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**GREETINGS:** *It is our sincere wish that all of our readers will enjoy Health, Happiness and Prosperity through the year 1916.*

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# ELECTRICAL AGE

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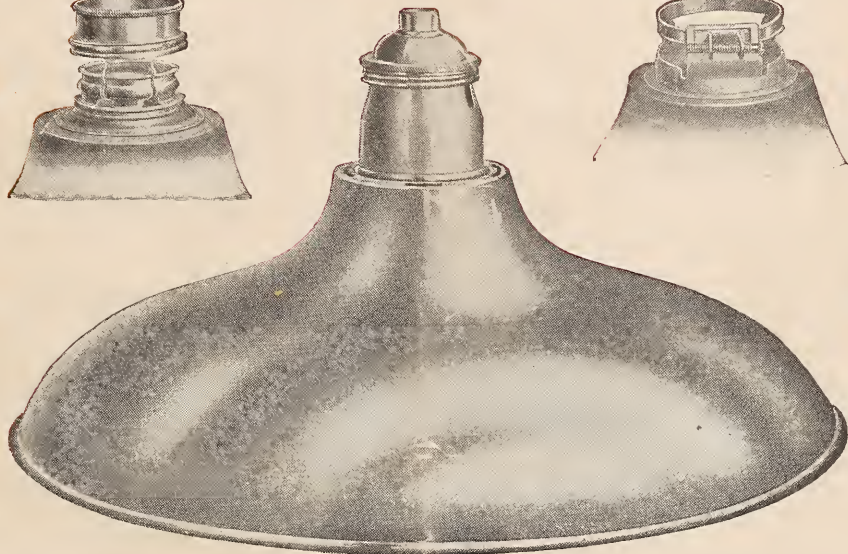
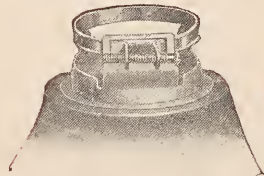
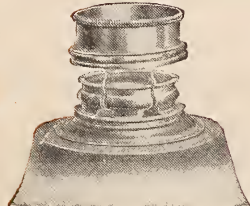
*The National Monthly of Electric Practice*

Technical Journal Co., Inc.  
233 Broadway, New York

**JANUARY, 1916**

Volume 48, No. 1.  
Subscription One Dollar

*621,5051  
E3821*



*Send Today for BULLETIN H*

**The A-A ELECTRIC MFG. CO.**

**BRIDGEPORT, CONN.**



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"Standard for 50 Years"

Stock Sizes for all voltages and specials made  
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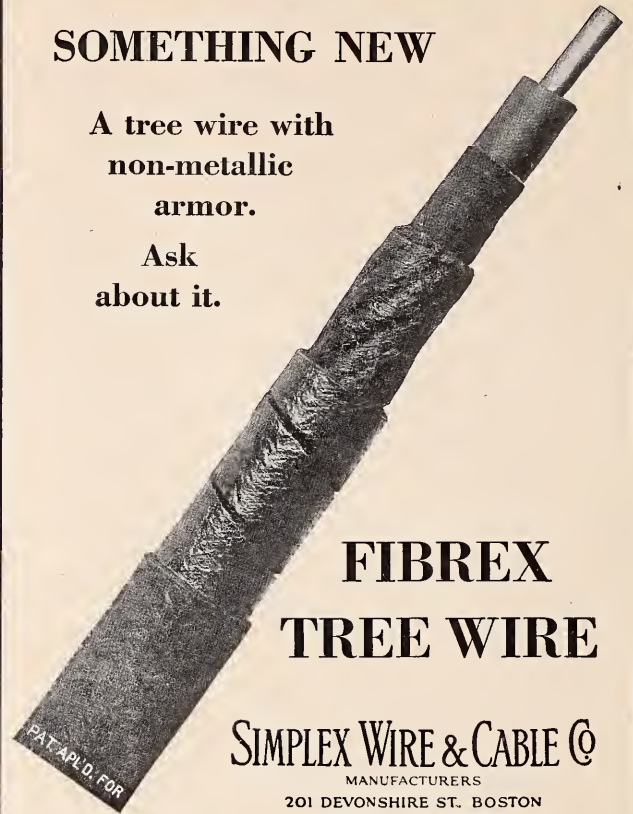
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A tree wire with  
non-metallic  
armor.

Ask  
about it.



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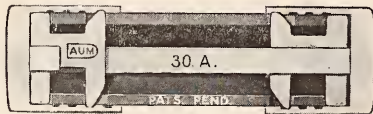
**SIMPLEX WIRE & CABLE CO.**

MANUFACTURERS  
201 DEVONSHIRE ST. BOSTON  
CHICAGO SAN FRANCISCO

16

## *The Last Word in Fuses*

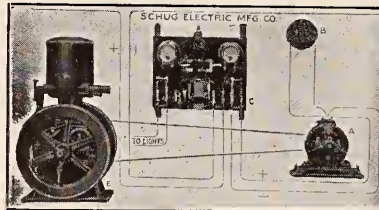
### A New Type B Fuse



3-60 Amperes. 250-600 Volts.

**C**APS removed by the twist  
of your wrist, no tools  
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The fusible element comes in  
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For Country Homes  
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Send for sample and catalogue.

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**The Nungesser Carbon & Battery Co.**  
CLEVELAND, OHIO

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Telephones: New York, Barclay 7448; Chicago, Central 3792

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PRODUCTS**

CATALOGUE  
No. 8



CABINETS  
CUT-OUT BOXES  
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Write for this new catalog and discount sheet that gives you better prices than ever before on Columbia Products.

**COLUMBIA METAL BOX CO.**  
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**Stands for Quality in  
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**Paranite Rubber Covered Wires** made to meet all requirements of New Code Specifications. For Aerial, Submarine, Underground and Inside Use. Telephone, Telegraph, Signal Electric Light and Power Wires and Cables.

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Free sample - use company letterhead or state your position.

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**Time Savers In Any Electrical Work  
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Unexcelled for test sets, meters, transformers and motor test floors, shop test benches, college and laboratories, motion picture projection work and storage battery charging.

**R. S. MUELLER & CO. 419 High Ave., S. E., Cleveland**

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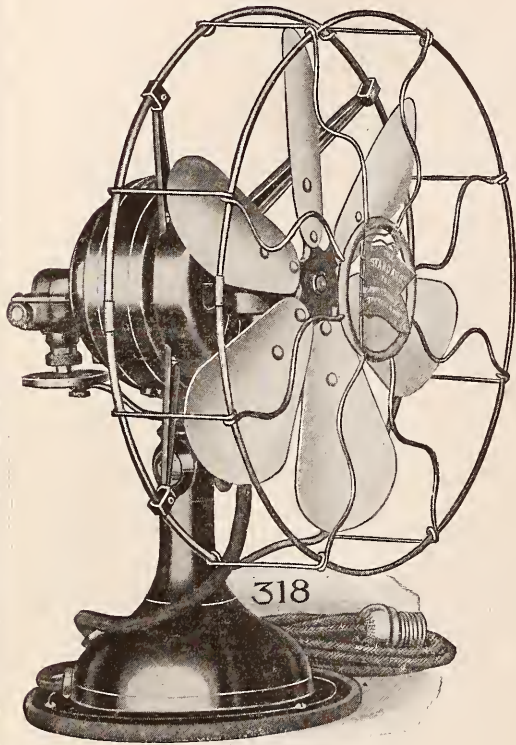


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# *Air Volume, Not Velocity, Is The True Measure Of Fan Efficiency*



Fans are often judged by comparing the velocities of the breeze they produce. This method is incorrect as the blade construction of a fan may be such as to impart a high velocity to the air while the air leaves the blades at a very narrow angle. The area it affects and the volume of air moved is consequently low.

To stand in front of such a fan, however, one would get the impression that it is more powerful than another fan which gives relatively low velocity but throws the air out from the blades at a wider angle and moves a greater volume.

And in judging a fan the volume of air moved should be considered as well as velocity, for the fan which gives wide distribution and moves a large volume of air will cool a larger place and give greater comfort than the fan which moves a smaller volume of high velocity.

A high velocity breeze may really prove objectionable and unpleasant if one remains in it any length of time. Then too, high velocity is usually accompanied with a disagreeable air hum.

The greatest comfort from a fan is obtained with a gentle breeze of large volume and wide distribution—such as is obtained with Robbins & Myers Fans.

Robbins & Myers Fans are made in all styles and sizes—6-inch to 16-inch drawn steel and cast iron frame construction. And every fan is guaranteed to satisfy your customers.

*Write for catalog and trade discounts*

## THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO, U. S. A.

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NEW YORK

PHILADELPHIA

BOSTON

CLEVELAND

ST. LOUIS

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CHICAGO

SAN FRANCISCO



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Telephones: New York, Barclay 7448; Chicago, Central 3792; Cleveland, Main 557

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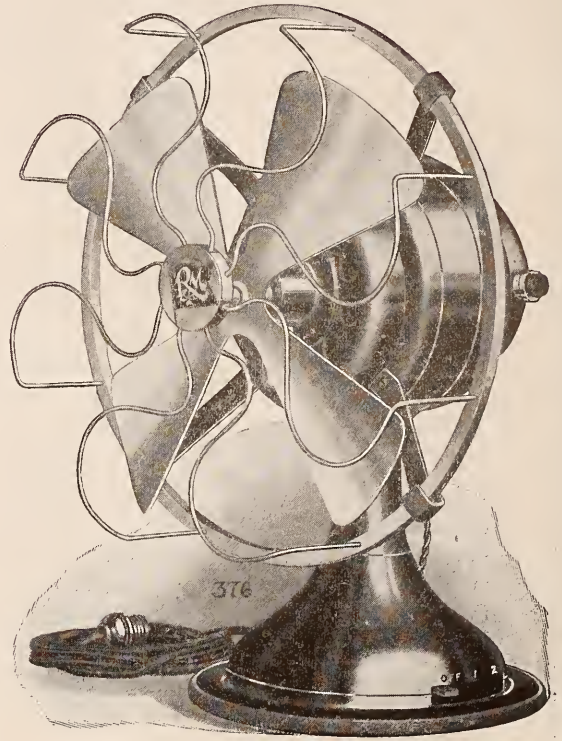
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# It Is Now Possible To Put A Fan In Every Wired Home In Your City

The low cost of the Robbins & Myers 6-inch Desk Fan, places it within reach of everyone who has electric current in his home.

And this new fan is ideal for household use. The motor is large and powerful and the blades have a steep pitch, giving the kind of breeze one would expect from a much larger fan.

The motor is universal and will operate on any direct or alternating current circuit where the voltage is anything from 100 to 120 volts. This fact, together with the small size and light weight of the fan makes it ideal for the traveling man, as he can easily carry it in his traveling bag and use it anywhere he may stop.



The drawn steel frame of this fan is graceful in design and attractively finished. The switch in the base provides two running speeds. A felt pad covers the base and enables the fan to be placed on the most highly polished surfaces without danger of marring the finish.

In every detail this fan comes up to the Robbins & Myers standard of quality. With proper care it should give a lifetime of service. It is sold under the same guarantee as the larger sizes and the dealer selling it is sure that every fan will stay sold and be a working advertisement which will make more sales for him.

Each fan is equipped with a cord and plug.

*Write to-day if you haven't made arrangements to handle this new line.*

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## A LETTER

March 6, 1916.

Mr. A. Hall Berry,  
97 Warren St.,  
New York City.

Dear Sir:

This is your authority to advise the trade that Duraduct as now manufactured and as it has been manufactured for some time in no way infringes any patents.

Our engineers have developed a great improvement in conduit construction. The tube is made entirely of high grade cotton yarns. This permits the compounds to permeate the tube whereas all ordinary methods of conduit making allow for merely a surface compounding.

The value of this achievement is big. We have done what has been considered impossible.

Yours truly,

Tubular Woven Fabric Company.

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The Monthly Authority of the Trade

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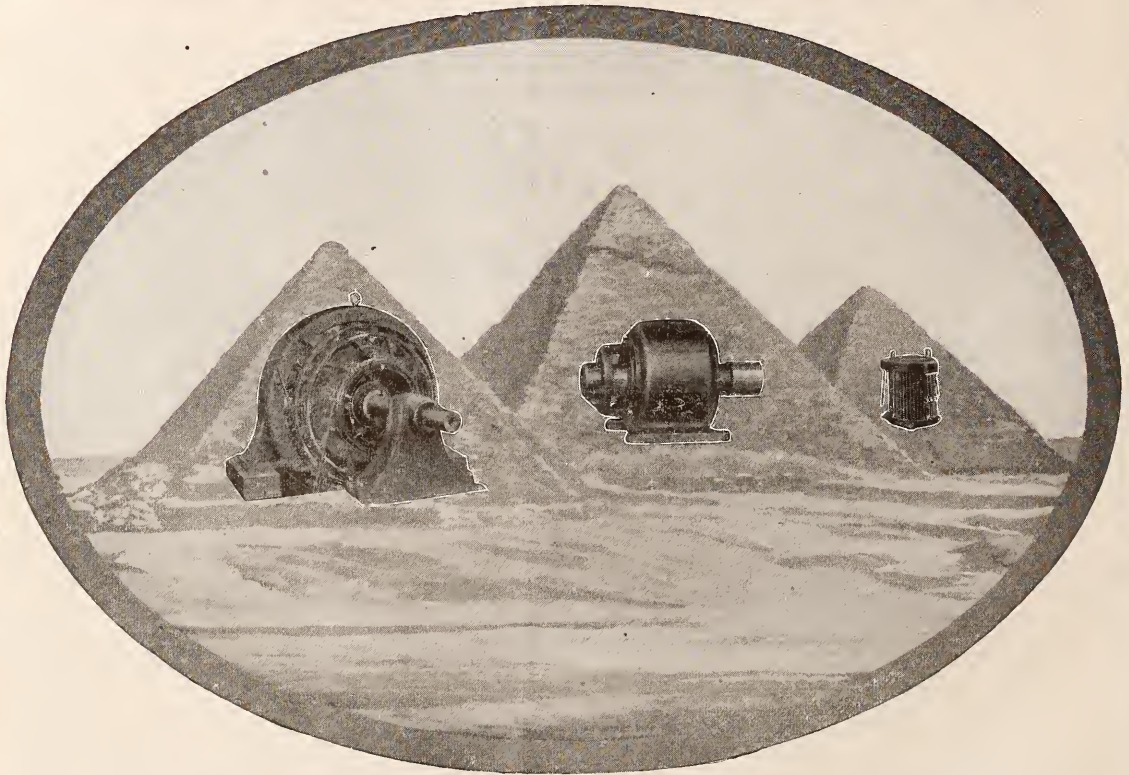
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# ELECTRICAL AGE

The Monthly Authority of the Trade

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chas. B. Thompson, President

Wm. F. Eastman, Vice Pres.

CHICAGO OFFICE, 1209 WESTMINSTER BLDG.

Telephones: New York, Barclay 7448; Chicago, Central 3792

Volume 48

JUNE, 1916

Number 6

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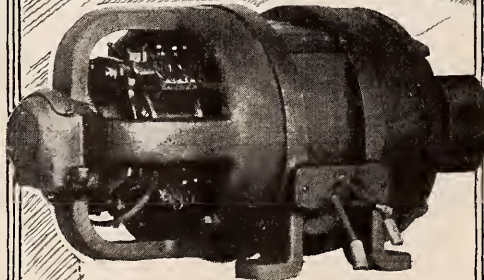
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# ELECTRICAL AGE

*The National Monthly of Electric Practice*

Formerly ELECTRICAL ENGINEERING

*Technical Journal Company, Inc., New York*

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Vol. 48

JANUARY, 1916

No. 1

## Modern Electrical Inside Construction

*Illustrating Recent Installations*

*By B. Gross*

Advanced practical methods of installing electrical building equipments attract particular attention in that they show the progress that has been made in this, now important branch of the electrical field. This progress is very apparent in all three stages of the work, which comprises, first, the original design of the equipment; second, the execution of the same from the engineering standpoint and thirdly, the actual construction work done on the site. The various typical equipments described below give evidence of this progress. Considerable credit is due the contractors installing this work, who build up an organization that applies special efforts towards making improvements at all times and places. The efficiency of the equipment after completion largely depends on the installation thereof, and hence it follows that this co-operation with the contractors and the owners is a most valuable asset.

In the past, the electrical plans were drawn up by the architect or a consulting engineer in a more or less, usually less, complete manner and turned over to the successful bidder for execution. The contractor would invariably send these plans to his foreman at the site, who would have to use his judgment in the installation, along with the infrequent instructions and guidance of the architect or engineer. This left the discovery of improvements entirely to a man who had to handle anywhere from 4 or 5 to 50 or 60 men and be somewhere between the sub-basement and the roof every now and then during the day, not to speak of the continuous nagging he received from the building contractors to push his work.

The writer personally found a case recently where an architect distinctly showed, on his plans, for 60 per cent of the floors, switches on wood and glass partitions 8'—0" high on 12'—0" floors with conduits di-

rectly run up from these switches to the ceiling outlets they control. The job was a rush one, and work would undoubtedly have been installed as laid out, the finished floors and ceilings set, and a fine mess found when the wood partitions were placed. This error was fortunately discovered by the contractor's engineering department before the installation started. The contractor to-day maintains a force of engineers in constant touch with his jobs and applies engineering science to his work in a practical manner. This service to the owner is invaluable.

Some good examples as up-to-date construction on inside work are briefly shown, as instancing the lines into which this practice is settling.

### Some Typical Installations

A Young Men's Christian Association in one of the largest cities in the country has recently completed an unusually interesting equipment for a building of this character. The energy is supplied by an isolated plant consisting of two 200-kw. and one 75-kw. generators driven by heavy duty single valve engines, operated on a steam pressure of 100 pounds. The generators are of two-wire type delivering direct current normally at 235 volts. The power system in the building is on 235 volts, whereas the lighting is 3-wire, 235/117½ volts. A pair of motor generator balancer sets provide the neutral of the lighting system and each will compensate for an unbalance of 68 amperes. The plant is very efficient, the exhaust steam being utilized during all seasons for either heating, or hot water supply throughout the building. There is also a low-voltage bell plant of 2-500-watt motor-generator sets and a 120-ampere-hour storage battery for supplying signal systems.

A marble switchboard in the engine room controls the output of the plant. The generator lines are equipped with time element and reverse current circuit breakers,

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and a duplicate pair of switches for operating any machine on either the power or light bus alone, or in parallel with another on either bus. The advantage of this flexibility is evident, as the usual flickering of the lights, due to the continuous starting of elevators, is eliminated by having one unit provide the power exclusively. When both switches of a particular machine are in that machine provides both light and power and the two buses are tied together through these switches. Generators are paralleled with the use of a differential voltmeter. The main ventilating fans and the elevators are provided with a further throw-over scheme, using a pair of switches for each, arranged so that the feeder in question can be shifted from the power to the lighting bus without interfering with the service. This enables the plant engineer to operate the units as near full load as possible and hence maximum efficiency.

