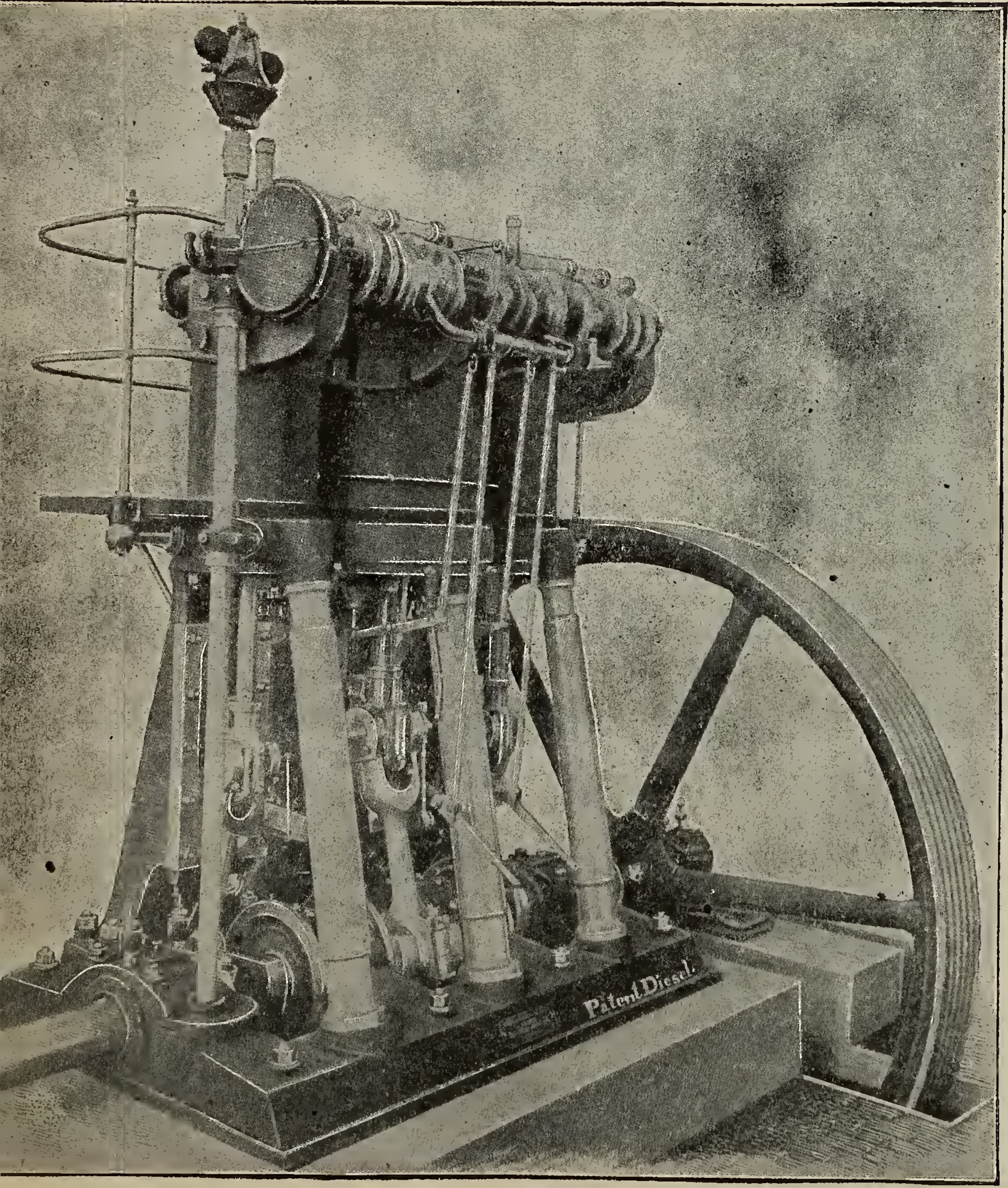
Tests have been made of the Diesel motor covering a period of nine months, the result showing that it can turn about twenty-six per cent. of the heat units latent in the fuel into mechanical energy. Comparing these figures with those obtained from a test of either gas or steam-engines, we find a great deal in favor of the Diesel motor. The high efficiency is certainly one of its most remarkable features. But this would be of little or no consequence if it were obtained by sacrificing simplicity of construction or low cost.



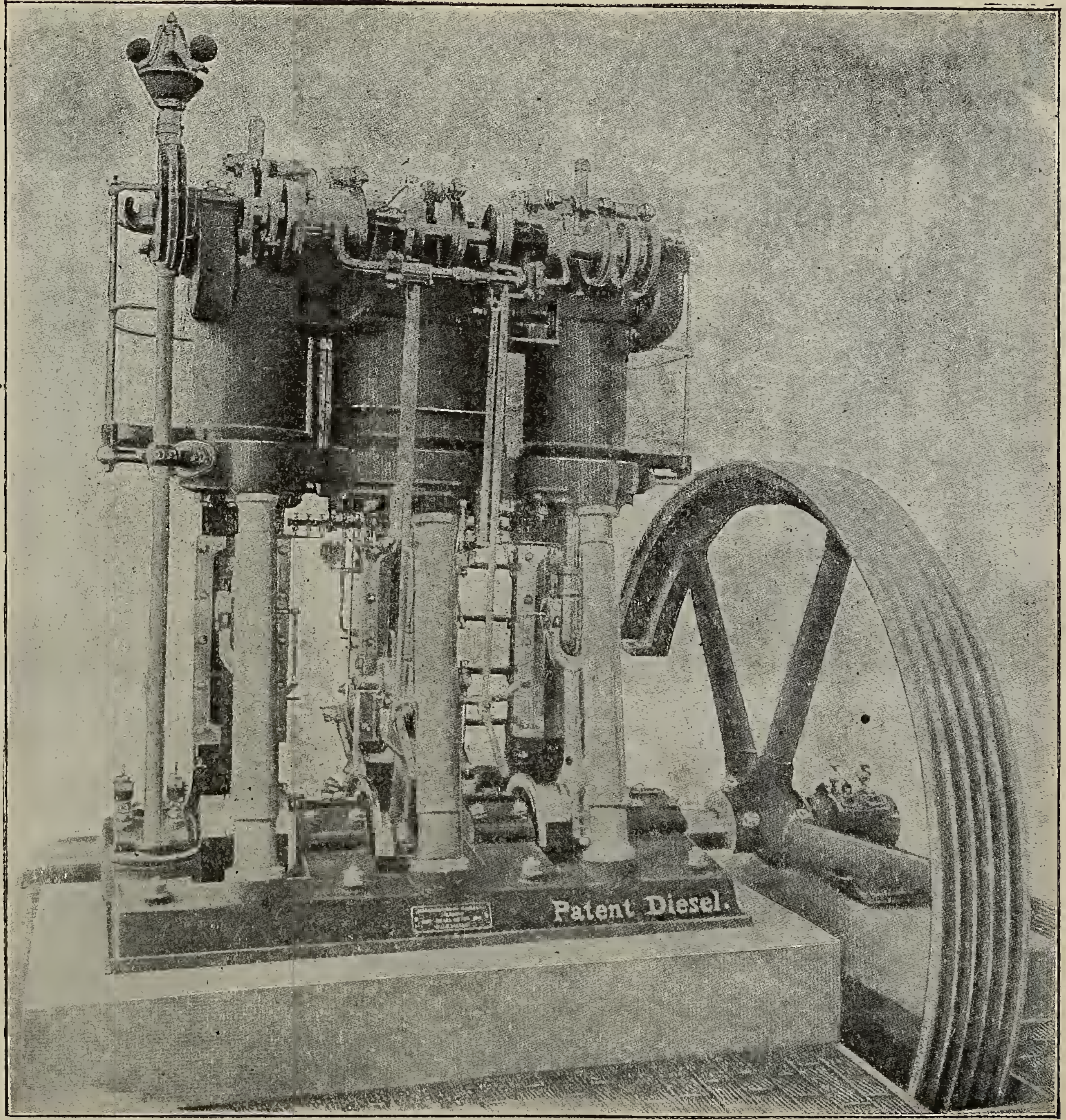
Three Cylinder 150 Horse-Power Diesel Motor. Rear View.