The building lighting is provided from two vertical shafts in each of which a distributing panel is placed on each floor. The auditorium lighting is controlled in a very novel manner through a dead face plug and receptacle switchboard which is extremely simple, flexible and compact. It is designed to meet the new requirement of the city authorities, which insists on dead front switchboards on stages, and also allows for easily connecting any circuits on any dimmer. The accompanying sketch, Fig. 1, shows clearly the general scheme. The various stage circuits that are to be controlled from the switchboard either through dimmers or direct on the buses are connected each through a pair of fuses to a double pole receptacle on section A. On panel B, eight sets of similar receptacles are mounted, six sets being wired in multiples of three, each through a dimmer to a separate circuit on panel C. The other two are connected direct

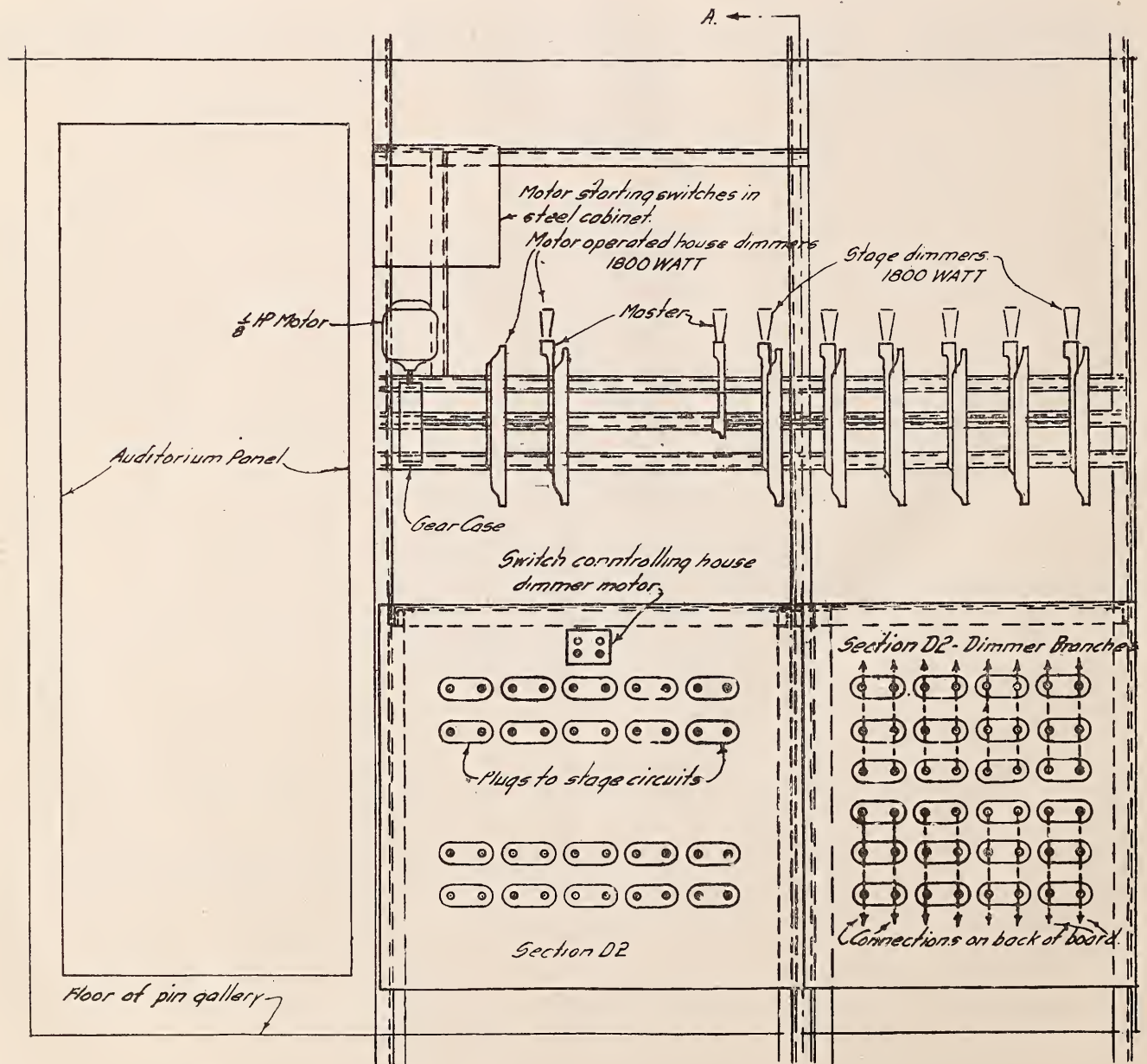


Fig. 1—Modern dead-front stage switchboard panel

to the panel without a dimmer. By the use of a two wire flexible stage cord, each end equipped with a double pole slug, and stage circuit or group of circuits can be plugged onto any dimmer or straight supply. This is a very desirable feature where special scenic effects are sought through the use of colored lamps in the foot light and border strips. A remote operated motor driven dimmer is provided for the house lights, which will dim the lights to a minimum in six seconds, and is controlled from the stage on the stereopticon booth. All house lights are fed from the stage board. A relay is also inserted in the main stage feeder at the switchboard in engine room, so arranged that a series of emergency lights in the auditorium are automatically thrown on to the low voltage storage battery should the main source fail.

Taken as a whole, this is a model equipment electrically, from both the engineering and construction standpoints.

For a factory installation, the system in the new building of a large biscuit making concern, not far from New York is noteworthy of special attention. The essential features of this electrical equipment are the motor system and the vehicle charging station, the latter being in an entirely separate building known as the "garage." Both gasoline and electric vehicles are stored and repaired in this building, where the electric installation was specially designed to meet the stringent rules regarding this type of building.

The plant is composed of 3-625 kva., 3-phase, 60-cycle, 220-volt alternators, driven by Curtis horizontal type steam turbines at 3600 r.p.m. Excitation at starting is provided by either the 15 kw. or the 35 kw. d. c. 125-volt, turbine driven exciters and after being started up, by a 14 kw. motor-generator set equipped with a 3-phase squirrel cage induction motor and a 2-wire, 125-volt direct-current generator. The boiler plant consists of six water tube type 250 hp. boilers. A large coal storage is adjacent to the boiler room into which coal can be dumped direct from the coal cars that may be brought up on a siding close by. A large coal handling device in the form of a jawed bucket similar to that used in excavating, and motor operated, is used for transferring coal from the railroad cars to the coal storage room from which the boilers are directly fired. There is also a large ammonia compressor driven by a 150 hp. Corliss engine in the plant used for their refrigeration system.

The switchboard is of very high grade construction, being of a fine quality genuine Monson oiled black slate, and very substantially built. There are no cable connections whatever on the rear of the board, except, of course, the small instrument and potential wiring. All feeders are extended from their respective switches by bare round copper rods to the top of the board where they terminate in the usual terminal lugs into which the feeders are sweated. This makes a very neat, compact, clean and accessible arrangement shown in Fig. 2. The main generator circuit-breakers, are of 2,000-ampere capacity, one mounted on the rear of the board on separate slabs and operated from the face by remote control toggle switches, at which red and green-pilot lamps are located to indicate when the breakers are on or off. The speed of the turbines is also remote controlled from the switchboard by governor control switches that control the operation of a motor on each turbine actuating the governor valve.

The power system is 220-volts, 3-phase throughout and all the motors five hp. and over are equipped with autostarting compensators. These compensators are each provided with a set of fuses that are short circuited while the machines are starting to avoid their "blowing" on the high inrush current, and with low voltage releases that automatically disconnect the motor from the line when the main voltage fails.

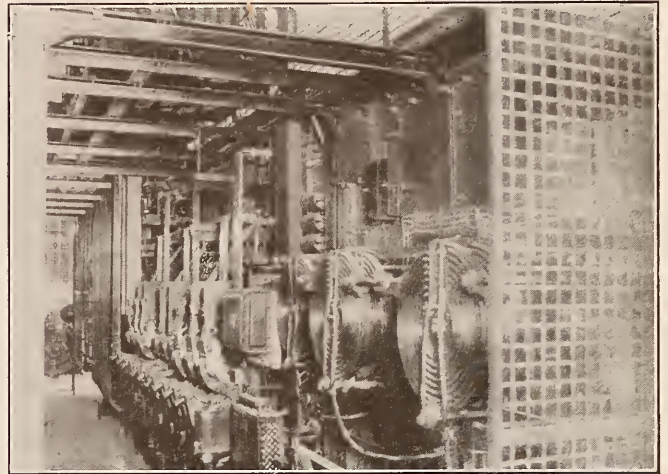


Fig. 2—Rear view of a factory switchboard

This last feature is very desirable and a necessary device. If the plant is suddenly shut down due to some accident and again started up, with the motors that were operated at the time of shut down still connected across the line, there would be a tremendous peak load on the plant due to the summation of all the inrush currents that average anywhere from 50 percent to 300 percent more than normal. This feature is indispensable in large equipments.

There is in the building a total of 161 motors with an aggregate of 832 hp. These motors are used for driving conveyors, dough and wafer cutting machines, ovens, dough mixers, grain elevators, sieves, grinders, nailing machines, lathes, etc. They are all of squirrel cage induction type. Fig. 3 shows a series of these motors and their starting compensators installed. A series of

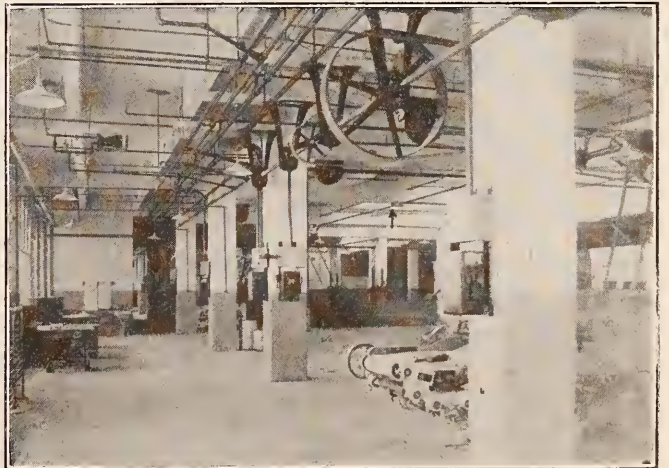


Fig. 3—Motor and wiring arrangement

junction boxes with 3-pole polarity receptacles are provided throughout some of the floors for supplying portable devices on cutting tables, which are mostly all equipped with 2 or 3-hp. motors. One of these receptacles is indicated by the arrow.

The lighting is supplied by 3 240-120 volt balancing transformers, located behind the main switchboard, one being connected on each phase, and the building divided in three parts, one for each transformer.

The entire conduit system is exposed throughout, suspended from inserts placed on the forms before concrete was poured.

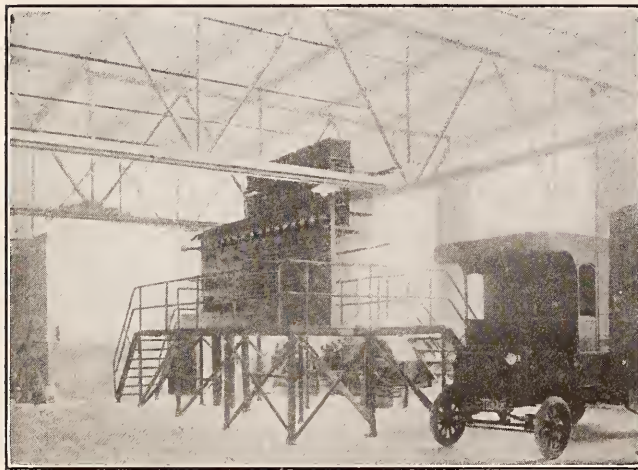


Fig. 4—Garage switchboard mounted on platform

The gasoline vehicle storage and electric vehicle charging station in the separate garage building also supplied from the plant, at a distance of 600 feet. There is provision in the electric machine room for charging 18 1-ton and 12 2-ton trucks simultaneously, and also boosting 6 of each at 100 percent above normal rate. Two 100-kw. motor-generator sets with squirrel cage induction motors and 2-wire, 125-volt direct generators are used to supply direct current for charging. The switchboard is mounted on a steel structure 5'-0" above the floor as shown in Fig. 4. The entire floor of the platform is of 2" slate. An individual charging circuit is provided for each truck, fed from a separate fused

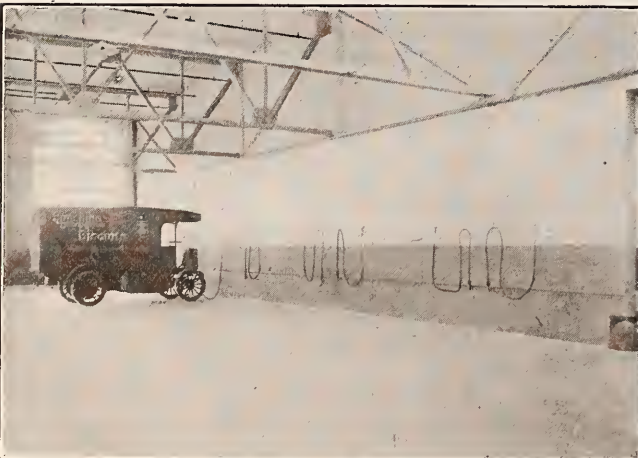


Fig. 5—Vehicle Storage Room

switch and through a separate variable rheostat. Each circuit switch is double-throw, arranged to put an ammeter in the circuit when thrown on the instrument side. A potential receptacle is also provided for each circuit, so that the voltmeter on the panel in question can be connected across any circuit on the charging side. This allows for the usual measurements of voltage and current and on charging. The rear of the board is arranged similar to the main switchboard with extension rods. This board set on a platform, gives the operator a clear view of the entire room.

The equipment at the vehicle end of each circuit is clearly shown in Fig. 5.

This entire electrical equipment was designed and installed by one company as contractors and is a splendid example of high grade electrical construction.

#### A Warehouse Example

Another modern installation is that in a large warehouse building, 500 feet by 250 feet, six stories high. The supply is from the local lighting company's lines.

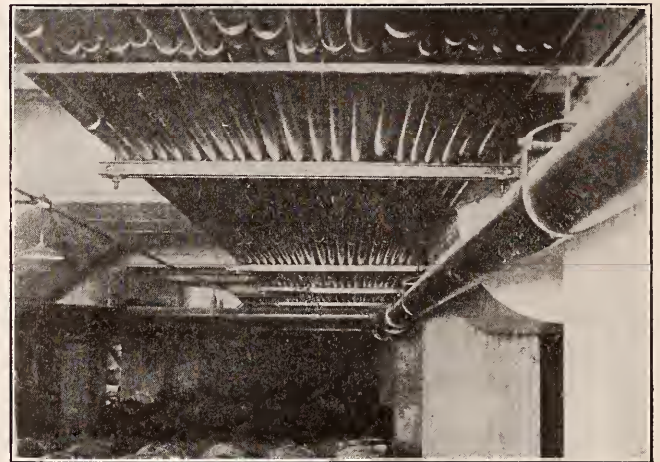


Fig. 6—Feeder conduits in a warehouse building

The run of main feeder conduits is a part of the extensive pipe work shown in Fig. 6. The entire conduit system is exposed and designed to have a minimum number of pipes on the ceiling for circuit work. Fig. 7 shows a fine example of some of the lighting installation.



Fig. 7—Warehouse lighting installation

There are approximately 150 motors ranging from  $\frac{1}{4}$  to 40 hp. in this building.

extended. This was all done with the plant in operation and the buses alive. The new section was made in a

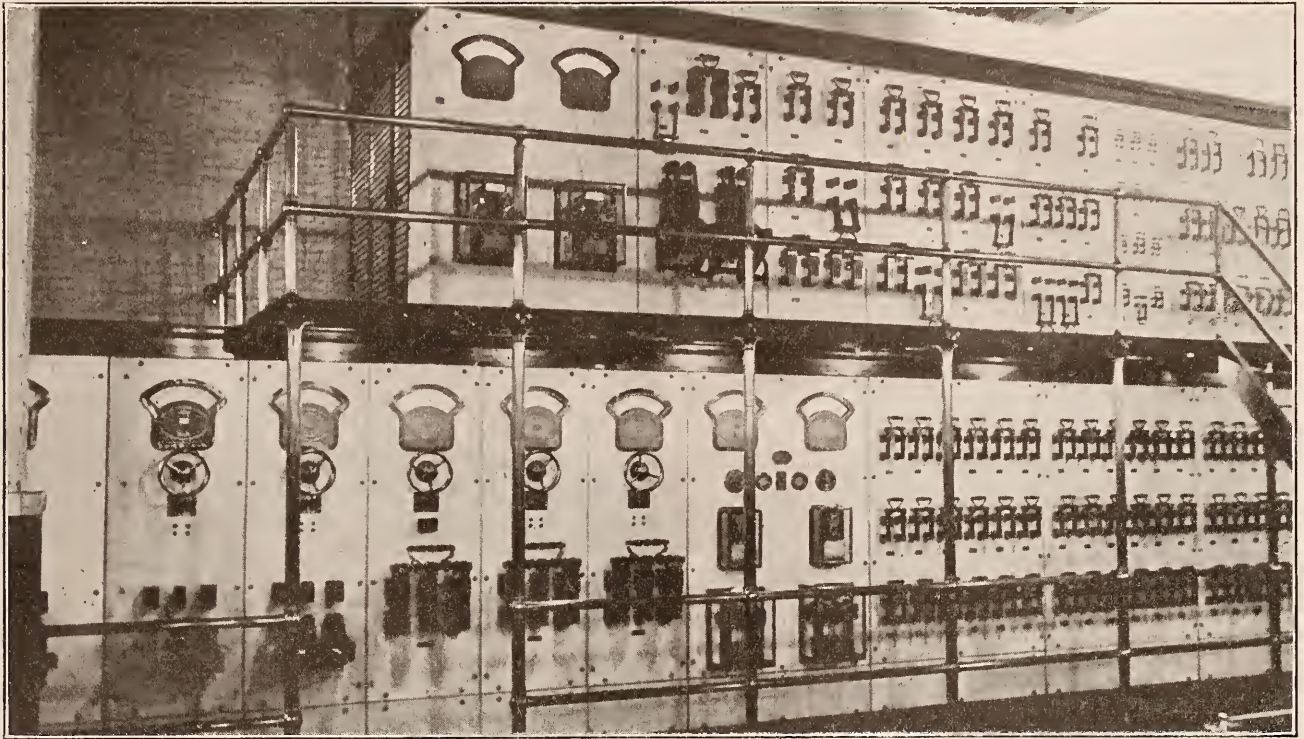


Fig. 8—Two-story switchboards in New York Department Store. The upper portion is extension section.