The Diesel motor is easier to build and less expensive than the ordinary type of either gas or oil engine. The supply of fuel is regulated automatically and the variations in load are taken up with such ease as to prevent any changes in speed of a perceptible nature.

Another advantage of the Diesel motor is due to its readiness in starting when required for use. There is no time lost in this operation, its smooth running making it far superior to the majority of types using other sources of power already on the market. The fuel used in the Diesel motor is petroleum, although other combustible gases will serve the purpose as well. The machines so far have been manufactured in Nuremberg, many of which



Three Cylinder 150 Horse-Power Diesel Motor in Prospective.



Three Cylinder 150 Horse-Power Diesel Motor. Front View.

DIESEL MOTORS FOR HEAVY POWER.

re in use for railroad work and street cars.

The large firm of Mirrlees, Watson & Yarvan, well-nown engineers and builders of heavy machinery, are onstructing special reversible Diesel motors to be used for heavy work. Well-known scientific authorities have commended the Diesel motor to the general public on account of its remarkable efficiency, cheapness of construction and excellence of workmanship.

The Diesel Motor Company of America, controlling the patents in the United States and Canada, have offices at No. 11 Broadway, New York City.

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THE ELECTRICAL AGE PUBLISHING CO., Publisher

TERMS OF SUBSCRIPTION:

One Copy, one year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables,) "Electage," New York.

W. T. HUNT, President. H. C. BECK, Vice-President.

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ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

First Floor, World Building.

NEW YORK.

NEW YORK, JUNE 25, 1898.

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Thus the modern engineer has three things in view, namely: coal to save, a plant to keep in good running order, and lamps to save. It now becomes a question at the end of the year as to whether the engineer has actually been economical to such an extent as to have really saved money for the proprietor of the plant; whether it be private or one used for public illumination. Observation will show that the light has been too well paid for under such circumstances as these, although the engineer in charge will be able to show an economy in fuel consumption and a minimum of burnt-out lamps. Take the case of an electric light plant burning one hundred lamps, requiring ten horse-power, and a coal consumption of one quarter of a ton per day; the plant running ten hours. At $3.00 a ton a run of thirty days would require a little over seven tons of coal, costing about $21.00.

Suppose the engineer, desiring to prolong the life of his lamps over as long a period as possible, runs them a few volts below their proper pressure. He is thereby diminishing the light given out by the lamps from ten to twenty per cent.; the lamp being very sensitive to slight changes of voltage when burning at about twelve candle power, a few volts being sufficient to send it up to sixteen and a slightly increased pressure to a state of blinding incandescence. The small change in volts has but little effect upon the pounds of coal consumed in the engine room, but it will have a remarkable influence upon the light of the lamp. It becomes evident, therefore, that in a well-equipped engine room, under the supervision of a careful man, a loss of from ten to twenty per cent. of the light may be sustained in the desire to prolong the life of the lamps.

One hundred lamps can be replaced at a cost of twenty dollars. If the hundred lamps be kept in service for one year instead of being renewed at the end of six months, the engineer has saved twenty dollars on lamps, but he has wasted about twenty per cent. of the fuel burnt by not allowing these lamps, for lack of normal pressure, from producing sixteen candle power apiece. He has, therefore, burnt twenty per cent. of the fuel unnecessarily; that is to say, wasted $50.40 in an effort to save $20.00 worth of lamps.

These facts, when shown in proper relation to each other, will engage the attention of a practical engineer long enough to make him realize that a saving in lamps is a most expensive piece of business and is only done by sacrificing an item more costly than the object sought. A private installation in charge of an over-careful engineer is frequently run with lamps below candle power. Light produced in this manner is the most expensive we know of, being much dearer than any form of illumination to which reference could be made. The true way to economize is to burn the lamps at their normal pressure and renew them when required. The coal, heat and brightness of the carbon are so closely related that the efficiency of a plant can almost be estimated by considering the two in the manner spoken of above. The general conclusion of any sensible man will be that "You can't cheat the devil in the dark," when running an electric-light plant.

AN ELECTRIC SHRIEKER.

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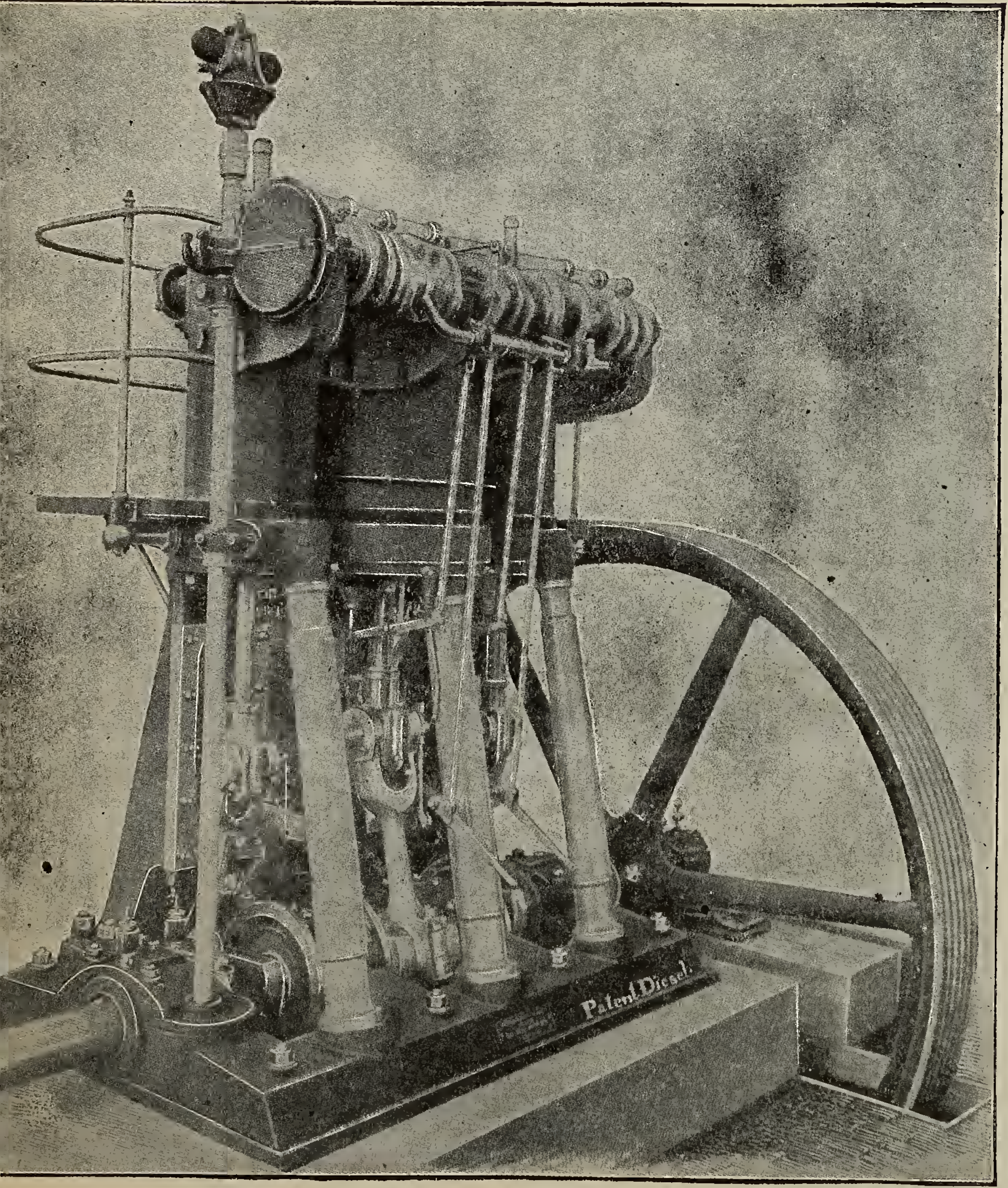

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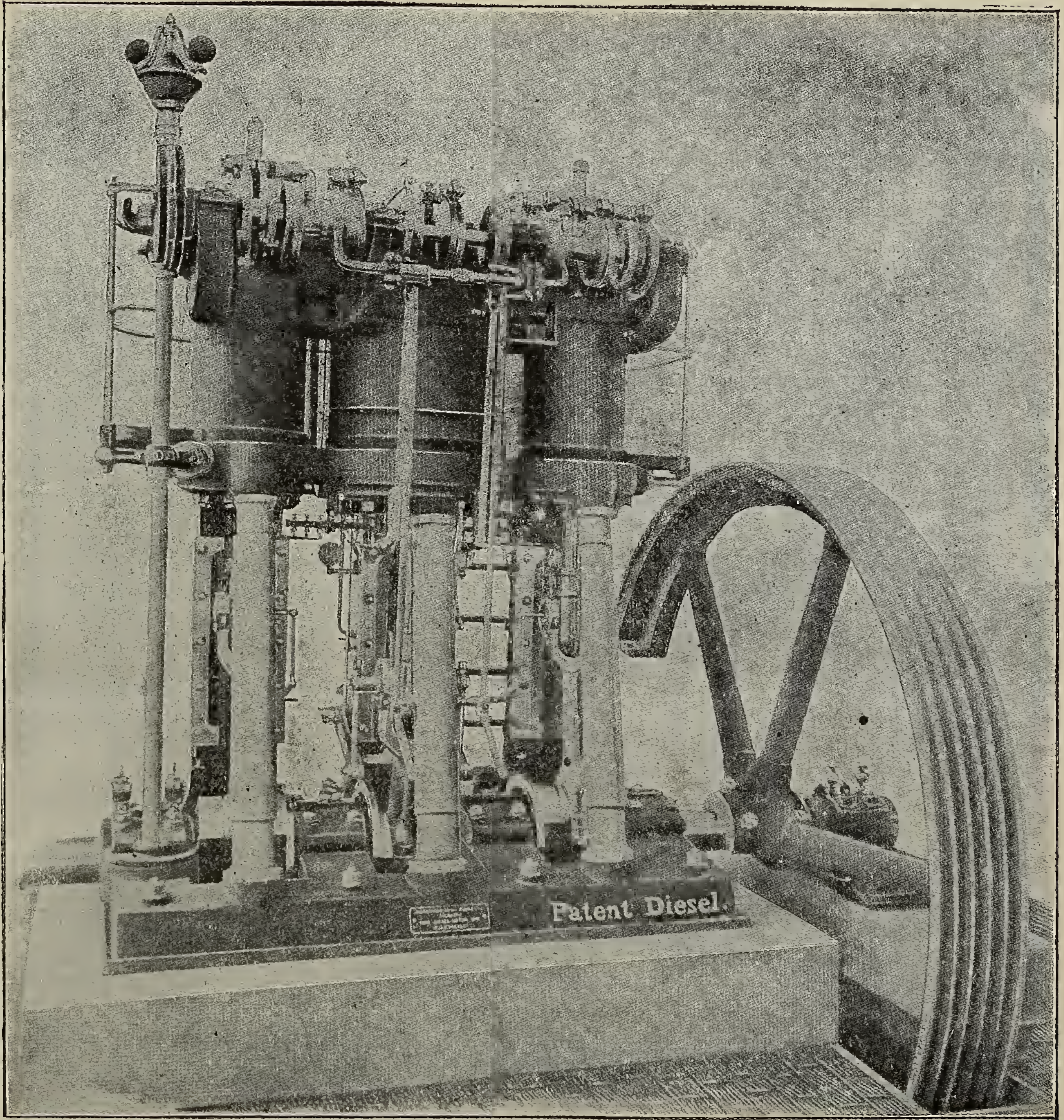

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N. E. L. A. CONTENTION EXHIBITS AND ATTENDANCE.

(Concluded.)

The New York & Ohio Company, of Warren, O., were represented by W. D. Packard, one of the smartest boys in the lamp trade.

Anchor Electric Company was represented by Manager Marshall and Western Manager Baker.

In dynamos and motors, Roth Bros. & Company, of Chicago, attracted considerable attention.

The Chicago Insulated Wire Company was represented by General Manager Smith, with his pockets full of samples.

Jonesboro Insulated Wire and R. E. Lucas, the secretary of the Indiana Rubber & Insulated Wire Company, were well illustrated at the convention. Paranite, Mr. Lucas wishes you to understand, is his favorite brand.

Mr. W. R. Garton, our old friend of the Garton-Daniels Electric Company, was on hand and kept busy answering questions about their famous lightning arresters.

The Jandus Electric Company, of Cleveland, O., makers of the oldest enclosed arc lamp, were represented by J. H. Cook, Chicago, and H. T. Edgar, New England agent.