The manner in which the plant of a big New York department store was augmented, illustrates what can be done in limited space by modern methods. A large addition was made, the extension really being larger than the old building. Two new 400-kw. units had to be added to the plant, which is a 110-volt direct-current supply. The already massive copper on the board (for 3-400 and 2-200 kw. machines) had to be increased and

second tier as seen in Fig. 8. The rear of this board is shown in Fig. 9 and illustrates the massive and almost "wireless" evolution of the modern board.

Undoubtedly the greatest single step in improving the methods of indoor construction has been the development of iron-armored conduit and the placing of distribution conductors of all kinds is now invariably in conduit wherever the standard of work is first class. From switch-board to panel-boards and from these to the service outlets, the system of conduit as now put, in forms a complete protection against all external abuse.

The mileage of this material installed in even moderate sized buildings is well-known to reach astonishing figures. To place such a system in place with minimum confusion and occupying a minimum space in the places allotted is very often a problem whose solution calls for very careful planning, and great attention to detail.

The result of considerable experience in this line is shown by the gradually increasing voltages that are being handled in indoors with ample safety by the help of conduit. The work, as now put in, is absolutely tight as to wall, and curves are eased so as to enable the conductors to be readily withdrawn, where occasion arises. Especially noticeable are the improvements in the outlets and terminals of conduit lines, all of which are utilized in his work by the modern engineer-contractor.

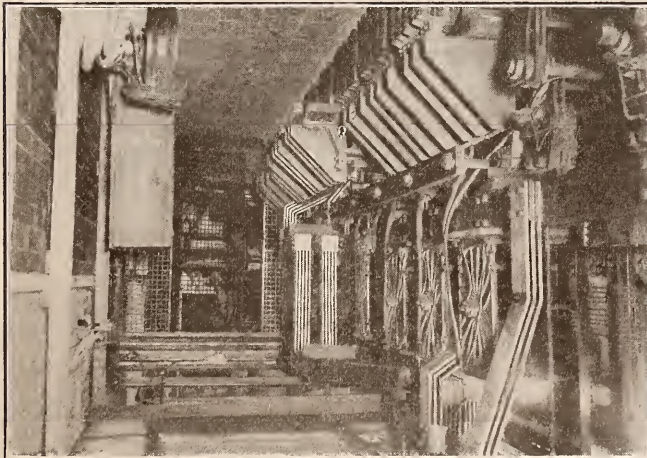


Fig. 9—Rear view of department store board

Figures 10 and 11 show some heavy conduit work, indicating a very high class of construction. These illustrate the quantity of pipe that can actually and accurately be installed in a given space with

With modern methods of insulation manufacture and the latest provisions for the protection of all parts of the electric system from abrasion, moisture, overload, or other injury, it may be confidently predicted that in-



Fig. 10—Line of conduit risers in office building

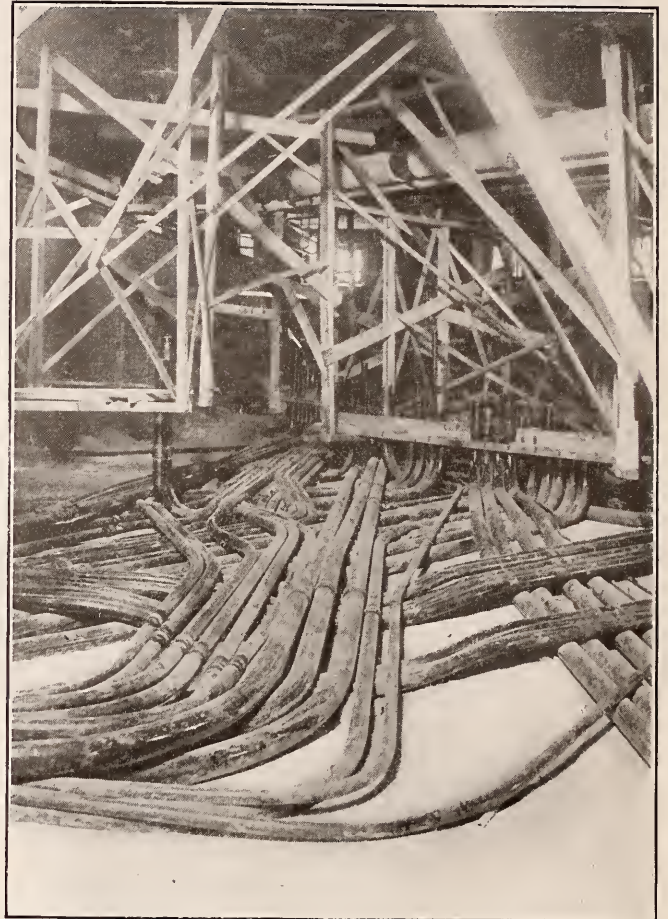


Fig. 11—Heavy installation of conduits in course of construction  
—temporarily from ceiling

the aid of modern electric construction methods. A particular feature shown in the latter is the use of overhead templets to hold the piping accurately in place while the concrete floor is being laid.

The foregoing gives a good idea of the tendency of up-to-date inside installations to get away from all that is insecure or uncertain in operation. The replacement of the old methods of fastening and housing conductors by rigid systems of rods and conduits is but one instance of this. Every detail is put in with the idea that it will "stay put" indefinitely. Access to conductor systems is possible only at the points where connections are to be made.

A good way to realize the progress that has been made along these lines in the last decade or two—and one that is very frequently presented to those in touch with this class of work—is to examine old installations in buildings that are in process of being torn down or remodelled. In almost any of the earlier types there will be found regular rats' nests of tangled wiring which would horrify the inspector of to-day. The wonder is that so many have given good service throughout their life.

installations of the class described above will have a very slight depreciation, if properly operated and cared for, and that they will last as long as the buildings, of which they are not the least important part.

\* \* \*

Many operating companies have been having difficulties in maintaining the service of flaming-arc lamps on account of the lack of high-grade imported carbons. Since the supply of German and Austrian carbons fell off some months ago the lamps have not been giving efficient service, and no remedy has been found for the trouble. The Altoona shops of the Pennsylvania Railroad have abandoned all their flaming-arc lamps and will not use them, it is stated, until new supplies of carbon can be secured from Germany and Austria.

\* \* \*

**Hydroelectric Developments.**—At the present time there is practically no hydroelectric power development in China. Such electrical plants as have been installed are driven almost altogether by steam. The immense delta plains of the Yangtze and Yellow Rivers, are not, in a general sense, suitable for hydro-electric plants, but in Fukien, Yunnan and parts of Shantung provinces, water power stations may ultimately be installed.

# March of Electrical Progress in 1915

By Theodore Dwight

Progress has been registered in every branch of the electrical industry during the past year, either by the invention of new appliances, the improvement of old, the finding of additional applications for electrical power or in simply their more extended use. As the possibilities of its use are more generally understood, its economy, adaptability, convenience and safety, insure its broader adoption for light, heat and power purposes. For this reason it is only possible in a review of the past year to draw attention to a few isolated applications of special interest.

## WIRELESS

The word "wireless" has meant heretofore the transmission of messages by telegraph by the telegraph signals only—the year 1915 has now extended the meaning to include the transmission of the human speaking voice over distances of 4900 miles. By the use of the DeForest Audion tubes it has been possible to carry on conversations between the Arlington station near Washington and the Eiffel Tower in Paris, and also to communicate with San Francisco and Honolulu from the same place. The voice of the speaker has been recognized. Surely 1915 will go down in the annals as an all important year in the science of long distance communication. An interesting feature of the long distance land-water transmission to San Francisco was the fact that sound waves were carried from New York to Arlington by wire and relayed by wireless.

Wireless telephone communication from moving trains has been placed in service on the Lackawanna Railroad. It is believed that this will be not only a great convenience to the traveling public, but that it will be shortly extended for signalling with freight trains in transit to avoid the serious expense, often over \$25 represented by the stopping and starting of long freight trains to get orders.

## IN WAR

### SUBMARINE MICROPHONE DETECTOR FOR DEFENSE

Detecting the presence of submarines when under water and accurately locating them became one of the serious problems for the scientists to accomplish. An American electrical engineer, invited to solve the matter by one of the Allies, has been successful in operating a system using two submerged microphones separated by a measured distance and which he has succeeded in tuning by the use of closed telescopic tubes and interior a compressed air pressure to protect against water pressure, so that the characteristic hum of the electrically driven engine of the submarine can be accurately identified and the vessel located. The apparatus can detect a submarine at a distance of twenty miles. After one instrument picks it up, the other one locates it and it then becomes a simple problem of triangulation. After the vessel is spotted, torpedo boats or other armed craft are ordered by wireless to proceed to the locality and are kept informed by the same medium of the maneuvers of the enemy craft.

Wireless controlled aerial torpedoes.

A number of patents have been issued during the year for electrically controlled air and water torpedoes, but so far as known none of them have been successfully used.

However, gunfire-control both on land and sea has been largely governed by data sent by wireless from scout aeroplanes and has revolutionized warfare. The electric searchlight has been an important feature in night attacks, and wires imbedded in gun cotton or other high explosive and electrically heated has now replaced the detonating cap in large gun firing.

### ELECTRICALLY PROPELLED BATTLESHIP

The California, whose keel was laid in the Fall of 1915 will be

the first electrically driven line battleship. The vessel will be of 30,000 tons displacement, will cost over \$15,000,000 and is to be electrically operated throughout. The plan submitted is for two 18,000 hp turbines, 2200 r.p.m. to drive the two generators of similar capacity, while there will be four motors, running at 167 r.p.m. normally, directly connected to the four propeller shafts. At full power a speed of 21 to 22 knots will be obtained while up to 19 knots can be had with the four motors operating a reduced speed from one turbo-generator. For cruising at 12 knots only about 1-5 of the coal consumption will be required with a consequent cruising radius of about 300 nautical miles for each 100 tons of coal consumed. This arrangement of generator and motor units gives full reverse power by the simple throwing of switches.

### ADVANCE OF RAILWAY ELECTRIFICATION

The increasing electrification of not only terminals of steam railroads in the large cities, but its extended use for suburban service and on the mountain divisions of some of the great systems has been justified by both the economy of operation and the reliability of service. The New York, Westchester & Boston reports had 99 percent of its trains arriving on time during a 12 months period.

In terminal service, the Pennsylvania Railroad has had many of its electric engines operating under the North and East Rivers at New York, run over 100,000 miles without requiring any general repair work or the truning down of tires. These locomotives have averaged about 15,000 miles for every minute of detention.

The Chicago, Milwaukee & St. Paul placed in electrical operation in the late Fall, 113 miles of its Montana Division with grades of 2 percent and expects to have another 100 miles in service around the first of the new year. A further 200 miles will be electrified later. The equipment for the present will consist of 21 freight and passenger locomotives of 520,000 lbs. each with continuous service horsepower of 3,000. Each equipment will have eight 375 hp. motors connected to separate axles and will be capable of exerting a tractive effort of 85,000 lbs. Power has been contracted for at about 1/2 cent a kilowatt hour on a 60 percent load factor. A tendency is shown in these large projects to purchase power rather than to attempt its generation. This applies both to localities where water power is available as well as to territory where steam is the primary source of energy.

The successful experiments with the steel reinforced mercury vapor rectifier on the New Haven road is attracting attention to the use of high-tension direct current and may have an important influence in the future operation of electric railways. These tubes can be used either on the locomotive or in conveniently located substations.

The Norfolk & Western has placed in service during 1915 some twelve freight locomotives of 540,000 lbs. with sixteen 62 inch drives and tractive effort of 90,000 lbs. This system, like the Pennsylvania Railroad at Philadelphia, is using 11,000 volts, single phase. Many short lines or branches have been electrified during the past year and the Swedish State Railway has recently equipped 87 miles of its lines in the polar circle. The line operates from Kiruna to the Norwegian border. Power is transmitted 155 miles at 80,000 volts. This electrification has increased train capacity 40 percent and speed of the trains by 50 percent. Everyone is familiar with the successful towing of ships through the Panama Canal locks by electric engines. Over 2500 miles of track of "steam railroad" are now operated by electricity.

### Pennsylvania Railroad Electrification for Philadelphia

The suburban line, of the Pennsylvania from Philadelphia to Paoli is being electrically equipped in order to increase the capacity of the Broad Street Station and give better local service. It covers the equipping of over 90 miles of track with overhead conductors. Current is supplied at 11,000 volts, 25 cycles, single phase. It is proposed to follow this improvement by extending to the Chestnut Hill line. By this means it is believed the present Broad street terminal will meet all traffic requirements for six or eight years to come. Further relief will be possible by extending the system to further lines.

It is estimated that the saving in operating cost will readily pay interest on the full expense of electrically equipping the entire track service of the terminal. The power for operating the trains is purchased from the Philadelphia Electric Co. which will transmit it at 13,000 volts from their Christian street power house under the Schuylkill river by armoured cable. The Pennsylvania will step the voltage up to 44,000 at which potential it will be delivered to the various transformer substations. It will be delivered direct to the trains at 11,000 volts. The high voltage transmission was chosen in view of the probable extension later to other local lines and ultimately to the main line of this division of the Pennsylvania system and also because it avoided the necessity of sub-stations with moving machinery.

### Water Purifying

Ultra-violet-ray purification or disinfection of water has been practically employed among other places during the past year in the swimming pool of the N. Y. Athletic Club and the West Side Y. M. C. A. of New York City. In the former case tests showed a count of 280 bacteria per c.c. with the colon bacillus present in 75 percent of the inoculations. After treatment only 2 bacteria per c.c. with no colon bacilli. At the Y. M. C. A. tank tests gave a count of from 2200 to 5100 with colon bacillus present. Treatment reduced this from 10 to 70 with colon bacillus exterminated.

### Hydro-Electric Power

There is nothing radically new in this field, but extensive development has been carried on and more thought is being given to the vast water powers in the North, South, East and West. In California with its 600,000 hp of hydro-electric development over 25 percent is utilized for agricultural purposes. In New England there is also in operation 600,000 hp. The saving in coal, the supply of which is being seriously depleted in the United States, amounts annually to far above \$50,000,000 and the use of electricity in farming both for irrigation and mechanical drive (in fact there are over 125 uses to which it can be profitably put on the farm), is really only in its infancy.

Electrical energy from the Keokuk plant on the Mississippi is being sold at wholesale in St. Louis at \$18.00 per hp year.

Dr. T. Kennard Thomson has proposed a scheme for developing 2,000,000 horse-power from the Niagara River below the falls. The plan was presented to the New York Legislature in August. It is suggested that the State of New York and Province of Ontario undertake the project jointly at an estimated cost of \$100,000,000 or \$50.00 per horse-power or jointly grant the right to some private corporation. From the base of the falls to a point just above Lewiston there is a difference of elevation in 100 feet. A curved dam of about 1,000 feet in length would be required and the height from the bed rock about 130 feet.

### Million-Volt Transformer

The great 750,000-volt transformer used at the General Electric Works at Schenectady for testing insulation is no longer king. A transformer having now been built to operate at 1,000,000 volts and develop 1,000 kilowatts. 225 barrels of insulating oil are required to fill the metal-lined cement-pit in which it is installed.

Air brakes electrically operated on each car unit of a train are being introduced and found to save the quite appreciable

time required to transmit the air pressure from the locomotive. By this more direct action, greater safety is secured.

### Illumination

The science of illumination has been closely studied by specialists and the development of the gas filled incandescent lamp, to work with. These high candlepower, high intensity units have greatly stimulated the use of indirect and semi-indirect lighting methods, as the direct light caused injurious eyestrain.

For street lighting these lamps are fast replacing the various types of arcs. Several million of the gas filled incandescents have been placed in service during the year, and the old carbon lamps are fast disappearing.

The New York Public Service Commission has recently ruled that replacements must be made with tungsten lamps as the carbon lamps are antiquated and inefficient.

Total incandescent lamps sales have exceeded 80,000,000.

### Concentric Wiring

Much discussion has taken place during the year on the subject of concentric wiring and the system has found many advocates. Its successful use in Europe for several years is strongly in its favor. The question of its use in the United States was brought before the National Fire Protection Association at their bi-annual meeting and while it was not deemed best at this time to include this system in the National Electric Code—it was favorably received and referred to a sub-committee to obtain field experience. A number of installations have been made by central stations under the approval of the fire inspectors and others are planned. They have proven very satisfactory. At the November meeting of the N. E. L. A. Committee on Wiring, the committee offered to co-operate with all manufacturers who may engage in developing concentric wire and fittings.

### Domestic Appliances

A partial canvass of the manufacturers shows that over 8,000,000 electrical devices are in use in the home—the electric iron leading all other appliances with a total of over \$3,000,000.

The Society for Electrical Development, has already listed over 1700 communities where electric current is available at 5c or lower per kilowatt hour for heating and cooking— $\frac{1}{3}$  of this number at 3c or under. This liberal rate is certain to create a great demand for ranges and lead to far more extensive use of electricity in the home.

### Domestic Heating

Interesting new types of domestic heating units have been developed. The electric steam radiator utilizes a portable type of the familiar steam one and using a quart or more of water which is heated by an electric bayonet type unit built in the frame. These are proving very satisfactory. Another is made by combining an electrically driven blower with heating coils enclosed, this method insures the quick distribution of the heat throughout the room. Large hot air radiators of the fixed and portable type are being manufactured.

### Telopticon

And the blind shall be made to read. The phonopticon invented by Dr. F. C. Brown performs the remarkable service of permitting the blind to read by means of the transformation of light waves into sound waves. This is made possible by the use of selenium crystals which respond electrically to varying intensities of light.

The printed letters are illuminated successively by a narrow ray of intense light which travels across the page. The image from a lense acts upon a parallel group of from 2 to 4 selenium crystals (as the arm of a Wheatstone bridge) operates on a telephone receiver in place of the usual galvanometer, double magnets being used in two telephone receivers where 4 crystals are used.

In series with the telephone receivers is an interrupting device giving a definite frequency and a resonating arrangement gives a different pitch for each crystal. A change in intensity of these pitches occurs when different letters are brought into range of the illuminated band permitting the letter to be "read" by sound.



# Electrical Growth Under War Condition in England

By R. E. Neale

The well-intentioned slogan of the first war weeks—"Business as Usual"—has long since given place to that of "Nothing as Usual" and in writing of central station and manufacturing activities during the past year, one can speak of little but the effects of the war on the work done by and prospects of these interests. Of development as reckoned by ordinary commercial standards there has been little, but the industrial activity of the country has been reorganized and placed on an entirely new footing. The present results of this revolution are to furnish a machine spending money at an unpleasant number of dollars per second, but its ultimate effect will be to win the war for the allies and it will leave the whole industrial fabric of the United Kingdom equipped and tuned as never before for its share in the world's markets. There has been no corresponding revolution in the central station field; central stations have simply continued their normal work of producing current with economy and reliability and they have been adversely affected by the war to a much less extent than could have been anticipated. There has been a general reduction in use of "luxury" units and reduced lighting regulations have hit badly a number of small provincial stations dependent mainly on street, shop and residence lighting demand. In all large towns, however, and particularly in industrial centres such as Manchester, Sheffield and Birmingham, the increase in power consumption due to industrial demands for war work has more than compensated reduced sales in other directions; indeed, the fall in residential demand has been quite useful in some instances in releasing generator capacity for power supply of far greater national importance.