President A. M. Searles, of the Diamond Electric Company, and Electrical Engineeer G. A. Scheefer exhibited their most excellent Scheefer meters.

The Central Electric Company, of Chicago, was well represented by its many representatives. We did not get one of those handsome souvenir ash trays distributed by the company.

The Electric Storage Battery Company did not have an exhibit at the hotel. They dispensed hospitality in their parlor. The Edison station contained the greatest exhibit of storage batteries in the world.

Manager R. H. Bouslog, of the Peru Electric Manufacturing Company, Peru, Ind., was on hand with a big line of specialities and their new fuse plug.

The Western Electric Company held a continuous reception in one of the large club rooms of the hotel. The room was made brilliant with their "Sunbeam" incandescent lamps and "Midget" arc lamps. Literature was very plentiful. The hotel was well supplied with Western Electric fans.

The General Electric Company was represented by its entire Chicago selling staff.

Mr. Cyrus O. Baker, Jr., master of transportation, was elected an honorary member of the National Electric Light Association at the Chicago Convention.

Mr. S. Marsh Young, vice-president and general manager of the Manhattan General Construction Co., 11 Broadway, New York, was at the Auditorium Hotel during the convention of the National Light Association with a full line of the new Manhattan Enclosed Arc Lamps. These lamps are designed to burn in multiple on circuits of from 90 to 250 volts, and two or more in series on circuits of from 200 to 600 volts, and on alternating-current circuits of from 90 to 130 volts and any number of alternations. He made a big hit. Mr. Young was the first to place the enclosed arc lamp on the market.

Habirshaw, Dr. William, India Rubber and Gutta Percha Insulation Co., New York; Hagar, Edward M., Southwark Foundry and Machine Co., Chicago; Hanley, W. J., General Electric Company, Cincinnati, O.; Hapeman, Douglas, Thomas Electric Light and Power Company, Ottawa, Ill.; Harrington, Walter E., and wife, Camden and Suburban Railway Company, Camden, N. J; Harris, B. F., Jr., Urbana and Champaign Railway, Gas and Electric Co., Champaign, Ill.; Hart, F. D., Jr., Pineville Electric Light Company, Pineville, Ky.; Hays, W. P., General Electric Company, Cincinnati, O.; Healy, Frank E., Illinois Electric Company, Chicago; Hine, William S., Stanley Electric Manufacturing Company, Chicago; Hirota, Seuchi, Takata & Co., Tokyo, Japan; Hixson, H. R. Simplex Electrical Company, Chicago; Holcomb, Eugene, Holcomb & Green Electric Company, Springfield, Ill.; Hold, W. F., Chicago General Fixture Company, Chicago; Holl, Thomas, Smith-Hill Elevator Company, Quincy, Ill.; Hubbard, W. M., Bradford Belting Co., Cincinnati, O.; Hubley, G. Wilbur, Louisville Electric Light Company, Louisville, Ky.; Hughes, W. D., Central Manufacturing Company, Chattanooga, Tenn.; Hull, J. W., Cabinet Manufacturing Company, Steubenville, O.; Hunt, Charles B., London Electric Company, London, Ont; Huntley, C. R., Buffalo General Electric Company, Buffalo; Hutchins, A. W., D. & W. Fuse Company, Providence, R. I.

Insull, Martin J., C. & C. Electric Co., Chicago; Insull, Samuel, Chicago Edison Company, Chicago.

Jackson, George T., National Conduit and Cable Company, New York; Jackson, D. C., professor in the University of Wisconsin, Madison, Wis.; Jenney, Charles D., Jenney Electric Manufacturing Company, Indianapolis; Jennings, John J, Wilkinsburg Electric Company, Wilkinsburg, Pa.; Johannson, J. E., Wagner Electric Manufacturing Company, St. Louis; Johns, S. C. D., and wife, Cleveland Electric Illuminating Company, Cleveland, O.; Johnsson, Edward H., Sprague Electric Company, New York.

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Neal, George B., Charlestown Gas and Electric Company, Boston; Nelson, Frederick, Westinghouse Electric and Manufacturing Company, Chicago.

O'Connor, Richard, National Carbon Company, Cleveland.

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Uptegraff, J. W., Sewickley Electric Company, Sewickley, Pa.; Urquhart, D. F., T.-H. Carbon Company, Boston.

Van Trump, C. R., Wilmington City Electric Company, Wilmington, Del.; Varney, G. E., Varney & McOuat; Indianapolis.

Wade, E. E., El Paso Electric Company, Colorado Springs, Col; Wagner, Herbert A., Missouri-Edison Electric Company, St. Louis; Walbank, W. McLea, Lachine Rapids Hydraulic and Land Company, Montreal, Canada; Watriss, A. W., Charles A. Schieren & Co, Chicago; Webb, A. F., American Carbon Company, Noblesville, Ind.; Webb, H. E., Solar Carbon and Manufacturing Company, Pittsburg, Pa.; Weeks, Edwin R., Kansas City Electric Light Company, Kansas City, Mo.; Wells, H. S, Smith-Hill Elevator Company, St. Louis; Wells, R. S., Shelbyville Water and Light Company, Shelbyville, Ill.; Wells, Edward F., Shelbyville Water and Light Company, Shelbyville, Ill.; Wendle, G. E., Lycoming Electric Company, Williamsport, Pa.; Wetzler, Joseph, and wife, Electrical Engineer, New York; Whyte, George S., Leschen-Macomber-Whyte Company, Chicago; Wiley, J. R., Standard Underground Cable Company, Chicago; Wilkins, E. Ward, Partrick, Carter & Wilkins, Philadelphia; Wilkinson, C. D., Western Electric Company, Chicago; Williams, John R., Electric Storage Battery Company, Philadelphia; Wilmerding, C. H., Chicago Sectional Underground Electric Company, Chicago; Wilson, Charles E., Fort Wayne Electric Corporation, Philadelphia; Wolff, James, New York Insulated Wire Company, Chicago; Woodbridge, J. E., Electrical World, New York; Wright, Peter, Virginia Electric Company, Norfolk, Va.; Wunder, F. A., Fort Wayne Electric Corporation, New York; Wurts, Alexander J., Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Wyant, Robert E., Derby Gas Company, Derby, Conn.

Young, E. P., Sewickley, Pa.; Young, S. Marsh, Manhattan General Construction Company, New York.

Zamel, A. G., Zamel Arc-Light Meter Company, Chicago.

JOSEPH HENRY BURKE.

We are pleased to make mention of the excellent work being done by Mr. Joseph H. Burke, formerly an inspector of the Board of Electrical Control of New York City, now occupying a position of considerable prominence in Queens Borough, L. I. The Brooklyn Eagle comments as follows upon his able services:

"The public buildings now cared for by the department are the town halls at Jamaica, Newtown and Flushing; village halls at Whitestone, Richmond Hill; the borough hall at Long Island City and justices' court rooms at Far Rockaway, Flushing and Long Island City.

The same department has charge of every electric light, telegraph, telephone and trolley wire in the borough. The whole district has been mapped out and every line of wire marked out upon charts in the possession of the department, so that in any application for extensions or changes the location can be determined at a glance. Not a pole can be erected or a line of wire strung without a permit from the department. This is in marked contrast to the methods that prevailed before the local governments were merged into those of the city. Chief Inspector Joseph H. Burke and his corps of assistants are constantly travelling about the borough looking after the thousands of miles of wires and thousands of poles, and in seeing that all work is done in strict compliance with the regulations of the department and that no work is done without a necessary permit from the department.

The principal companies in the borough under the charge of this office are the Long Island Electric Railroad, New York and Queens County Railroad, Brooklyn Heights Railroad, Newtown Light and Power Company, Citizens' Illuminating Company of Long Island City, New York and Queens Light and Power Company, Jamaica Electric Light Company, Citizens' Light Company of Far Rockaway, Bowery Bay Electric Light and Power Company, Electric Illuminating and Power Company of Long Island City, New York and New Jersey Telephone Company, Western Union and Postal Telegraph companies, and several gas and naphtha illuminating companies. The department looks after the safety of the entire community as to life and property in the matter of electric wires.

The great area of the borough of Queens, comprising over 123 square miles, about as much territory as the three boroughs of Brooklyn, Manhattan and the Bronx combined, makes the labor of inspection a great one, and the duties of the borough office are constantly growing."

ADDRESS OF SAMUEL INSULL.

Pres. of Chicago Edison Co.

(Conclusion.)

Selling Price Based on Cost.

It is of prime importance to central station managers that they should sell the product they manufacture, namely, electric current, to the greatest number of customers at the lowest possible price, and yet obtain a reasonable profit. For a number of years the basis of charge on the part of most companies has been a given unit price, with discounts for quantity. In the early days of the business some companies were in the habit of charging a fixed price per lamp per month, having no control whatever over the use of the product, but being necessarily responsible for the increased operating expenses caused by the wastefulness of customers, who could hardly be expected to economize, inasmuch as they paid exactly the same price for the use of light, whether they burned it one or twenty-four hours a day. A majority of these companies, however, following this last method, realized at an early date the absurdity of distributing that for which they were not paid, and as a result I presume we can fairly assume that electric lighting business (with the exception of arc light service) is run almost universally on a meter basis. It is therefore unnecessary for us to discuss the question as to whether the measuring of current is a desirable thing in our business, as it is now generally recognized as a necessity. If you will make a careful examination of the factors entering into the cost of current you will very quickly come to a realization of the fact that interest is by far the most important single element, and that this item varies very considerably with the different classes of service furnished by a central station company. The interest factor in cost depends upon the yearly average consumption of your product by the customer; or, to put it another way, you can figure your interest on the basis of so much per unit of output at maximum load. For instance, take the two probably extreme classes of customers to whom the central station company supplies current for lighting purposes. On the one hand, you have an office building whose tenants only use artificial illumination for a very short space of time each day during the winter only. On the other hand, you have a basement customer whose use of your product averages nearly one-half of the day of twenty-four hours during the whole year. Your investment, to take care of each of these customers, is practically the same; therefore your total interest cost must be the same in both cases, but if you distribute this interest cost over the actual units consumed you will find that the tenant of the office building costs you for interest per unit of current sold many times more than the occupant of the basement. There are of necessity as many different grades of customers between the two extremes I have mentioned as there are different classes of business and different characters of structnres in which these businesses are conducted. Surely, if the cost of production varies according to the different conditions under which your customers use your product, it is but fair that the selling price per unit should vary correspondingly. If it does not, you, of necessity, encourage the use of electricity by customers whose business is unprofitable to you, and discourage the use of your product by customers whose business at a lower price would yield you a fair return.

In past conventions the question of how to improve the day load for the purpose of raising the average output, what classes of business should be encouraged other than lighting to achieve this result, and the price at which we can afford to sell current to the operators of these different lines of business, have come up for discussion. At the last convention the realization of the fact that great differences exist in the elements governing the cost of product for different classes of lighting customers was ably presented by Mr. Arthur Wright, and he pointed out that the improvement of your load factor, the broadening of your curve and the rendering less acute of your peak is a matter within your own adjustment, providing that you will realize in considering cost with a view to making a selling price that conditions are so dissimilar that the expense to you per unit of supplying two customers in the same block is likely to be widely different. Various plans have been adopted by a comparatively small number of companies to meet the conditions as we now know them to exist. Some companies have adopted the scheme of allowing certain special discounts, providing the income per month per lamp connected exceeds a certain amount. Other companies charge one rate for current used during certain specified hours of the day and a much lower rate for the current used during the remaining hours of the day. A third method is a system of discounts based upon the total consumption of current during a given period, considered in connection with the maximum consumption at any time during that same period.

These various methods all have the same object in view, namely, the meeting of the conditions of each individual customer, and yet at the same time earning a fair return on all of the investment provided for all of your customers.

Samuel Insull, Ex-Pres. N. E. L. A.

In discussing this matter I have referred alone to interest cost because it forms so large a proportion of the total cost, but you will find that this same principle enters into a number of the other elements which go to make up your total cost. It would therefore appear to me that in considering the cost of generating electricity you should bear in mind that a large proportion of the items which go to make up the total are within your own control, and their amount per unit of output depends very largely upon the methods adopted in selling your product.

Public Control and Private Operation.

A subject of growing importance to a number of our members is the question of the public ownership and operation of the undertakings now operated by electric lighting companies. The agitation in connection with this subject has called forth a great deal of discussion, partly by those interested in it simply with a view to extending the influence of political parties, and partly by serious disinterested thinkers who believe that the best interests of the greatest number are to be obtained by the creation of a municipal socialism, which, if carried to its logical conclusion, must ultimately result in municipalities performing, with others, such public service work as we are engaged in, and also in producing the food we eat and the clothes we wear. To tnose occupied in the management of electric lighting properties it does not seem possible that the movement in favor of municipal operation of electric lighting plants, based upon the assumption that a municipality can produce electricity cheaper than, or even as cheap as, a private corporation, is well founded. We all realize, from the close attention we have to give to our own affairs, that self-interest and the necessity of getting a return on our investment are the first essentials to the economical administration of large enterprises.