The first effect of the war was to reduce the current consumption for all purposes in most districts. Traction units are still relatively low in most places. Domestic consumption is down in individual cases, but in many instances it is up in the aggregate, due to new consumers. This and the remarkable way in which heating and cooking business has kept up, form a very healthy sign. Power sales suffered by a very temporary depression, in many cases hardly noticeable. In Sheffield power sales for the uncertain days of August, 1914, amounted to 800,000 units more than in the previous August and much larger increases were shown later. Double shift working being practised in every work of any importance, there must be an enormous increase in total central station sales and a corresponding advance in load factor. Analysis of the generating costs under such conditions should give any hesitating engineer sufficient stimulus to aim at keeping up the higher load factor in peace time by adding to heating, electric vehicle and electro-chemical loads. The improvements in generating costs this year (statistics not yet available) will probably be only relative since fuel and wages items are abnormal. Last winter a number of important stations were reduced at times to a few days' stock of fuel, the sudden outbreak of war happening at an unfavorable moment from this point of view.

This winter the situation is well in hand.

## Policy and Publicity

The unprecedented nature of the war made it difficult to determine at first the right line of central station policy with regard to development work. Insofar as concerns capital expenditure there was a complete reversal of policy during the first six months of war, yet it was all for the best. At first municipalities and others were urged to go ahead with extensions and improvements to prevent distress due to unemployment! Later it was found that all capital and labor was re-

quired for work, but a result of the initial policy was that a number of stations got plant in hand without which they could hardly have met subsequent demands. Material ordered for less urgent requirements has, in several instances, been requisitioned for use here where it was needed for munition work.

It is becoming appreciated outside the circles immediately affected, that our central stations are really on war work of the most vital kind. Without the availability of central station power for driving new works and extensions, our present output of munitions would be quite impossible and the manner in which electric power and lighting is now making good under emergency circumstances in an infinite variety of industries must be to the permanent benefit of electrical interests.

Publicity work, is being maintained as far as possible. It was prosecuted energetically by the more farseeing concerns during the early months of the war, but recently it has fallen off for two reasons. The rigid economy now observed by middle class householders to whom residential publicity is chiefly addressed, makes it impossible to get a great deal of fresh installation work besides which material and labor are lacking for the latter. In the power field, circumstances have forced manufacturers of all classes to realize the unique advantages of electric driving. The position is therefore that power supply needs no publicity whilst residential publicity would yield poor results at present; most stations are fully occupied keeping pace with power demands and no station has either capital or staff to spare for publicity. It is safe to say that after the war, domestic loads will make unprecedented progress. Experience of the benefits of good load factor, the loss of special war loads and the availability of low candlepower, high voltage gas-filled tungsten lamps will force central stations into a very active policy. The manufacture of heating, cooking and small power devices has reached a state which will justify their being pushed more vigorously than in the past and the improved industrial power prospect (even allowing for loss of much night load) will justify more stations offering cheap unit tariffs which are essential to vigorous heating and cooking development.

## Plant Extensions

For the present, plant extensions are permitted only where it can be shown that the need for them is national. The object of this restriction is naturally to prevent unnecessary absorption of capital and to leave every possible workshop free for war production. On the other hand, wherever a new factory or extension is erected, it is cheaper to supply it with power from a central station than to install isolated power plant whilst, from the central station standpoint, the high cost of coal and materials makes the economy of new plant an important factor. Due to these several facts most of the industrial centres have extensions completed or in hand.

During the last financial year (including only 8 months of war) there was an increase of 18 million units (i. e., 68 percent) in current sales at Sheffield. The total sales were nearly 45 million units, at an average total cost of 0.85 c. per unit and the surplus on working was \$130,000. In addition, one at least of the great Sheffield firms has a very large station of its own. Largely as a result of the immense increase in power and electric furnace demands, Sheffield needs \$500,000 for urgent extensions and the Local Government Board is adopting the novel course of lending this money at interest, retaining the option of removing plant after the war if the corporation does not purchase it.

In Bradford as elsewhere the electrical demand of textile mills is rising steadily and one of the recent load additions was 1,000 kws in electric furnaces; giving practically 24 hours daily demand all the year round. At the moment of writing, a new 5,000 kw generator and two 1,500 kw rotaries have just been set to work. The Stepney district in the East End of London contains probably a greater variety of trades than any other district. Within the last five years the annual output has risen from 10 to 20 million units, largely as a result of sustained publicity work in all fields of supply. Two new 5,000 kw turbo-sets were started a few weeks ago and the system is linked up for interchange purposes with adjoining areas, along the lines which financial considerations must compel as the first step in centralized supply for London—when that scheme shall really come to pass. Recent extensions at South Shields are of peculiar interest owing to the arrangements for three varieties of supply. One turbine drives a 1,000 kw, 550 volt, direct current generator and a 1,100 kw, single-phase, 2,100 volt alternator in tandem; and a second set consists of two 1,500 kw, 3-phase 2,100 volt alternators turbo-driven in tandem.

The Greater Birmingham area 68 sq. miles in extent contains many hundreds of factories of all descriptions. The three existing stations approach 50,000 kw capacity but extension of the supply area and rapid development of electric driving led to a 100,000 kw station being started in the Nechells district. Work on this scheme being interrupted by the war, a temporary 10,000 kw plant has been erected which is interesting by reason of the care devoted to making the buildings and plant capable of subsequent transfer to the main station.

The largest station in the country will be the 160,000 kw plant at Barton (Manchester) which is designed for four 15,000 kw and four 25,000 kw units but may easily have larger units in its later parts. Work is already far advanced and the special features of the scheme include the use of semi-purified sewage for condensing, silo coal storage (in place of open piles) for two months' supply, and bunkers over the boilers for 36 hrs. supply. The finished plant will consist of eight distinct coal-to-feeder units and on 40 percent load factor, with coal at £2 a ton (500,000 tons used per annum) it is reckoned that the works cost will be 0.275 c. and capital charges 0.175 c. per unit. The capital cost of the station complete is estimated just under £54 per kw. Present sales in Manchester average 500,000 units a day.

#### Technical Features

A noticeable feature of many recent extensions is the temporary omission of such items as suction ash plant, oil storage and filters and other equipment which can be dispensed with at the cost of some inconvenience and loss of efficiency. These omissions will be remedied at the earliest opportunity, for they are no less than essential to efficient operation as judged by normal standards.

Turbine speeds continue to be raised and the overall dimensions of turbo-units to be reduced. The boiler house of the new Barton station occupies about three times as much ground as the power house, and boilers and fuel storage together take up nearly 10 times the power house area. For average industrial stations 5,000 kw turbo-units are very popular just at present, but there is no doubt that larger sets will steadily become more common. Three-phase generation with high-tension cable distribution to substations is practically standardized in this country for all extensions. It is abundantly evident that most plants in older stations will be replaced long before it is worn out and the effect of obsolescence in shortening loan periods, as well as the high interest on fresh loans, make it important to increase load factor and revenue by every means available. A curious point is the recently displayed official tendency to limit loans on reinforced concrete work to 10 (instead of 25) years. This attitude is inexplicable and should only be temporary.

#### Rural Supply

The development, even the continued stability, of many provincial stations in this country depends on the surrounding agricultural districts being tapped. A small scale, but profitable example of what such stations can do is to be found in Hereford where overhead lines are taken out several miles in various directions to farmers and other scattered consumers. Stranded aluminum lines with iron wire neutral and guard wires beneath are used; the construction, all in compliance with Board of Trade rules, costing about \$2,600 per mile. With lighting at 12 c. and power at 6c. a unit, about \$480 a year is obtained from small farms and a revenue of close on \$4,800 per mile of line is averaged. In the Weaverham district, four villages distributed over an area of 12 sq. miles, are served by 460/230 volt, 3-wire direct current and 3,000/230 volt, single phase alternating current systems connected by motor-alternators in the generating station. Use is made of a mixed network of cheap overhead line and direct-laid cables and a fair profit is realized from 200 consumers representing 10,000 30-watt lamps, with current at 12 c. for lighting, 2.5 c. for heating and cooking, and 4 to 2 c. for power.

#### Price Increases

Increases in supply tariffs were mooted in some districts early in the war to cover decrease in sales. On this basis the policy would have been mistaken and has not been called for but rises in prices of coal, wages and stores have since compelled price increases in about 80 districts. Generally this increase has taken the form of a temporary percentage surcharge—10 percent being the commonest increase and 15 percent the next commonest; corresponding increases have been adopted by most gas companies. Where possible heating and cooking tariffs have been advanced less than others and the prepayment meter difficulty has been overcome by temporarily altering adjustments so that less energy is delivered for given payment. Such price increases as have occurred have been chiefly in residential stations. Improved load factor and increased sales have made price increase unnecessary in industrial districts.

#### Heating and Cooking

The outbreak of war interrupted a boom in domestic electric heating and cooking which will probably be resumed on the conclusion of peace and has not been utterly paralyzed by present conditions. The number of large electric kitchens in restaurants, hotels, hospitals and so forth continues to make good progress. There are half a dozen 60-100 kw. kitchens in Sheffield, as many more in London, a large new one in Derby, and a number in temporary hospitals and camps. The "Point Five" movement which takes as its creed the sale of current for heating or cooking at not more than 1.0 c. a unit (supplemented if necessary by a fixed charge), continues to make good progress. The cheap unit is essential and a charge as low as 0.5 c. is definitely foreshadowed in at least one industrial area. Given such a low price per unit, rapid cooking development is assured, a fairly heavy fixed charge being much less of an obstacle than a fractional increase in the charge per unit of actual consumption.

An important point is to take sufficiently active measures to help the consumer to electric methods. This sounds a truism but what can be done in this direction is exemplified in Marylebone (London) where a new block of flats is cabled throughout for lighting, heating and cooking and an annual consumption 20 times that usual in such buildings, i. e., 1 million units per annum or 3,000 units per head is expected. Electrically heated hot water is being installed which is interesting in view of the magnitude of the hot water load and the pessimism with which it is generally regarded. Given thermostatic control and correct design of thermal storages, electric water heating in bulk is quite a commercial proposition. Too many storages show ignorance or neglect of the simplest principles of the mechanism of heat transmission.

### General Electrical Business

At the present time there is a flood of work for every firm employing skilled labor and, barring small wiring contractors and dealers, there is probably not a slack firm in the country. Last fall (1914) there was a temporary depression, but there is now an immense demand for electrical goods of all kinds for hutments, hospitals and other special buildings besides the equipment of munitions works. Initial dislocation of trade—financially and in respect of materials—coupled with decreased exports spoiled the tone of many balance sheets for 1914-15, but on the period of the war as a whole few firms will not have contributed heavily to the war-profit tax. This is to some extent making the best of a bad job, for the whole war activity is waste from the purely commercial standpoint. Also, war orders must collapse as suddenly as they began, but the national organization and speeding up of works to meet present needs must have a permanently beneficial effect.

Attempts at co-operation between manufacturers in co-ordinating their policies and lines of activity showed some success before the war and are likely to come into active being there-

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## Incandescent Lamp Progress

By R. W. Shenton

Without a doubt the most popular development in the incandescent lamp industry during the past year has been the placing on the market of a nitrogen-filled lamp in the 100-watt size. This lamp has been the means of bringing the advantages of the gas-filled construction within the reach of the great body of consumers. Until the arrival of this lamp, the uses for these multiple lamps were more or less restricted to those fields requiring relatively high candle-power light sources. Office buildings, stores, and residences also to a certain extent, have benefited largely through the use of this type of lamp. It has also been the means of improving billboard illumination. It is generally recognized that by illuminating these important advertising media their efficiency may be doubled from the standpoint of the number of hours they are visible, to say nothing of the fact that at night the average mind is in a more receptive mood for the advertiser's message and the fact that a billboard illuminated at night stands out by contrast more prominently than it does in broad daylight.

The largest field, however, for the use of these lamps is the lighting show windows. The 100-watt gas-filled lamp has made it possible to effect an increase in intensity of illumination in show windows at so increase in wattage. Its excellent color quality, the presence in good proportions of all the primary colors, makes it possible to obtain efficiently almost any desired color effect. While it is possible to obtain greatly improved illumination without increasing the wattage, experience has shown that once the store owner sees the advantage of improved illuminations his tendency is to go to higher wattage even than he used with less efficient lamps.

While the higher wattage multiple gas-filled lamps have been available for some time previous, the past year has witnessed the development of fields for their application. The lighting of large outdoor areas such as railroad yards, athletic fields, and tennis courts by means of incandescent lamps has opened up avenues for considerable new business. The use of these high candle-power lamps for spectacular purposes in connection with amusement resorts, play houses, etc., has continued to grow, constituting a very desirable central station load.

The flood lighting of public buildings is practically new. A number of important installations have been made during the past year and lamps designed especially for this purpose placed on the market. The extremely desirable effects obtained in such cases as the Woolworth Tower and the emulation of this example on the part of other buildings throughout the country indicate that this particular use of light for advertising purposes is destined to open up a most desirable field for the sale

after. Many industries lost or not started in the past will be revived or initiated and there is a need for special factories turning out in bulk parts required by other manufacturers (along the lines of the lamp cap industry of Holland, for example). All such developments will benefit the electrical industry and central stations more or less directly. There is an urgent demand for a central body competent to deal with matters of national economic and technological importance; and for better utilization of the facilities for technical training which already exist in this country. It must be obvious to the impartial observer that the labor problem is not the least serious before us and it will not be simplified by the fact that many men now earning \$50 a week will have to return to \$10 or \$15. Nevertheless such after effects of the war will be largely offset by other more beneficial effects, including the enduring influence of war organization, so that there is no reason to expect that it will not be long after peace is declared before the commercial and technical advance of the British electrical industry—thus rudely interrupted—is again proceeding rapidly and with increased vigor.

of electrical energy and electrical appliances, supplementing, as it does, other forms of building exterior lighting that are not universally applicable.

Other more specialized developments have been the placing on the market of special lamps for stereopticon purposes, automobile headlights, and locomotive headlights. The high concentration of the light source of gas-filled lamps as well as their high efficiency have been of no little value in the development of projection apparatus of practically all classes.

The application of these intensely brilliant lamps to photography occupies an important place among the developments of the past year or two. Combining as it does the advantages common to incandescent lamps in general with high actinic value, this lamp has proved a boon to portrait photographers as well as to moving picture producing companies. By increasing the voltage on these lamps to 10 percent above normal during the time of exposure the actinic value is increased 50 percent, so that with two 1,000-watt gas-filled lamps the photographer is able to take portraits with the same length of exposure by artificial light as he would ordinarily make by daylight. This lamp has been supplied in a special blue bulb which reduces the visual intensity to about one-third that of the clear lamp leaving the actinic value practically unimpaired. In one moving picture studio over 500 of these lamps have been added to a preliminary installation of 200 lamps.

While most of the recent incandescent lamp developments have been confined to the gas-filled lamps, another development during the past year has been the placing on the market of coil filament lamps. The filament of these lamps operates in a vacuum but is of the helical-coil type so wound that its light is given off in a more downward direction than in the case of the ordinary lamps. The particular field for their use is in connection with decorative glassware where artistic effect has been the principal object of design with little or no attention to efficiency. Where efficient reflector equipment is at hand, the ordinary lamp is, of course, the more satisfactory. This lamp is of interest because it benefits the consumer in the average home, where dense decorative glassware is mostly used.

The use of gas-filled series lamps has grown relatively more than that of any other class of incandescent lamps during the past year. The example of some of the larger cities of the country, notably Chicago and Cleveland, has been followed by many of the smaller cities who have replaced existing lighting systems with gas-filled lamps to the benefit of the municipality as well as the central station. The advantages offered by the new system are briefly: low initial investment, high power factor,

adaptability, the readiness with which the light may be controlled especially by means of the best type of refractor, and the possibility of taking advantage of future developments in the art without the necessity of scrapping considerable material. The fact that these lamps are available in a large range of sizes makes it possible to satisfy street lighting requirements of all classes.

### Science in its Relation to Engineering

An inspiring address on "Science in its Relation to Engineering," was delivered at the recent annual meeting of the American Society of Mechanical Engineers, in New York by Dr. John A. Brashear, the retiring president.

Dr. Brashear in the very humane manner, of which he is master, started his subject, by an appreciative tribute to the great engineers of bygone times, who were at the same time the great scientists and mathematicians of the past. He touched on the notable work of the Egyptians, Greeks and on the Roman masterpieces in concrete work, bridges, roads and aqueducts. All their work was interlocked with science and engineering and Dr. Brashear finds but a hazy line between the two, if engineering be considered as applied science. Speaking of these early efforts, he said:

"It is a long way from the sundial of Ahaz to the Riefler clock; a long way from the Pyramid of Cheops to the stately steel structures of our great cities; a long way from the ox-cart, with its wheels cut from the end of a log to the steam and electric locomotive; a long way from the log bridge across the narrow streams to the magnificent steel and concrete spans that now cross our widest rivers; a long way from the tiny Egyptian cedar boat, built without iron, steel or copper, to the majestic steel steamship that daily crosses the ocean; a long way from the smoke baloon of Montgolfier to the dirigible, or the biplane that soars like a bird through our skies; yes, and all along the pathway of the evolution of these and other inventions of man are unwritten histories, which, if told, would be filled with romance and oftentimes with tragedies—aye, with the sacrifice of the lives of many of the world's noblest pioneers who have contributed to the treasure of our best storehouse of learning."

He then spoke of the strict necessity of applying scientific methods to engineering work and pointed out how frequently engineers in all lines had appealed to the scientist giving especially the noted case in which the velocity of the propagation of light waves was determined by scientific reasoning and experimentation of the most refined nature, the process of solving the problem remaining for a long time in the domain of the exact sciences as a masterpiece of the human mind. Applied, however, it gave to the world a value for the international meter in terms of light waves that will remain absolutely unalterable as long as this old world moves in the luminiferous ether of the universe.

He also noted the case in which the machinery manufacturers of the country appealed to a famous professor of astronomy for help to enable them to turn out tools of such precision that nuts of one manufacturer would go on bolts of another. He paid a high tribute to American engineers who have developed instruments for mechanical measurements to a very high state of precision, which in their turn have been mighty factors in the development of interchangeable machinery. He cited the diffraction grating made accurate within one forty-five-thousandth of an inch and rendered possible, first by rigorous scientific research, second by the skill of the artisan, third by a knowledge of and care to avoid temperature changes, and fourth by the accuracy of the mechanism which includes the screw.

Dr. Brashear reminded his hearers of what happened in the domain of electrical science since the first little dynamo of Faraday and the telephone of Bell. He likened the application of science to the arts and industries to the "widow's cruse," and regretted that he could not go into very many fields where pure science may take the hand of fellowship of the engineer. The address concluded in the following words: "To-day we are

learning, but single notes; to-morrow we will blend them into chords; the hour will chime when all humanity shall know the law of harmony—when every note in every chord shall find its part in the sublime oratorio of the universal life."

\* \* \*

### Coming Growth of Domestic Demand

President E. M. Herr, of the Westinghouse Electric & Mfg. Company, in a recent address before the Railway Club of Pittsburgh, said: "Due largely to the wonderful development in the steam turbine and its direct-connected electric generator, and the remarkably flexible, efficient and easy distribution of electricity, we are on the eve of a notable—in fact, I believe an epoch-making change—in the utilization of electric power.

"First—The modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place.

"Second—This makes possible and advantageous very large individual generating units. The growth in the capacity of generators has really been enormous, made possible by the steam turbine.

"Third—Electricity can be transmitted long distances in large or small quantities and its characteristics changed at will, all with small losses and at comparatively low cost."

The speaker then proceeded to trace the development of large generating units as exemplified by certain notable installations of central stations, industrial and railway plants, and then discussed the effect of the concentration of such a large amount of power in one station.

Mr. Herr said the building of units as large as 50,000 and 60,000 kw., was contemplated.

This address has been published in pamphlet form by the Westinghouse Electric Company, and will be sent to anyone interested.

\* \* \*

### Domestic Utilities Sold

Electrical supply dealers and all engaged in the electrical trades will be astonished at the figures below concerning the number of domestic utilities sold.

The data was collected with care by the Society for Electrical Department and is believed to be nearly correct.

This field has only begun to grow.

Total Number of Household Utilities Sold and in Use in the United States

Irons .....	3,025,995
Fans .....	2,629,414
Vacuum Cleaners .....	469,282
Toasters .....	411,645
Disc Stoves .....	234,885
Washing Machines .....	212,082
Grills .....	114,267
Percolators .....	106,278
Heaters .....	76,925
Heating Pads .....	67,107
Chafing Dishes .....	29,316
Ironing Machines .....	28,000
Ranges .....	14,140
Tea Pots .....	6,397
Radiators .....	3,190
Dish Washers .....	261

\* \* \*

6,429,182

### An Advantage of Electric Drive

Electrical manufacturing plants, or those equipped for electric drive, have proven themselves readily available to command the great war orders recently placed in this country, on account of the ability to rearrange the machine units. With well-subdivided group drive, or better still, with individual motor drive, the problem of re-arranging the machinery to get the best results for the new output was greatly simplified as compared to the factories which were still limited by shaft drive.

**Some Things That People Ought to Know**

BY GLENN MARSTON

EVERY business carried on in a civilized community is subject to regulation. The prices of food, clothing, and such things are governed by competition. The regulation of public utilities through competition is more difficult. Competition in the telephone business was once looked upon as advisable, but experience has taught that such competition was more trouble than it was worth.

There are two ways of securing competition—by permitting another company to install a new system, or by making the city itself do so. In either case the community should have assurance that the saving to be effected through competition will be greater than all the fixed charges against the competing plant; otherwise the competition will save nothing. It is not enough that the new rate is slightly lower than the old rate. The money invested in both plants is going to come out of the people in the long run, and a duplication of equipment means that it will require more money to furnish electricity to the community. Therefore, the new rate must be lower than the old rate by a sum equal to or more than the fixed charges upon the duplicate plant. If this is not so, competition is a demonstrable failure before it has begun.

Competition between two companies has frequently been tried, and the inevitable result has been either consolidation or a division of territory between the competitors, with a thorough understanding on the question of rates. After the consolidation or understanding, rates are restored to a point where they will earn back the losses brought about by competition. Courts and utilities commissions have held that such increased rates are fair because it was through the public that competition was permitted, and therefore the public cannot expect to be protected from the consequences of its own action. The argument may be advanced that such consolidations could not take place if the city itself conduct the competing utility. However, such consolidations have taken place, and municipal competition is thus of no more value than private competition.

It is frequently said that municipal plants give lower rates to their patrons than are given by private plants, but this by no means indicates that the municipal plant is giving less costly service. The accounting systems of municipal plants generally conceal from the casual investigator the true cost of service by omitting many of the essential items which are paid out of taxes. In Ohio the position of the municipal plants is so weak that they have laws which forbid municipal plants to pay their own bills—that is, in that state it is the law that the interest and sinking fund on bonds cannot be paid by the plants, but must be paid by the trustees of the sinking fund, and plants which are able to meet part of the payments simply turn this money over to the sinking fund trustees without indicating what proportion of the total charges are thus taken care of. There are many plants in the state of Ohio which earn enough gross revenue to pay their operating expenses, and by whom all excess of revenue over operating expenses is called profit! They do not make allowance for interest, sinking fund, depreciation, lost taxes or any of the fixed charges which must be met by somebody, either taxpayers or consumer, whether the plant is publicly or privately owned.

A little over a year ago I had occasion to secure some information on the municipal plant of Amherst. In 1913, during the time the plant charged 8 cts. for lighting, the cash book shows income from all sources (except taxes) of \$4,120.66 and expenditure for operation of \$5,867.67. During the same year there was appropriated \$3,850 from taxes to meet maturing fixed charges and operating deficits. During 1909-1910 over \$8,500 was spent out of taxes on the lighting plant. Yet in August,

1914, the authorities decided to reduce the rate from 8 cts. to 6 cts.

I inquired into this and was told that the reduction was made "because some of the people thought they were paying more than they ought!" And when I asked if the plant hadn't lost a good deal of money the answer was: "Oh, no, we always have paid all our bills. When we don't get enough from the customers the council makes a levy, so we have never lost anything." Canal Dover has a municipal plant in competition with a private company. In 1913 the gross revenue, including street lights, was \$19,123.86, while the operating expenses were \$19,974.53—an operating deficit of \$850.67. The fixed charges for that year were \$11,000, making the total deficit \$11,850.67—a little more than 100 percent of the gross revenue from private consumers, making the cost of electric light 20 cts. per kilowatt hour, of which the taxpayer pays half, whether he uses light or not.

The question of depreciation is one which is almost invariably neglected by municipal plants. Less than 10 percent of the reports on municipal plants in this country take depreciation into consideration, yet it is as inevitable as interest, or I was going to say, taxes. But municipal plants do not feel themselves obliged to pay their share of the taxes either. Perhaps that is why they can so easily overlook depreciation.

The compiler of the 1912 census figures on electricity took thirty cities and towns, including five places where municipal plants are in operation, and found that the average rates for service in these thirty places, ranging in population from 700 to millions, were as follows:

Residence, large .....	127 kw.-hr. @ 9.10
"    small .....	27 " 9.4
Retail store, large .....	1126 " 6.3
"    "    small .....	67 " 8.1
Drug store .....	200 " 7.4
Saloon .....	377 " 6.4
Church .....	156 " 8.7

This census director, in discussing the tendency to group several local properties under a single management, says: "Under such centralized management there have invariably followed a renovation and enlargement of the properties, the installation of new apparatus, increase in service and facilities, and supervision by men of higher abilities and attainments, each of whom is expert in his chosen field, furnishing, therefore, talent utterly beyond the power of the small plant to hire or retain."

\* \* \*

**Determining Standard for Electric Service**

The Maryland Public Service Commission has invited electric corporations doing business in that state to attend a conference in the offices of the commission in Baltimore on January 12, the conference to last two days if necessary. It is proposed to discuss at this meeting all matters appertaining to electric service with special reference to the following: Inspection and maintenance, interruptions to service, service-testing facilities, records of tests of service, information to consumers, accidents, complaints, voltage variation, meter testing and accuracy, meter-testing facilities, records of meter tests, meter readings and bill forms, meter rentals and deposits, permissible meter accuracy, conditions of test, average accuracy, "normal" load tests, tests on request of consumers, fees for testing on complaint, periodic and installation (service) tests. The chief engineer of the commission has been directed to secure and report to the commission such information as may be necessary to enable the latter to determine the proper standards for electric service. He is authorized to employ such experts as may be reasonably required to advise in the premises, including officers and employees of the Bureau of Standards maintained by the government of the United States.

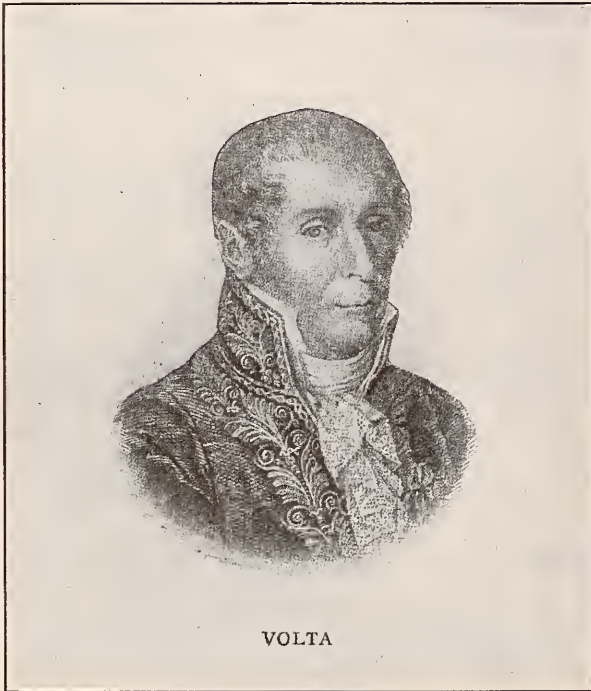
Extract from an address before the Lorain (O.) Board of Commerce.

# Electrical Fathers

## Alessandro Volta

The term "Volt," which is the word used for the unit of electrical pressure, is named after Alessandro Volta, who invented the electric battery.

Volta was born at Como, Italy, Feb. 18, 1745, in a home in which the Volta family had lived for more than 300 years. His people, though of good origin were very poor—so poor that the boy had to borrow the little coin used for buying his copy-book when he first went to school. As a child, strange as it may seem, he was very backward. He was thin and pale, and other little boys thought him dull, indeed. He was four years old when he spoke his first word, "no." From the time of this "event," however, his mind seemed to turn entirely to the wonders of nature. Many times as a child he almost lost his life in exploring caves and odd places where people never went.



VOLTA

Two of his uncles interested themselves in his education and he soon became a very accomplished student.

At sixteen he wrote poetry, and at seventeen he won prizes in philosophy. At eighteen the famous Abbe Nolet, impressed with the boy's knowledge, had him write essays on electricity for the great men of the day, because people knew very little about this mighty force in those times. At 20 he was proficient in English, German, French, Swedish and Spanish, and knew what was being done in the realm of science in those countries.

In 1774 he was appointed professor of physics in the school at Como. In less than a year he constructed the first "electrophorus," which was made of two circular plates of metal with a plate of resin in between. This was the idea of the condenser.

A few years later Volta became professor of physics at the University of Pavia. Here it was that, trying to improve the electrophorus, he invented the condenser which stored up electromotive forces. However, before long this was overshadowed by a more important discovery, for it was here, also, that he made the famous discovery with a frog's leg voltmeter that resulted in the invention of the first electric battery.

The frog's leg voltmeter was a crude method of indicating the presence of electricity, which had become known, when Galvani, a distinguished Italian experimenter of Volta's time, had by accident noticed that when the leg of a frog is left attached to the trunk by the sciatic nerve only, if a mental be

interposed between the severed muscle and the nerve, the muscle would contract whenever contact was made. Volta turned his attention to this.

Being a metal disk and replacing the frog tissues with disks of cloth soaked in acid, he produced the first battery electromotive force. He soon found that using two different kinds of metal greatly increased the power of his "pile" as it was called, and in the end the idea of the battery was complete.

The fame of this discovery first spread Volta's name over Europe, but the striking effects of a giant battery that he built in the year 1800 were needed to direct attention to its marvellous possibilities. This battery consisted of a series of discs that must have given many hundreds of volts. It produced a current that, to use the words of a writer of his time: "caused light when applied to the muscles of the eye; made a thin wire to glow and burn; caused a blinding flash of light when the ends of the wires were pulled apart; decomposed water into gases; made iron magnetic and deflected the magnetic needle from its path," and the writer goes on to describe other effects of the electric current, many of which were really not generally known until some years after.

Now, for the first time, a steady, measurable source of electromotive force could be produced at will and in constant quantity.

It took Volta years to work out this complete battery from the simple idea of the generation of electricity by contact. But his fame was great and little else was talked about for awhile in the scientific circles of Europe.

In 1782 Volta had travelled in Germany, Holland, England and France. On his return he is said to have introduced the culture of the potato into Lombardy.

He went on his second tour as a renowned scientist. In London, Berlin and Paris he was given all the honors the world's great men received. The First Consul founded the Volta prize, which was once conferred on Alexander Graham Bell, inventor of the telephone. Bonaparte gave Volta a sword a sum of 10,000 francs and made him a senator of Lombardy. He also pensioned him to the extent of 3,000 francs a year. The emperor took the same liking to Robert Fulton and gave Fulton 10,000 francs to help the Yankee to keep up on French soil his experiments with submarine boats. It is told of Bonaparte that he once visited the National institute and found there a laurel wreath on a bronze tablet, on which were the words, "Au Grand Voltaire." The emperor erased the last three letters, thus making it read, "To the Great Volta." The interest of Napoleon in Volta's work is partly explained by the fact that Italy was then a part of the French Empire.

More impressive to Volta, must have been the statement of Arago, one of the greatest minds of the time, who declared "Volta's pile is the most wonderful thing that has ever come from the mind of man, not excluding even the steam engine or the telescope."

After his return from his triumphal tour, Volta was a leading light at the University of Pavia until he grew old and retired to his home near Como.

He was noted for his kindness, piety and liberality. He married late in life and was a loving husband and father. He lived to be nearly 82—dying in 1827.

Volta's two great ideas were the storing of electromotive forces in the condenser, and the generation of electromotive force by contact of certain metal and acids.

When therefore, many years after his death, the leaders in electrical science met to give the names in use to-day due to the different units of measurement that were being used in electrical work, it is not surprising that the name of the inventor of the electric battery which for a long time was the chief source of electrical pressure, was given to that unit of measurement. As a result, today the word volt preserves the genial Italian's name in the languages of all civilized countries.

# EDITORIAL

## Happy New Year!

The ELECTRICAL AGE takes pleasure in wishing a peaceful and prosperous New Year to all its subscribers and other readers. In spite of the deplorable war still raging on the other side of the world, we think that the prospects of these wishes being realized were never better. The high tide of prosperity now setting in on our fortunate country is reaching into nearly every field of electrical activity. Manufacturer, contractor, dealer, all those who supply electrical energy in its many forms, unite in reporting record demand for their output. And the indications of vast undertakings for the immediate future promise that good business and its resulting prosperity will continue.

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## A Glance Backward

This is the time of the year when men pause for an instant in their activities to look back over the period just closing and see what has been accomplished.

On another page we have spread before the readers of ELECTRICAL AGE some brief outlines of what has been accomplished electrically in the year just completed.

Aside from the brilliant performance in wireless telephony and the rumored improvements in submarine defence devices in England, there is nothing spectacular in the picture—only a steady and solid advance all along the line under none too favorable conditions in this country and downright adverse circumstances abroad.

Nevertheless there are a few developments that stand out in their significance. Among them are the laying of the keel of the first electrically driven battleship, the start on construction of the first 40,000 kilowatt turbo-generator and the increase in the efficiency of the tungsten lamp.

The most encouraging feature of the year's development, however, is the steady increase in the wide-spread use of electricity all along the line—in the small town and among the farmers, as well as in the cities. Undoubtedly this has been doubly fostered by the increasing economy and reliability of the incandescent lamp and the numerous devices that now form part of the equipment of the "home electrical," and perhaps even more by the gradual cheapening of the cost of electricity itself.

The further reduction of rates which are being announced from time to time will further increase this growth in consumption. In some of our large communities it would seem that there is still room for movement in this direction, as it appears that the average rate in London is much less than half that obtaining in the larger cities in our own country.

The closing of the year with a rush of almost all kinds of business and the amassing of capital, in the cities, taken in connection with the record-breaking crops, has

started many plans for large improvements that have been quietly maturing in the past season of depression.

One of the most important of these seems to be the project for the construction of a huge, 130-foot dam at the lower end of the Niagara gorge. By this plan the output of electrical power from the Niagara River can be almost doubled without in any way affecting the scenic beauty of the falls.

There are other large prospects in the West, and the huge generators lately ordered for Eastern plants are certain evidence of the growth in demand for electrical power.

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## Facing the Future

As the New Year comes in, thoughtful people invariably look ahead in the hope that, so far as limited human prescience permits, they can divine the coming trend of events. In a line that progresses as rapidly as does that of electrical developments, it is especially difficult to make any accurate forecast. A single basic discovery or invention may so affect the path of progress as to turn it in an entirely different direction. Nevertheless by an understanding of what is now going on some reckoning may be made as to what the coming days will bring forth.

The questions that confront the world to-day—questions that affect the future course of civilization on this planet—depend to a great extent on the development of electricity and the men to-day employed in the electrical industries are, therefore, those who will take up these questions and ultimately solve them.

### TELEGRAPHY AND TELEPHONY

The first and oldest, and still one of the most indispensable applications of electricity is the transmission of thought. The achievements of wireless telephony during the past year, lead to the belief that the time will come when world wide international wireless telephony will carry out the great work begun by the ocean cables, of binding all men closer and by so much, lessen the chances of a recurrence of the catastrophe that is now threatening the economic ruin of Europe.

In ordinary telephony, loud speaking receivers will be so improved that in the near future the hearing of concerts in our own homes may supersede, to an extent, the "canned music" of the phonograph. The advance in wireless telephony may even mean that a great singer, performing in some old world capital, may be heard all over North America by millions of people in moderate circumstances without their having to go outside their homes. What this may mean to the general well-being can hardly, as yet, be realized.

### ELECTRIC LIGHTING

In the next oldest field of electrical achievement, the foremost indications point to the increased cheapness of electric lighting and its vast extension. This form of

light is to-day in most places, cheaper than the oil and gas lighting that it is supplanting. Yet less than half of the people of this country to-day use electric light. The field for extension is enormous. It will be occupied.

The continued improvement of the incandescent lamp is possibly approaching its ultimate limit, yet the best lamp is still one of the most wasteful applications of electricity known, utilizing less than one-fifth of the total energy supplied. So there is a great and alluring chance for improvement in this respect.