While I do not pretend to claim that electric lighting companies are beyond reproach, I wish to point out that many of the evils complained of as pertaining to corporate management are the direct results of the enforcement of unwise conditions through legislative action. Ill-advised efforts are often made by legislative bodies to secure advantages in the direction of control which cannot be obtained without giving an equivalent in protection to the industry. This causes the investor to feel that his property is being attacked and compels him to resist such legislation. The result is a feverish agitation, crimination and recrimination, between the would-be improvers of municipal government and the owners of corporate properties without reaching a conclusion satisfactory to either. The fallacy of the so-called reformer's theory results from looking only at what he calls the injurious effects of corporate management without taking into account its indisputable benefits. He does not seek for the cause of the trouble. If reformers will take accurate account of all the points in the problem, they will discover that the evils complained of result from errors in legislation designed to determine the relations between municipal bodies and electric lighting companies. It seems to me that the claim that municipal operation is the universal cure for all diseases for which electric lighting companies are supposed to be responsible merely proposes the substitution of political in the place of industrial management. This raises the question: Is the administration of municipal affairs in the various cities throughout this country so economical as compared with the management of private industries and the class of service rendered so efficient as to justify the increasing of the burdens already imposed upon municipal government? It appears to me that a correct division of power and responsibility requires political government to control private industrial management. Where political government and industrial management are merged into one interest, the power of control is seriously impaired, since a political administration cannot be reformed without overturning the party in power.

I cannot bring myself to the belief that the citizens of this great country are in fact opposed to large aggregations of capital in corporate form, as such aggregations are absolutely necessary to the operation of all great undertakings by private enterprise. It is as impossible to operate such vast affairs with individual capital, as a personally owned business, as it is for us to live without municipal, state and national governments. The misunderstandings which from time to time occur between communities and the managers of electric lighting companies will, to my mind, disappear entirely if the relations between the two are correctly founded on the basis of public control, with corresponding protection to the corporations operating this industry. It would seem to me to be a very proper function for this Association to address itself to educating the public to a definite legislative policy which will be fair to the municipalities, securing to the public the best service at the lowest possible price, and protect corporations by giving them franchises, which, while conserving municipal control, will insure to the investor the permanency of the undertaking.

Competition Is Not the True Regulative Force.

It is supposed by many who discuss municipal affairs that the granting of competitive franchises for public service work is the true means of obtaining for users the lowest possible price for the service rendered, whereas, as a matter of fact, the exact opposite is the ultimate result. This is proved by results in all large cities where the most severe competition has taken place. Acute competition necessarily frightens the investor, and compels corporations to pay a very high price for capital. The competing companies invariably come together, and the interest cost on their product (which is by far the most important part of their cost) is rendered abnormally high, partly owing to duplication of investment and partly to the high price paid for money borrowed during the period of competition. The selling price of a service should be based on its cost, and in any business, such as public work, where the investment is large and the annual turn-over is comparatively small, if the item of interest be unnecessarily augmented, it must be reflected in the price paid by public and private users.

While it is not supposed to be popular to speak of exclusive franchises, it should be recognized that the best service at the lowest possible price can only be obtained, certainly in connection with the industry with which we are identified, by exclusive control of a given territory being placed in the hands of one undertaking. In most European countries public service operations enjoy exclusive franchises, under proper control, and are able to obtain capital for their undertakings at the lowest commercial rates, thus materially affecting the cost of their product, of which interest, as I have already stated, is necessarily so great a part. In order to protect the public, exclusive franchises should be coupled with the condition of public control requiring all charges for services fixed by public bodies to be based on cost, plus a reasonable profit. It will be found that this cost will be reduced in direct proportion to the protection afforded the industry. The more certain this protection is made the lower the rate of interest and the lower the total cost of operation will be, and, consequently, the lower the price of the service to public and private users. If the conditions of our particular branch of public service are studied in places where there is a definite control, whether by commission or otherwise, it will be found that the industry is in an extremely healthy condition, and that users and taxpayers are correspondingly well served.

Compensation for Franchises.

When prices for services are based on cost, it matters not whether in the establishment of a system of legislative control provision is made for paying a portion of the receipts direct to the municipality. If the public demands a percentage, surely we can afford to pay it, as it would simply be added as an item of expense on which our selling price would be figured. If the public does not demand a percentage, this selling price would be proportionately less. It is simply a question as to whether our municipal bodies prefer to raise a portion of their income by taxing their citizens through the agency of public service corporations, or whether they prefer to raise that portion of their income by collecting it direct from citizens themselves. Revenue raised by a percentage on gross receipts of the electric lighting business would, at the present time, however, seem to be somewhat unfairly obtained in cases where the selling price is subject to legislative control and based on cost of service, as the result would be that a small minority of citizens using electricity would be forced to contribute largely to the public revenue, whereas the benefits enjoyed therefrom would be to the advantage of the whole community.

Taking Private Property for Public Use.

Another point that should be included in a proper scheme of public control is a condition under which the municipality would have the right to purchase the undertaking. Such a right should include a direct obligation on the part of the municipality to purchase the property at a fair price whenever it is thought desirable that the industry should be operated by the municipality. The possibility of the exercise of the right of purchase by the municipality would of itself make it to the interest of the owners of the property to do their full duty in their relations to the public. On the other hand, if a community licenses a corporation to perform a certain public service, and if that corporation invests its money and develops its business, surely it is unfair for that community to go into the same line of public service work itself without first purchasing the existing plant. If this is not done the value of private property will de destroyed without just compensation being made therefor in an attempt to secure a public benefit. I do not believe that the people as a whole are so unfair as to demand that such a course shall be taken.

My recommendations on the subject, which I have just presented, are by no means original. Most public service corporations in Great Britain are run on practically the bases indicated, and in more than one state in the Union corporate legislation has taken the same direction.

I would summarize the position which I think we should take on this subject in just two sentences.

First—Franchises granted to public service corporations should secure them the same degree of protection in their rights to their property as is enjoyed by other investments.

Second—Public control of charge for service based on cost, plus a reasonable profit, and eliminating the factor of competition, is the proper safeguard for the interests of users, taxpayers and investors.

CUTTING SUBMARINE CABLES.—The following paragraph appeared in the London "Electrician" of June 10th, and its publication in your columns cannot fail to be of interest to your readers.

Yours very truly,
JAMES BROWN,
Supt.