The other factor that will bring the domestic electric light into its own will be the further cheapening of commercial electricity. This is forecasted in the increasing size of the coming generators which will pass the 50,000 kilowatt limit mark in 1916.

#### WORKING, COOKING AND HEATING

The coming year will see a great increase in the use of the one-hundred-and-one so-called "domestic utilities." The washing machine, the iron, the sweeper, the jack-of-all-trades house motor, the numerous table and kitchen devices, as well as the electrical range and the domestic electric refrigerator, whose application is one of the most promising possibilities to the central station companies, as well as to the public at large—all these will make a long stride forward in general use during the coming year.

Bold experiments in reduction of rates after the first quota of kilowatt-hours used are being made to stimulate the use of these household helps, in one well-known case running to as low as two cents a kilowatt-hour. They will be successful and remain in force. There will be no step backward. As the domestic servant of man, the electric current will go on increasing its usefulness to an extent that only a few years ago would have appeared impossible.

#### INDUSTRIAL POWER

In this field, the progress already made, vast as it now is, is only a step compared to what the near future will show. The electric motor is conceded to be the best, most flexible, durable and convenient driver of machinery known. It is also one of the most economical of electrical devices. All it needs to capture the entire field of industrial power is the coming cheapening of the motive energy.

The realm of marine propulsion is that in which the largest power units known have been used until recently surpassed by the turbo-generator in the big power stations on shore. The first electrically propelled battleship is under construction. The new mercantile and fighting fleets that are being built to repair the ravages of the present war among the great shipowning nations of the world, will be "electrically" operated throughout.

#### TRANSPORTATION

The rapid accumulation of capital in this country, ensuing from the present revival of business, will undoubtedly stimulate the much-discussed "electrification" of steam railroads, where the traffic conditions justify it. This field of expansion has now passed well out of the experimental and into the practical stage. Reaching out from the great cities, the electrically operated sections will gradually join and close up the gaps between.

Still more, the electric railroads which have been slack

in expansion, will now move forward to catch up with the growing needs of the country. Signs of a quickening movement in this industry, which was badly scared for a while, by the bogie of jitney competition are coming to the front.

The electric trucks and the electric automobiles, still awaiting further improvement in the storage battery to come fully into their own, are, nevertheless, forging ahead and will continue to expand.

#### MISCELLANEOUS APPLICATIONS

Without attempting to touch on the ever-increasing application of electricity to nearly all the branches of industry, we may note that the making of electric steels and electric smelting of metals continue to progress and may in the near future lead to a result of basic importance in the great iron and steel business.

Striking, too, is the promise of the newly invented electrolytic irons which may in their development lead to the production of generators, transformers and motors much lighter and cheaper than those of to-day.

But most important of all the possible applications of electricity perhaps, is the rapid increase of the commercial production of nitrates from the fixation of atmospheric nitrogen. The effects of this industry on the parent industry of all, agriculture, may come to be of more importance to mankind than all the other electrical industries put together. We look for a continued expansion in the field, as in many others.

#### GENERAL

The various developments of electrical industry touched upon in the foregoing, all point to an enormous increase in the production, distribution and utilization of electrical energy. The inevitable result of this increased demand will be a series of steps that will ultimately end in a vast net work of power stations, both steam driven and water driven, that will cover virtually all of the thickly populated sections of the country with their circuits. With the cheap and abundant power thus provided wherever a demand can be built up, will gradually evolve a national electrical supply industry, country wide in its scope, soundly financed and wisely regulated, that will bring the full benefit of the coming electrical expansion to all our people and become one of the world's mightiest sources of material, comfort, prosperity and civilization.

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#### Remembering the Fathers

Believing that the lives and pioneer work of the early fathers of electrical science and invention are worthy of being kept fresh in mind, ELECTRICAL AGE proposes to run, through this year, a series of brief, non-technical sketches of twelve great men in the history of things electrical.

On another page we present the leading facts and the basic invention in the long and useful life of the Italian scientist whose name was chosen for commemoration in the familiar word "volt." We trust these brief portraits will help make vivid to our readers the always interesting and often tragic life stories of the men whose memories are preserved in the naming of electrical units of measurement.



# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## Street Lighting by White Flame Arc Lamps

By Ben Perris

With the advent of the gas filled tungsten incandescent lamp, those interested therein immediately relegated the arc lamp to the museum. Three years of service, on the contrary, have brought out unexpected limitations of the incandescent lamp, and by contrast, the high efficiency and suitability of the flaming arc lamp in this field.

As to the future of street lighting units, we have the opinion of such engineers as Dr. C. P. Steinmetz (remarks of Dr. Steinmetz at the I. E. S. convention, Washington, D. C., Sept., 1915) that the metallic incandescent lamp is limited in its future development, and hardly any further improvement in efficiency is to be expected.

Luminous arc lamps of the magnetic and titanium carbide types and the true flaming arc, employing treated carbon as the light giving element, are not limited by any physical properties of the materials used, so that undoubtedly even greater efficiencies than those obtained are to be anticipated. Of the arc illuminants, the carbon flaming arc has the greater possibilities. The luminous arcs are limited somewhat in the choice of suitable materials, whereas the study of materials used in the carbon flaming arc has hardly begun, so vast is the field.

Almost all that has been published on the "high efficiency" tungsten lamp has been based on the bare lamp under laboratory conditions. Little information is supplied on the built-up unit for street lighting. The bare incandescent lamp gives poor street illumination, owing to its unsuitable distribution and high intrinsic brilliancy, causing blinding glare. Its very life depends on protection against cold, rain and snow. Hence, the need of building the bulb into a lantern, with the result, ultimately, that the overall illuminating value of the lighting unit is approximately 1.25 watt per spherical c.p. (9.5 lumens per watt). Figure 1 is from a commercial advertisement of the N. Y. Testing Laboratory in the Lighting Journal. It shows a loss of 47 per-

cent in the delivered c.p. by equipping the 400 c.p. (nominal rating) tungsten for use on street service.

The 300 watt (600 c.p. nominal rating) used by the city of Chicago gives but 298 spherical c.p. with clear glassware, or an efficiency of 1.1 watts per spherical c.p. (11 lumens per watt), inclusive of the transformer loss of 25 watts. The values are somewhat less under service conditions with the denser glassware used and the higher transformer losses of the old equipment, in fact 9.5 lumens per watt is the actual light value of one of these units.

The commercial tests by the N. Y. Testing Laboratories on used flame arc lamps for the street lighting committee of the A. I. E. E., 1915, have developed the fact that illumination of the white flame, series, street-lighting units with good modern glassware will average during life of the trim better than 17 lumens per watt. This value of 17 lumens per watt is comparable to the 9.5 lumens per unit above quoted, since the units in each case are commercial types of diffusing glassware. Considering the white flame street lighting lamp as 100 percent efficient, the "half watt" incandescent street lighting unit has an efficiency of 56 percent. It should be stated that in each case the light is nearly all in the useful lower hemisphere so it is practical to double the lumens per watt (spherical) as given above, to obtain the lower hemispherical values, i. e. 34 lumens per watt = .35 watt per candle-lower hemispherical with white flame lamp, and flame 19 lumen per

watt = .63 watt per candle-lower hemispherical with tungsten lamp.

The refractor has been an aid to the tungsten lamp in redirecting the light to the 80° line (10° below horizontal). Use of this device has been made on the magnetite and the luminous arcs to raise the maximum beam nearer to the horizontal, so it is not without reason to presume that the refractor could be made use of in a similar manner on the carbon flame arc.

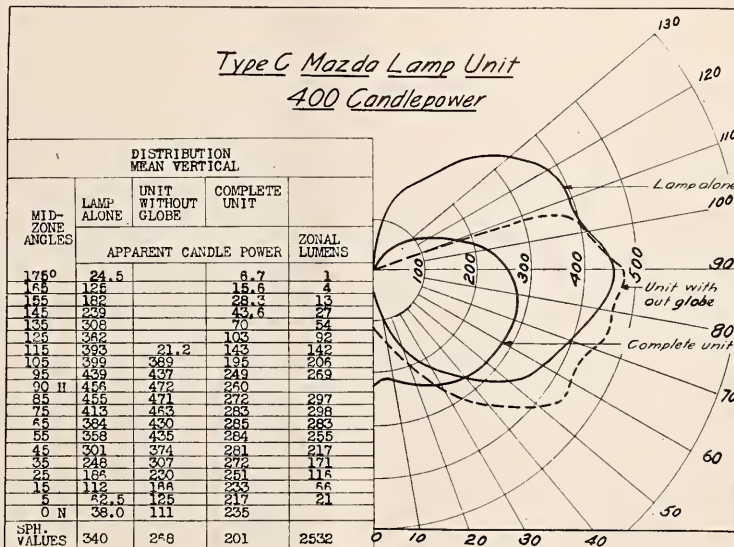


Fig. 1—Street light distribution curves

When so equipped, an efficiency of .14 watt per candle on the 80° beam is secured.

The use of the refractor has been questioned since its use entails an extra loss in candle power and also since the redirected system of lighting is not the best for street lighting purposes. Diffused lighting of streets is within the natural sphere of the flame arc lamp without the use of wasteful appliances. The distribution lies nearly all in the lower useful hemisphere, with the maximum beam along the 70° line, differing from the re-directed curves of the refractor in that the beam is not narrow and attenuated, but on the contrary, contains a large volume of light. This is shown in Fig. 2 where the curve lies almost wholly below the horizontal or 90° line.

The carbon flame arc is composed of certain chemical salts within a body of carbon. In burning, these salts have a tendency to deposit and to etch the inner glassware, a feature that has been made much capital of by the advocates of tungsten lighting. It does exist, but it should no more condemn the arc lamp than the 20 percent depreciation in the tungsten lamp should condemn that lamp.

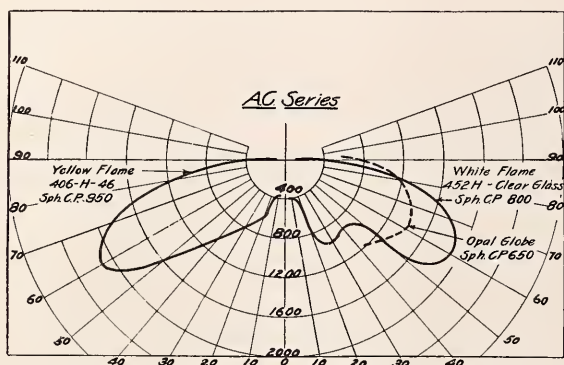


Fig. 2.—Diffusion curves of series alternating current flaming arc lamps

During the burning of the carbons, some deposit collects on the inner globe, somewhat after the manner of the old enclosed arc lamp. Most of it, of course, collects on the bottom and very little in the upper zones of greatest candle power, so that the spherical c.p. depreciation caused thereby during the trim, with the present white flame carbons, is between 5 to 7 percent. After several trimmings, the inner globe becomes somewhat etched, i. e. instead of being clear the globe presents a diffusing surface. In three to six months the transmission loss from this cause should not exceed 20 percent on spherical measurement, depending on length of time, on the care given the lamps, the use of a magnesium carbonate block in the condenser to neutralize the etching agent, and to an even greater extent to the use of high grade glassware instead of cheaper lead globes which cost a little less but are very much inferior.

To press the point further, a direct comparison can be made with the tungsten lamp. At the expiration of the guarantee of 1300 hrs. the loss in c.p. is 20 percent. This length of life corresponds to 4 months' service with the flame arcs. A higher depreciation than 20 percent in the case of the incandescent lamp would indicate improper operation; so does a greater depreciation in the flame arc lamp. The comparison shows that under proper service and maintenance conditions there is no occasion for regarding the arc lamp at a disadvantage with respect to the tungsten on the score of depreciation.

A loss of 5 percent in candlepower is reported on an installation of 3,000 lamps, after 3 months' service. This measurement is on the 80° line where most of the light emerges. On this installation, magnesium carbonate blocks are in use. Another installation of 10,000 lamps, where less attention is paid to

this detail of maintenance, has been given much publicity as showing a depreciation of 50 percent in 6 months. No information is given whether the depreciation is on the total or spherical candle power basis or is based on some single beam candle power measurements. Actually, the increased diffusing surface of the glassware at the lower angle, of such etched glassware, does not absorb as great an amount of light as would be indicated by a beam measurement at any one angle in that section of the globe. Much of the light that fails to pass through is reflected out at upper angles, resulting in a higher candle power than would be expected from readings based on beam candle power. It is well known that the distribution curve of a flaming arc lamp is foreshortened in the lower angles and increased in higher angles near the horizontal when the clear globe is replaced by a diffusing opal globe. Such condition is approximated by the etching of the lower portions of the globe.

Returning to the case in question, a 50 percent loss of light in six months would prove that this lamp system is not being run on an economical basis and to its best advantage. The yearly cost of this system (covering the flame arc lamps only) is \$500,000. New inner glassware is supplied every six months, during which period they are allowed to run down to 50 percent of the original illuminating value. During the year the average c.p. lost would be 50 percent of the available, i. e., \$250,000 worth of illumination. \$250,000 would purchase 2 new globes each week for the entire circuit for a whole year. It would seem then, that if such a loss were actually the case, it would be more economical to supply a new globe every three months at an increase of only \$6,000 (1.2 percent) and keep up the installation above 90 percent average of the maximum available illumination. Actually, there is plenty of data to show that the flame arc will operate throughout the year at an average of about 90 percent maximum available light with a 4 month renewal of inner glassware. The tungsten lamp with a loss of 20 percent per lamp life, can only operate at an average of 90 percent maximum available life. (Average depreciation during each 4 months is 10 percent).

The comparative costs of the above system of 10,000 flaming arcs and a 300-watt "half watt" tungsten system operated in conjunction is as follows: Elect. Jr., June, 1915 (Ray Palmer):

Flame arcs	\$50.31	17 lumens per watt	equipt for street use.
300 watt tungsten	\$40.66	9.5 lumens per watt	

The assumption is made that due to the depreciation of the glassware during the 6 months, the illumination is the same for both. Without questioning the facts, it would appear that economy would dictate an extra expenditure of 60c per year for each flame lamp, making a globe renewal each 1,000 hrs. (1,300 hrs. would be sufficient) and thus keep the system up to 90 percent average illuminating efficiency, which is no more than can be had from the tungsten lamps. The corrected cost of that system would then be

Flame arcs	\$50.31	17 lumens per watt	} equal { 100% illumination	
Tungstens	\$40.66	9.5		} depreciation { 62% "
Tungstens based on equal illumination	\$72.50			

Aside from reasons of efficiency and cheapness per candle-year there are esthetic and physiological considerations favorable to the white flaming arc. A softly diffusing light is as inherent to the flaming arc as glare is inherent to the incandescent lamp. In white way and business district lighting, the illumination from these flaming arcs cause an attractive contrast to the usual yellowish tint of the display window illumination. Such important physiological considerations as the quality of the light as well as the quantity were leading impulses that had led to the development of this source of illumination and are still the subject of ever increasing experimentation. The flaming arc in commercial use has proven these claims by giving better light, more light and cheaper light than any known commercial lighting unit now on the market.

# Direct Current Booster Notes

By P. Justus

A booster is a dynamo which is used for boosting voltage. Boosters are of various types and used in a variety of ways. In street railway work they are used to raise the voltage on trolley feeders and for regulating the charge and discharge of storage batteries. Feeders going out from railway power houses are of widely varying lengths. Assuming a condition such as is shown in Fig. 1. Here G is generator in power house connected to the positive and negative buses. The negative bus is suitably grounded to the rails. Connected to the positive bus are two feeders. Feeder to trolley section A is a short one so that with maximum number of cars that liable to be on it at one time, an excessive drop in voltage does not occur. Feeder to section B is a good deal longer and develops excessive voltage drop when loaded. Conditions do not warrant installing the extra copper required to reduce the excessive drop. It may be a feeder supplying a trolley running to a summer resort where the traffic is heavy for a few months only. A booster E is therefore placed in the line and is called a "line booster."

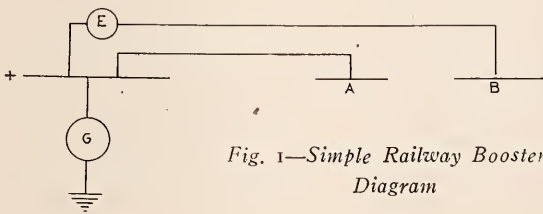


Fig. 1—Simple Railway Booster Diagram

Some power houses have generators specially designed for this purpose, although the regular generators that happen to be idle may by suitable switching arrangements be used as boosters. The armature of the booster is connected in series with the feeder whose voltage is to be increased; the station generators being as a rule compound wound so that when used as a booster, the feeder is cut in series with the armature and series field. Owing to the fact that the booster must carry the entire load of the feeder or feeders that happen to be connected in series with it, the armature and series field must be large enough to take care of all the load the feeders may be called upon to deliver.

The feeder current passing through the series field makes the voltage of the booster self-regulating to a great extent and proportional to the load. If additional voltage regulation is required, the shunt field may be separately excited by direct connection to the station bus. The voltage of the booster is that required to compensate for the drop in the feeder. Suppose that the maximum demand on the feeder is 600 amperes and with this current flowing the voltage at the end of section B is 460 volts with 500 volts at the bus bars in the station. Booster E in this case would supply the 40 volts loss. Boosters can be built to suit any special requirements. Where specially designed to meet some particular condition they are usually motor direct connected to a shunt motor. They may be located at any point in the system as long as the armature is in series with the feeder. Unless lack of space or some other condition prevents, it, boosters are located in the power house where they can be attended to along with the rest of the equipment. If located away from the power house there must also be provided with means for automatically disconnecting the driving motor from

the line when the power goes off. Referring to Fig. 2 shows that in case the power goes off the line the motor would stop and when the power comes on again if the motor is not disconnected before the power comes on again a short circuit would occur.

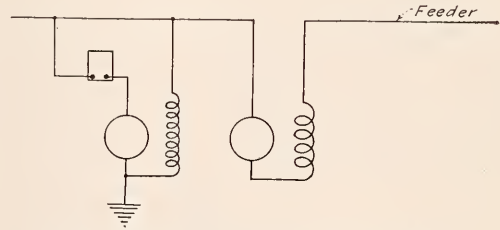


Fig. 2—Field Connections of Series Booster

Boosters are also used in connection with storage batteries for charging and discharging them. Take for instance an arrangement as shown in Fig. 3. Here a 110 volt generator is working in parallel with a storage battery on heavy loads and the battery alone on light loads. For the storage battery to maintain 110 volts to end of discharge when carrying the load alone would with a minimum of 1.8 volts require 61 cells. To

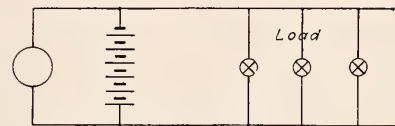


Fig. 3—Battery unboosted

recharge 61 cells would require about 160 volts. The battery is recharged by the generator during periods of light load. In order therefore to recharge this battery the generator voltage would have to be increased as the charging progressed to the above amount. This increased voltage would be detrimental to the lights. The voltage of 61 cells would also be considerably above 110 when fully charged. To maintain a uniform voltage on discharge a number of the cells called end cells are disconnected at the beginning of the discharge and cut in one by one as the voltage decreases.

To maintain 110 volts on the line and still charge the battery use is made of a booster in series with the battery will supply the voltage required in excess of 110 volts for charging the battery. This is known as a shunt booster.

By using a booster of the reversible type the voltage of the booster can be made to assist the battery in discharging. In such a case the end cells can be dispensed with. Then to charge 56 cells about 36 volts will have to be furnished by the booster. On discharge with a minimum of 1.8 volts per cell the voltage of battery will be 100 volts less than the line voltage and that amount will have to be supplied by the booster. Although the maximum voltage delivered by the booster is less when used reversibly, the cross section of copper in the armature will have to be greater as it has to carry the maximum discharge current of the battery.

Fig. 4 shows the connections of a non-reversible booster with end cells, and Fig. 5 of a reversible booster without end cells.

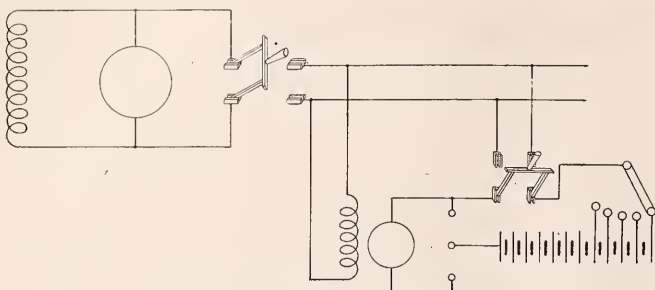


Fig. 4—Non-Reversible Booster

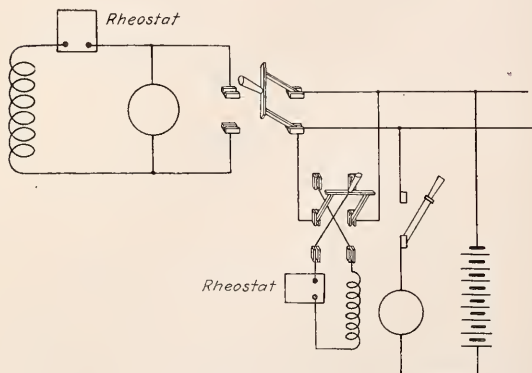


Fig. 5—Reversible Booster

Fig. 6 is a diagram of a differential booster in connection with a storage battery used in parallel with generators on a fluctuat-

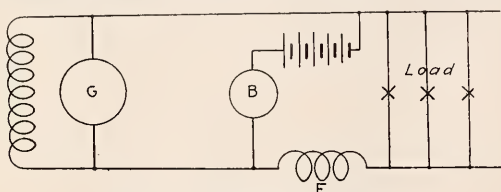


Fig. 6—Differential Booster

ing load such as is encountered in steel mills and railway service. This booster is provided with a series winding only which is in series with the load and must be heavy enough to

carry the entire load continuously. G is the generator. SB is the storage battery. B the booster armature, and F the booster field. The voltage generated by the booster is in opposition to the voltage of the generator G and helps to discharge the battery when a demand above normal is made on the system. On light loads the voltage of G is higher than that of the booster and current flows into the battery and charges it. Under normal conditions the booster voltage plus the battery voltage just balance the voltage of G and the battery is neither charged or discharged. There is also the booster controlled by a carbon pile regulator, a diagram of which is shown in Fig. 7. Two piles of carbon discs are connected as shown in the figure which are alternately compressed by the lever actuated by the solenoid S in series with the line. With heavy load the pull of the solenoid compresses pile C 1, the current then flows through exciter field EF so that the voltage of booster B is added to that of the battery causing it to discharge and aid the generator G in

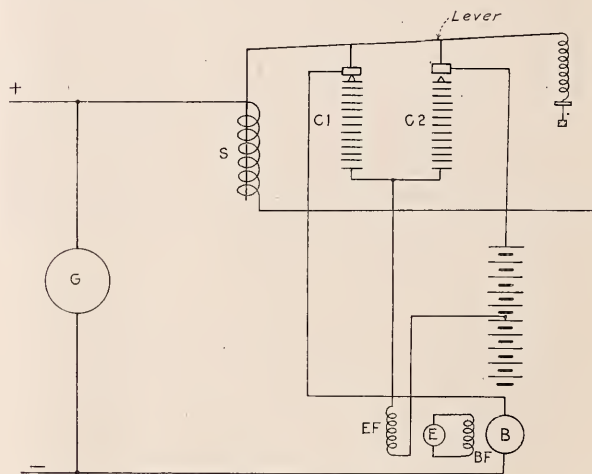


Fig. 7—Booster connections with carbon pile regulator

handling the load. On light loads the spring at other of lever pulls it down so that pile C 2 is compressed. Current through exciter field then flows in a reverse direction thereby reversing the booster field BF and reversing the polarity of the booster so that its voltage is added to that of the generator G and charges the battery. The amount of charge and discharge is varied by the tension on spring on the lever.

❖ ❖ ❖

## Alternator Bearing Heated

The pole-pieces and the armature of a generator or of a motor exert a strong pull on each other irrespectively of whether or not, the external circuit is supplying useful energy. With excited field poles of exactly the same strength and with a perfectly uniform air-gap, the magnetic pulls will be equal in all directions and it may fairly be assumed that the armature core is not forced in any direction excepting insofar as it is forced in a downward direction by its weight.

A 100 kilo-watt alternator was complained of on account of excessive heating of its field coils and bearings. An inspector who was sent to locate the trouble found that it was necessary almost to continuously pour oil through one of the bearings in order to avoid shutting down. It was ascertained that all trouble dated from the second night before when a stroke of lightning had grounded a field coil which had to then be replaced with a spare. Careful inspection of the coil failed to

reveal any irregularity but a compass test of polarity disclosed that there were three N poles in a row on the side opposite to that on which the bearing was heating. The middle coil of the three was the new one and evidently it had been installed end for end although its appearance would not have suggested such a condition. On temporarily reversing the coil by interchanging its terminal connections, all bearing heating stopped within an hour and the rectifying of the wrong polarity so increased the voltage of the machine that the exciter voltage had to be decreased in order to hold the alternating voltage down to normal.

With the alternator field coil reversed it had been necessary to operate the exciter with full field; this of course over-loaded both the exciter and the alternator field and caused both to heat. After the change the heating became normal.

E. C. Parham.

## Electrical Thawing of Frozen Pipes

The time will soon be here now when water pipes freeze up and other similar occurrences take place. Perhaps there is nothing more annoying and irritating than a frozen water pipe; and nothing gives one a feeling of greater satisfaction and relief than to have it remedied quickly and simply with the least possible expense and loss of time. Thawing frozen water pipes presents a very effective way in which the wide-awake central station manager may ingratiate himself and his company with its patrons, dispose of a few kilowatt-hours at extremely advantageous rates, and at the same time carry on an effective advertising campaign without appearing to do so and at no cost.

Thawing water pipes by means of electricity is not a new idea; in fact it has been done with very satisfactory results for many years. While its value as a means of overcoming the interruption to the water supply has long been well recognized, although not to the extent that one would expect, the value of doing it electrically has not been taken advantage of as an advertising medium. No great skill is required for thawing pipes, only a little care; nor is any special apparatus necessary, standard equipment being used. A thawing outfit consists of a wagon, a transformer, controlling and protecting apparatus, lengths of cable and wire, and two men. The transformer used may vary from 15 to 100 kilowatts capacity depending upon the diameter of the pipes to be thawed; the usual distributing transformer, 2300-230/110 volts being used. The transformer should be protected by a cut out fused at about 50 per cent above the continuous rating of the transformer. The wires which connect the transformer to the circuit should be arranged that connection can be made with least effort, delay and danger to the lineman. The wires should be heavily insulated, with wooden spacers affixed so that they cannot come together and cause short circuits. For the control of the voltage applied to the transformer, and the current flowing in the secondary therefore, a water rheostat is very suitable, although if much of this class of work is to be done a choke coil designed specially for the work will be more economical and permit of better regulation of current. Where a water rheostat is used the water supply should be ample otherwise it may heat up if the current is applied for any length of time continuously. The cables used for carrying the heavy current in the secondary should be of more than sufficient capacity that the voltage drop in them will be minimum. Good contact where the cables are connected to the pipe should always receive careful consideration, because often the resistance of the pipes is high and increases somewhat as they warm up. In all cases an ammeter should be placed in circuit, preferably in the transformer primary through a current transformer having a ratio of one to one. The lay out should be as simple and as compact as possible, so that the number of movements will be few.

The time required, and also the energy, to thaw a pipe of any definite diameter are both extremely variable quantities because the heat conductivity of the soils through which the pipe passes vary so widely. However the heating of the current varies as the square of the current, hence the desirability of using high amperage is apparent. There is another reason for using as high a current as possible compatible with safety to the pipe and its surroundings and that is that the heat losses through conduction will be lower the higher the rate at which the heat is applied, within limits. In the endeavor to thaw the pipe quickly the possibility of damaging the pipe or the surroundings must be kept in mind at all times. Experience is the best guide in this matter.

The charge for thawing water pipes is often a fixed one according to time, a definite sum the first hour, plus additional charge for the second hour or each additional fifteen minutes; or it may be a definite charge per thaw depending upon the diameter of the pipe and the ground in which it is submerged. Where a fixed price per thaw is charged, which charge usually varies from \$5 to \$15, it should be kept in mind that if electricity were not used it would probably be necessary to open up the street—in most cases an expensive proposition and one which requires considerable loss of time.

Remembering that thawing the pipes electrically is to be a matter not only of utility but also for advertising it follows that the wagon in which the thawing outfit is transported from place to place must be taken into consideration. Wherever feasible this wagon should be electrically propelled, and not horse-drawn. From the practical point of view the electrically propelled vehicle is superior to one using a horse because there is no necessity to consider feeding the horse or keeping it warm, there is no horse to be watched, the driver manipulating the thawing outfit. With the electrically propelled vehicle there is no restriction as to hours work per diem, heavier loads can be drawn and they can be moved from place to place much quicker. The use of an electric wagon shows that the central station company practices what it preaches; the fact can be made more conspicuous by placing a sign on the wagon saying "Electric Service, Simple, Economical, Reliable," and similar wordings or slogans.

Much is being said these days about preparedness in times of peace for war, that it would be well for all central station companies to prepare for cold weather before it comes. It is usually the first real cold snap that causes the most trouble, annoyance and expense. Thawing water pipes is a convenience to the public, it is a source of income to the central station company, and by a little judicious forethought it may also be an energetic and profitable advertising campaign.

K. Q. R.

## Switchboard Facilities for Testing Instruments

Henry A. Cozzens, Jr.

The recent developments in load dispatching and system plant operation have demanded that all switchboard instruments shall have a commercial accuracy. This accuracy must be determined periodically by routine tests on all station instruments and meters. This feature of central station practice has grown to such an extent that large systems maintain testing laboratories and employ instrument men for the purpose of checking, cleaning and repairing electrical instruments.

In the most modern stations provision is now made to facilitate this work. On the other hand the testing of instruments located in the older stations is somewhat of a problem. Inquiry into the cause of this problematic condition will reveal that the largest operating systems are holding companies. These companies have purchased the rights of several small companies and are operating their stations until the time arrives when

they can be abandoned and the load connected to a modern central station.

These small stations has no facilities for testing instruments. The switchboard control and instrument wiring was installed according to numerous and varied schemes. The causes underlying these schemes and their variation were mainly that the wiring of switchboard panels was not standardized. To-day manufacturers supply standard panels for feeder and generator circuits. Furthermore switchboards were formerly built with little or no provision for future growth.

Central station men realize the need for standardized wiring on the panels and the introduction of switches and other facilities for the testing of instruments. Standardized wiring means safety, neat appearance and facility of testing.

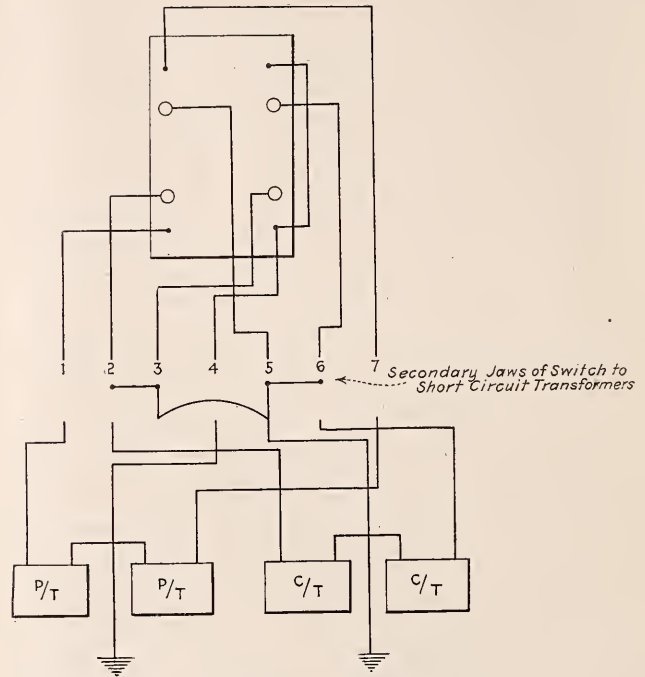
The first step towards facilitating the testing of instruments was the introduction of terminal blocks. When testing ammeters it was possible to trace the leads from the instrument down to the terminal block, placing test clips there to short circuit the current transformer. This scheme eliminated the practice of "skinning" wires on the rear of panels with its resultant unsightly appearance. To prevent testers from disarranging the wiring when removing the leads from the instrument terminals a loop scheme was tried. This consisted of looping the wire just before the terminal so as to enable it to be removed easily from over the instrument stud.

The latest idea in instrument testing is the introduction of the short circuiting switch. This switch is of the double throw pattern so constructed that when in one position the ammeter is in the circuit, while when thrown into the other position the ammeter is removed from the circuit and the transformer short circuited. The advantages gained in the use of this switch are several; firstly the tester cannot make the wrong connections as when he had to trace the wiring down to the terminal block and then run the possibility of attaching the test clips to the wrong terminals. Thus the introduction of switches involves the safety of both the tester and the equipment. Another advantage is the facility of testing, since with the switches the test leads may be attached directly to the jaws and the wiring on the board not disturbed to remove the leads from the terminals of the instrument under test. The wiring instead of being placed in single layers on the back of the board so as to enable tracing may now be grouped in a small space several layers deep.

The testing of station wattour meters passed through the same development. The first step in the actual improvement was the scheme of placing baby knife switches in series with each lead to the meter. After short circuiting the current transformers the switches could be opened and the test attached to the upper jaw of each switch, doing away with removing the leads from the meter terminals. This scheme was open to the objection that it lacked uniformity; that is the construction department would interchange the position of the leads on the switches on different installations. To combat this a seven pole switch for use with polyphase wattour meters was introduced. This switch works on the same idea as the ammeter short circuiting switch on the current leads, the potential leads being opened by ordinary single throw elements. With the introduction of the switch a standard wiring layout was adopted and now all meter installations are uniform.

Some switchboards are equipped with either five or six pole tests switches but the seven pole arrangement offers the ad-

vantages of expediency and facility of testing meters as well as simplicity in wiring. It has the disadvantage, however, that more wiring is used than with switches with fewer poles. In the illustration is shown the application of a seven pole test switch with short circuiting connections on the current elements as arranged for a 2 phase, 4 wire meter. The current elements



7-pole instrument test panel

of the meter may be placed in series by putting a jumper on jaws No. 3 and No. 5 and putting the potentials in parallel by jumping jaws No. 1 and No. 7. This enables the meter to be tested as a single phase meter. This scheme eliminates the removal of leads from the terminals of the meter for testing so that the wiring on the rear of panels need not be disturbed.

These recent developments in switchboard appliance make the maintenance of accurate indicating and recording instruments a simple matter. The appearance of the rear of the panels as well as their condition has been greatly benefited by these devices.



## Various Dimmer Devices

When the service is of alternating current the method usually used is what is known as reactive resistance. It consists of a coil of large wire connected in series on one side of the line, as shown in Fig. 1. It is so arranged that a core of soft iron wires may be inserted in the coil when it is desired to dim the

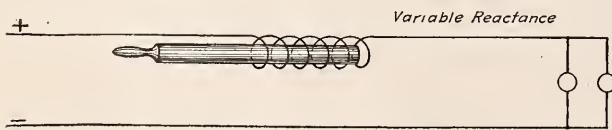


Fig. 1—Simple reactance coil dimmer for alternating Current

light. It depends for its operation upon the principle of self induction, which acts to induce a current in the wires of the coil which will tend to flow in the opposite direction to that from the line, as this opposing current is considerable when the core is inside the coil and very little when the core is not in

the coil. It will be seen that the main line current may be regulated in this way and no extra current wasted as is the case when resistance is cut in in series on the line.

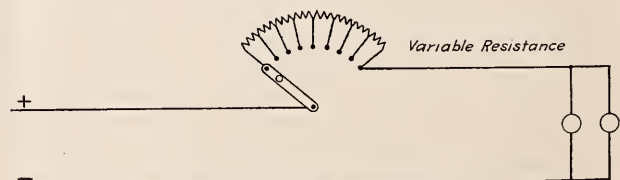


Fig. 2—Resistance dimmer for direct current

Another method shown in Fig. 2 is to connect in series on the line a variable resistance, which usually consists of some standard resistance spools and a variable contact tap, connected between each coil to a contact segment which are arranged on the face of a resistance box and an arm arranged to cut in or

out part of the coils, which will cut down the current taken by the lamps. This method is very expensive as it wastes the extra energy and causes it to be expended in heat.

Another method is what is known as the series parallel method and is controlled by a double throw, three pole knife switch which is connected so that when it is in on one side that the lamps will be in series and when thrown over to the other side that the lamps will be in parallel. As two lamps in series will

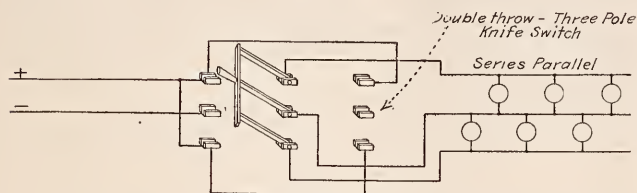


Fig. 3—Direct or alternating current single-step dimming connection

make them burn dim when connected across a circuit of the proper voltage for them to be connected across in parallel. This requires that the lamp sockets be arranged in pairs of two in series and requires a lot of extra wiring. It is not to be recommended as when the lamps are burned for some time their internal resistance will be changed and this will cause one of the pair in series to make more light than the other and will result in an uneven distribution of light. This scheme is shown in Fig. 2 and is too inflexible.