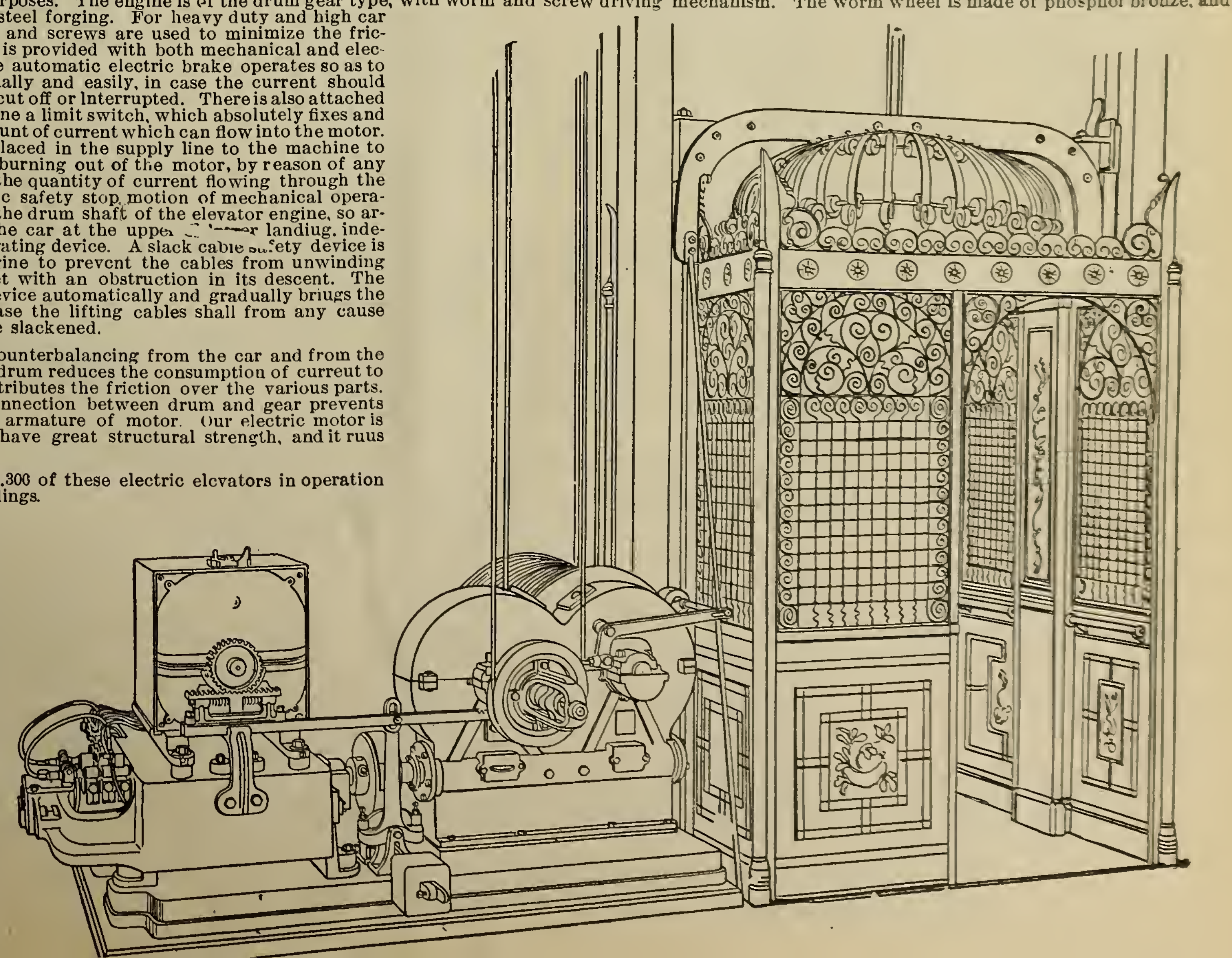
"With reference to statement made in daily press, that if the United States interrupt telegraph communication with Spanish colonies, Spain will retaliate by severing the cables between the U. S. and Europe, we desire again to point out in the strongest manner the futility of such an attempt, which would only result in injury to neutral property, without effecting the desired object, and would inevitably lead to heavy claims for damages, to say nothing about the practical impossibility of breaking some twelve or thirteen cables before those first severed have been repaired. We have it on the authority of one of the Atlantic companies that they have transmitted readable code words through a cable five hundred miles long, broken about midway, by means of apparatus invented by A. C. Brown, of the Single-Wire Multiple Telephone Signal Co."

THE COST OF OPERATING ELEVATORS BY STEAM, WATER AND ELECTRICITY.

The cost of operating elevators by steam, water and electricity has properly become the subject of careful investigation, in view of the extensive and growing use of these appliances. It is stated that in New York, the home of so many sky-scrapers, a larger number of persons are carried vertically in elevators than are transported horizontally by the various forms of traction. Experience with electric elevators in the United States is said to have shown the cost of carrying a useful load 1500 pounds to a height of 100 feet, inclusive of return to starting-point, to be one cent. In Berlin and Vienna the cost is reported to be considerably below the figure mentioned. In the former city the cost of lifting by electricity a load of 850 pounds to a height of 80 feet, inclusive of descent, was only one-fifth of a cent.—The Canadial Architect.

It will be of interest to the general public, hardly less than to the electrical fraternity, to know that Lieut. Frank J. Sprague, who has for the last six weeks been confined to his house, and in great suffering, from a severe injury to his right eye, is in a fair way to recovery. Nearly two months ago, a piece of the eyeglass Mr. Sprague was wearing was accidentally forced into the ball of the eye, and Mr. Sprague had to remain for some two weeks under the care of a specialist. Being very anxious to push forward to definite shape the Volunteer Corps of Electrical Engineers, which he offered some time ago to organize for early service at the front, Mr. Sprague imprudently went to Washington, where he caught cold in the injured eye. Severe complications set in, along with iritis, and for some time it was feared that blindness was inevitable. This danger, however, seems to have passed, and there is every prospect that Mr. Sprague will soon be able to renew his active part both in the affairs of the company with which he is identified, and the formation of a fighting corps that should fill a place of its own in the war resources of the Government.

Rutland City, Vt.—The Rutland City Electric Co. is removing to its new plant.



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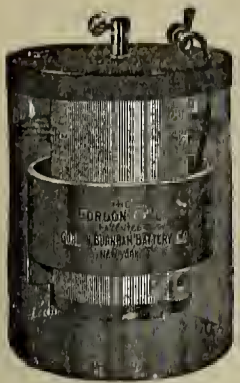

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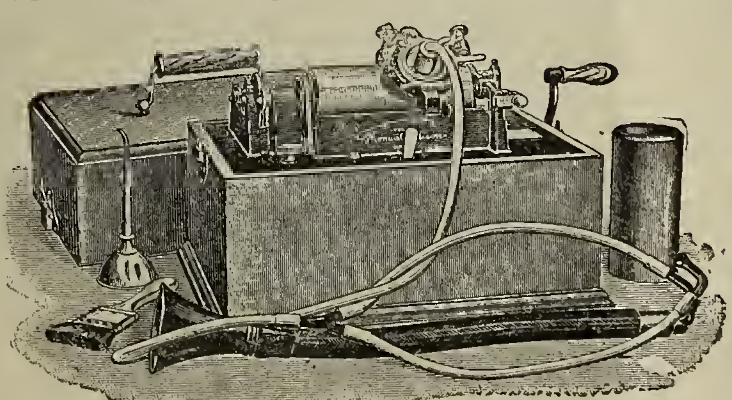

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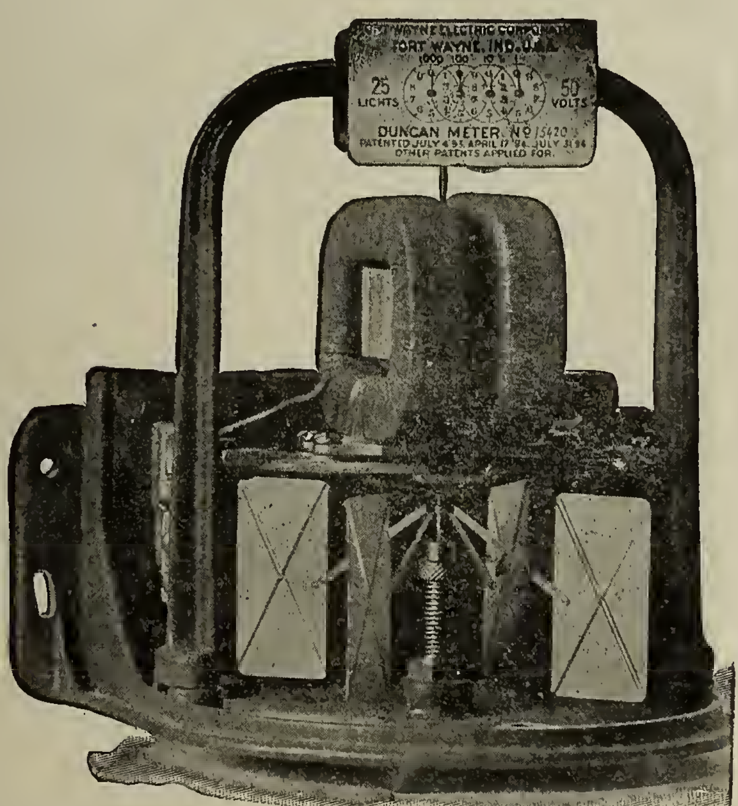

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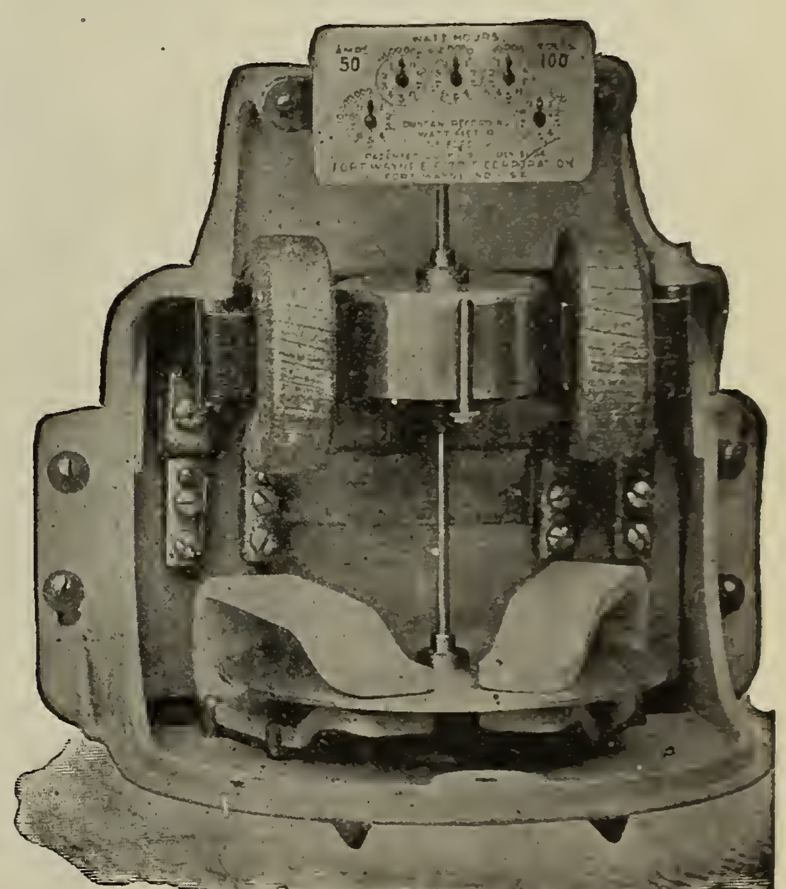

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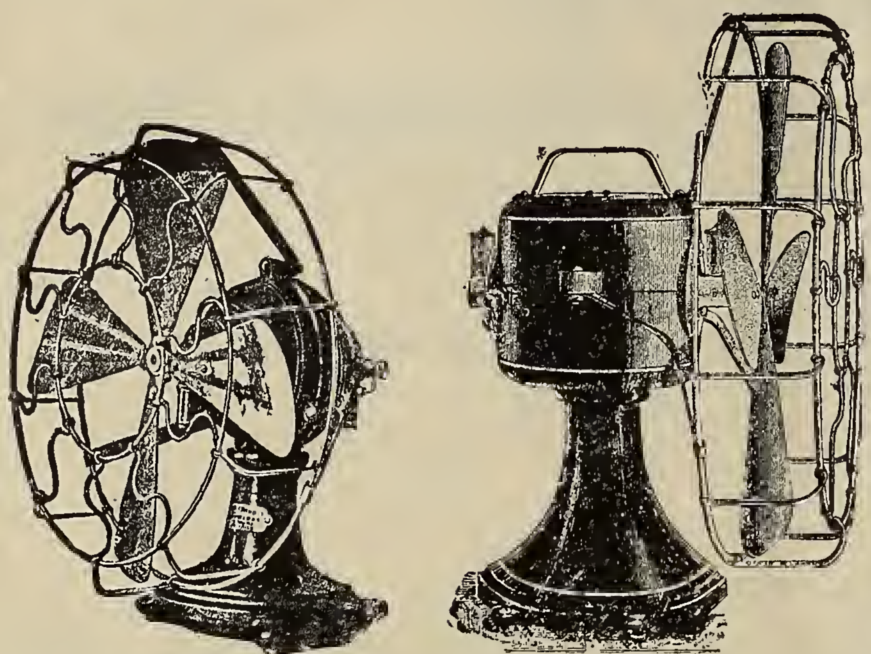

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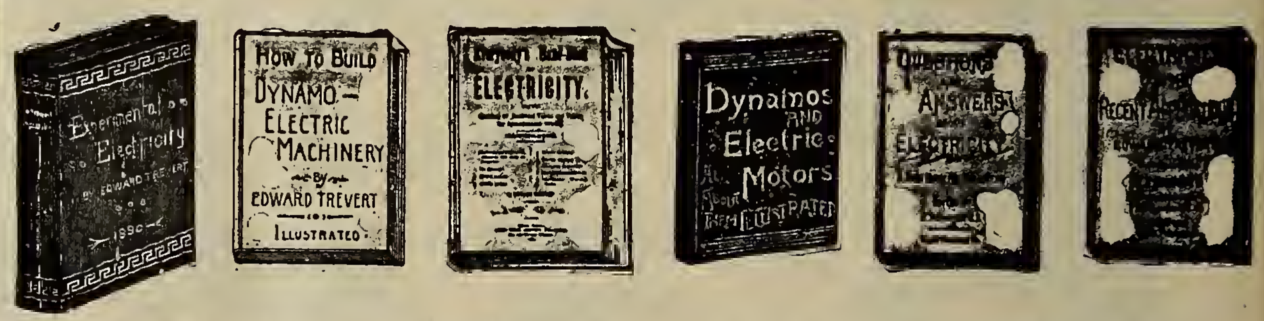

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