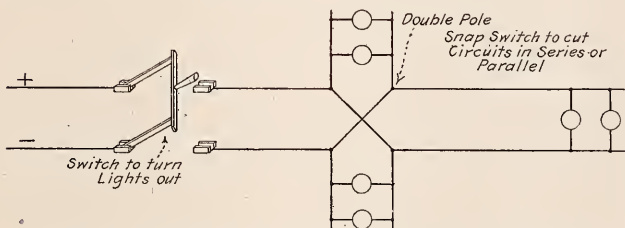


Fig. 4—Connection for same brilliance on 2 voltages

This same connection is sometimes used on test circuits where it is desired to use the same bank of lights and have alternating current at a voltage of 220 on one side and a voltage of 110 on the other side direct current. Which will result in the lights burning to their full brilliancy on both positions of the switch.

All the above is standard and is well known in the field but the method used in the following is said to be novel, especially as used for this purpose.

As will be seen from the accompanying sketch as used it does not require any rewiring of the place and is not expensive, as an ordinary double pole snap switch may be used. A main line switch should be used to control the circuits and the double pole just be used for the dimming effect.

The circuits are arranged so that they are fairly well balanced as far as watts per circuit is concerned. Then the connections necessary may be made in the panel board box and the regular circuit fuses may be left in circuit.

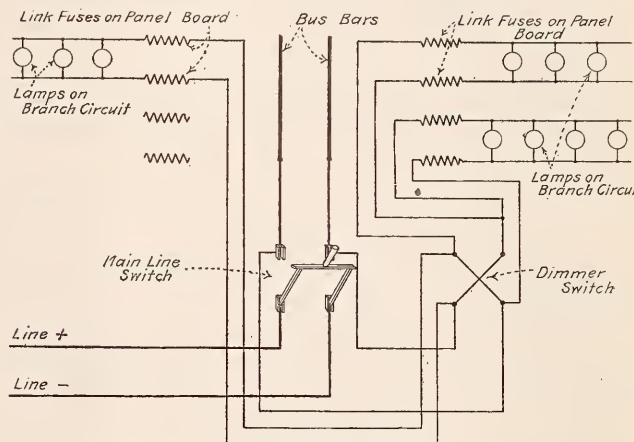


Fig. 5—Single-step dimming connection as arranged for 3 circuits

The effect produced will be: when the snap switch is on and the main line switch closed the lamps will be burning in parallel across the line and when it desired to dim the illumination all that is necessary is to turn the snap switch off. This will connect the three circuits in series across the line, as the resistance of the circuits will depend upon the number of lamps on each circuit and the size of the lamps. The range to which this can be used is almost unlimited.

This is the least expensive of all the different methods and should be used more. It is shown in Figs. 4 and 5.

The knife switch is used to turn the lamps clear out as the snap switch will not do this when connected this way.

\* \* \*

## Starting of Alternating Current Motors

By Arthur Hearvey

The most apparent weakness of the induction and synchronous motor is its poor starting qualities. This is due to the stator and armature being in the condition of a transformer with the secondary short-circuited when the voltage is applied to the stator winding while the armature is not moving.

Induction and synchronous motors require a starting current from 2 to 5 times the full load current. Such starting currents for motors of 5 horse-power and larger cause severe disturbances in the line by a large voltage drop and load variations. In order to keep these currents within reasonable limits, starting compensators or resistances are used.

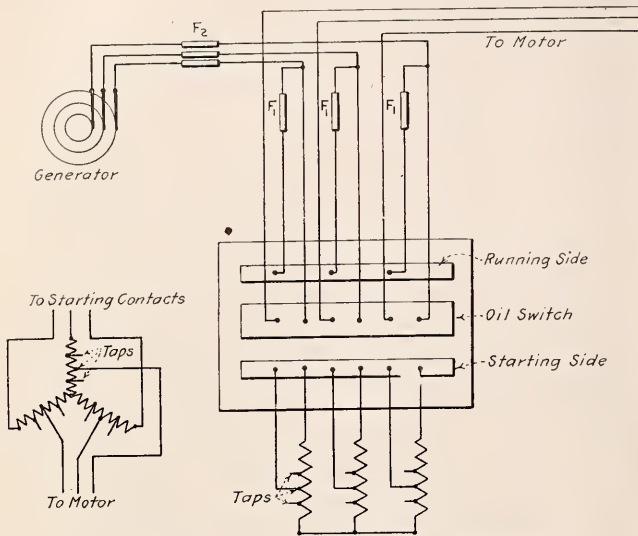
Induction motors with squirrel-cage rotors should be used where relatively large starting currents are not objectionable. If a heavy load is to be started, the supply line should be of sufficient cross section to prevent a large voltage drop, as the torque decreases with the square of the decrease in the voltage.

The squirrel-cage induction motor is particularly adapted to dusty places and on account of the absence of sliding contacts and switches in the motor, they can be used with safety in powder mills and other places where a spark may cause an explosion.

The best form of starter for the squirrel cage motor is known as the compensator. This consists of inductive windings, one coil for each phase, which are provided with several taps and which supply a large current to the motor at a reduced voltage. Their effect is equivalent to a step-down transformer. The product of the voltage and current on the line circuit is approximately equal to the corresponding product on the motor circuit. Each coil is placed on a separate leg of a laminated iron core and is provided with several taps to obtain a number of sub-voltages for permanent connection to the starting switch of the motor.

Diagram No. 1 shows the connections of a 3 phase compensator made by the General Electric Company. The cylinder switch is operated by a level which has three positions, "off," "starting," and "running." In the "off" position the motor and compensator are disconnected from the line. In the "starting" position the three free ends of the coils are connected to the line and the motor to the taps of the compensator winding as shown in Diagram 2. In the "running" position the compensator winding is cut out and the motor is connected to the line through fuses  $F_1$ , which are smaller than the fuses  $F_2$ . To

The starting torque of the synchronous motor is usually limited to the "pull-in torque," that is, the torque that is available when the motor is changed from an induction motor to a synchronous motor. This pull-in torque is usually about 25 percent of the full load torque. When starting the field should be short-circuited through a resistance as shown in Diagram 4 to prevent a high voltage being generated in the field coils which might break down the insulation. When the armature reaches synchronism, as indicated by a drop in the alternating current, the compensator switch is thrown into the running position and then the direct current switch is closed and its currents adjusted.



Diagrams 1 and 2—Starting Connections

meet the various requirements, the compensator for standard motors below 20 horse-power are provided with taps for starting the motor at 50, 65, and 80 percent of the line voltage, with currents at 25, 42 and 65 percent of the current that would be taken if no compensator were used. For larger motors taps are provided to give a starting voltage of 40, 58, 70 and 85 percent of line voltage with currents at 16, 35, 50, 72 percent of what would be taken if the motor were connected directly to the line. The contacts are easily renewable and so constructed that the arc does not take place on the rubbing surfaces.

When an exceedingly heavy load is to be started an induction motor with a wound rotor should be used. Its starting current is controlled by an external resistance in the rotor circuit as shown in Diagram No. 3. The type of motor has the same

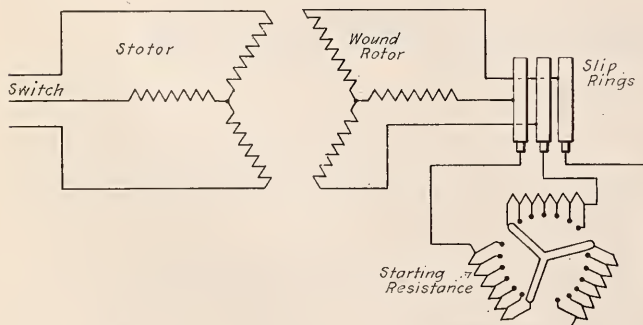


Diagram 3—Wound rotor motor connections

stator as that used for the squirrel-cage machine, but its rotor bars are connected together to form a winding. But this winding is not closed on itself as in the squirrel-cage machine, it is left open at points which are connected to 3 slip rings, and the winding is closed outside of the machine through resistances which can be adjusted. The winding is finally short circuited when the motor is up to speed.

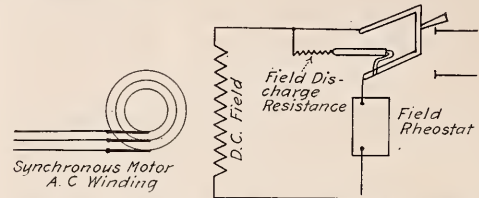


Diagram 4—Synchronous motor starting connections

The torque of the wound rotor at starting may be made equal to the maximum running torque by inserting resistances in the armature circuit equal to the difference between the reactance and the resistance of the rotor winding. The total resistance should be larger, as the maximum torque is usually designed to occur in running with natural armature circuits, at a decrease in speed of 10 to 15 percent of full load speed, the rotor and stator currents not exceeding twice full load currents. So that the resistance inserted in the rotor circuit serves the double purpose of increasing the starting torque and keeping the starting current within bounds.

The modern self-starting synchronous motor has a squirrel-cage winding distributed through slots in the pole faces of the d.c. winding, in both stationary and revolving field type. This squirrel-cage winding performs exactly the same duty when starting the synchronous motor as the squirrel-cage winding of the ordinary induction motor. The synchronous motor therefore, requires a compensator to step down the voltage when starting the same as an induction motor of the squirrel-cage type.

A large starting torque is obtained at a sacrifice of efficiency and a large air-gap clearance, and a large over-load capacity by a sacrifice of power-factor. The overload capacity of a motor should never be less than twice full-load because, since overload capacity is approximately proportional to the square of the applied voltage, a drop in voltage of 20 percent would cause such a motor to drop out of step if operating at 50 percent overload.

The direction of rotation of both the synchronous and induction motors is reversed by reversing two of the leads for a 3-phase motor and one of the phases for a 2-phase motor.



### A New Way For Changing Transformer Oil at Substations

At one of the smaller substations of the Pacific Power & Light Company, operating in Oregon and Southern Washington, it recently became necessary to transfer oil from three 200 K. V. A. transformers to another bank of 333 K. V. A. rating, newly installed. As this work could not be executed with the transformers in use, employing electric power as provided at the plant, a simple and rather ingenious method was devised by using an automobile.

One of the rear wheels of the car was jacked up, a three-inch belt run around the tire and over a pulley on the end of the motor shaft governing the oil regulation. With the automobile running, the control of speed was readily obtained from the gas throttle, and the oil transferred with utmost dispatch, at a considerable saving of time and labor.



# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

## Grounding of High-tension Overhead Details

Replying to question of J. N. in December issue of ELECTRICAL AGE on grounding, I submit the following information:

Ground wiring of the poles is the wire or wires used to connect apparatus with the ground.

Its object is to carry current to the earth in case of trouble which acts as a protection to the apparatus.

Steel pins and cross-arms at line and highway crossing on transmission lines.

Steel towers.

Unoccupied feeders.

Exterior high-tension meter installations.

Grounding of lightning arresters is shown in Fig. 1. The size of ground wire is generally No. 6 T.B.W.P. solid conductor being the same as the line wires. The ground wire is stapled under cross-arm and sometimes covered with wood moulding down pole to iron pipe into which it is soldered. The wood moulding is fastened by means of pipe straps. The length of ground pipe is generally ten feet but longer if the ground is in a dry place. Paper is put in pipe about 2 in. from top and then bare wire is inserted and solder poured around. The grounding of transformer cases is generally made by placing bare wire under a bolt and then fastening same, with ground at earth as in Fig. 1.

The grounding of through bolts on 12,000 volt line dead ends prevents the burning of cross-arms or pole in case the strain insulators are broken by lightning or damaged reducing the insulation.

The grounding of secondary distribution systems is carried out as in Fig. 1, joining the ground wire to the neutral or one side of a two wire system.

The steel bases of disconnecting switches are grounded for the same reason as in Fig. 2.

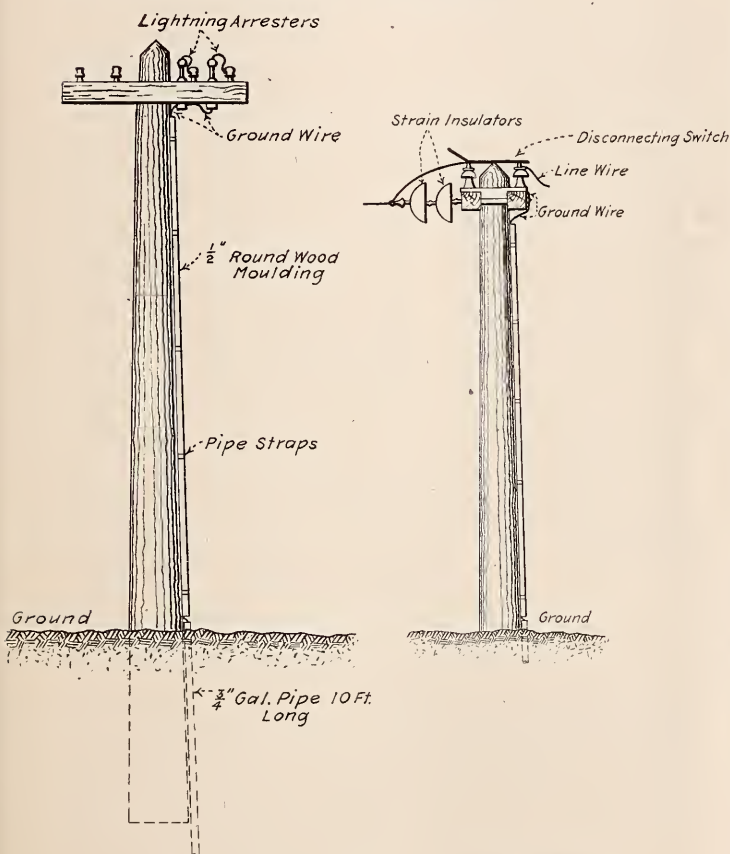
Steel pins and cross-arms on wood-pole transmission lines are often grounded at points of crossing with other circuits or at highway crossings. This is done to protect the circuits and cross-arms from burning, the idea being that the safety devices will operate in time to prevent the burning of pin or cross-arm. This arrangement is called for by standard practice in the United States and has long been obligatory in most European countries.

The grounding of steel towers set in concrete is recommended where tower is located in a dry place. Size of ground to be same as line wire and length of ground pipe depending on soil condition.

The grounding of unoccupied feeders, those of 12,000 volts or more is done at generating station or sub-station by throwing a disconnecting switch to ground position and by throwing a chain or similar conductor over line to steel rails while line is being repaired. The grounding of exterior 2200 volt meter installations is the grounding of current transformer secondary side and is carried out as in Fig. 1.

In general, the length of ground pipe is determined by the dampness of soil surrounding pole.

W. I.



Figs. 1 and 2—Details of Grounding Methods

Following are the different parts of apparatus that are sometimes grounded:

- Lightning arresters.
- Pole type transformer cases.
- Through bolts at dead ends.
- Secondary distribution systems.

**Ground Wiring of Transmission Lines**

In order to protect a transmission line from lightning and electrostatic disturbances, ground-wiring of the poles (or towers) is employed. If a transmission line is enclosed by a grounded conducting system, no external disturbances can enter it, and to approximate as near as possible this condition, one or two, and sometimes more, wires, known as ground wires are strung and connected with the ground at every fourth or fifth pole in case wooden construction is used, or at every pole in case metallic construction is employed. The greater the number of wires, the more perfect will be the protection afforded, but usually for reasons of economy, one or two wires are more often employed. When two are used, they are placed at the ends of the upper cross-arm, or in a separate cross-arm in a plane above that of the line. In such a case the ground wires are more likely to receive the lightning discharge due to their higher position, and to more effectively protect the line from electrostatic charges caused by storms drifting across it because of their position at the ends of the poles—the farther to the side the better. In case but one wire is used it is run on the pole top as shown in the accompanying sketch. For mechanical reasons ground wires are sometimes run on insulators, but quite often they are fastened direct to the poles. With steel poles and towers the latter method is generally used.

Barbed wire is sometimes used as the ground wire because it is more effective than ordinary wire against certain atmospheric disturbances such as electrostatic charges, but its great disadvantage is its short life. Galvanized iron wire is more often used.

It is estimated that the use of ground wires causes a reduction of at least 50 percent in insulator failures.

Irving B. Stanton.



**Problems for Solution**

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

**Testing Street Light Circuit**

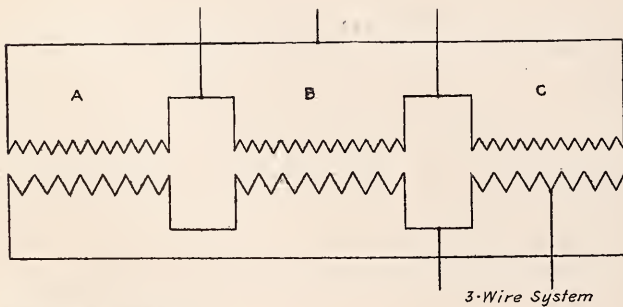
What is the best way to locate open circuits and grounds on series street lighting system? Some method is needed that will require minimum time to do the work.

E. A.

**Current Division**

With transformer connection is shown what proportion of current will be drawn from A and B when full load is being taken from transformer C? All three are to run 1600/220-110 transformer of the same make and type.

P. S. H.



**Making a Choke Coil**

Kindly give full directions for constructing a simple choke coil to produce an impedance of about 8 ohms so that a 4-ampere, 60-cycle current will be reduced to 3½ amperes when it is inserted in circuit.



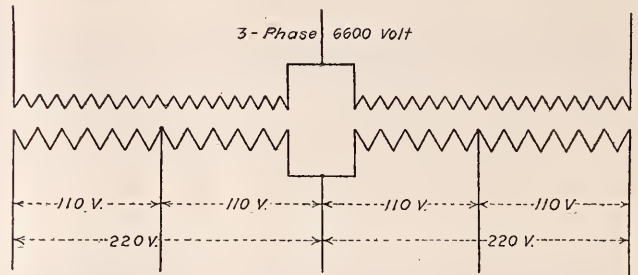
On a 3-phase, 4-wire, 220-volt distribution system should the neutral be grounded anywhere but at the substation?

**Grounding Neutral Wires**

Where a mixed light and power system is fed on 3-phase, open delta, 220-110-volts, is it advisable to ground one of the neutral wires or one of the phase wires? Connection as shown.

Please give reasons.

M. K.



Is there any objection to grounding the neutral of a 3-phase, 60-cycle, 220-110 volt bank of 15 k.w. transformers to the same ground as the primary lightning arrester.

E. F. O.



**To Construct a Rectifier**

A correspondent asks if anyone can give him full information that will enable him to construct a vibrating rectifier for charging small storage batteries, similar to those now on the market.



**Charging Current**

Answering J. E. M's question on transmission and distribution in December issue of Electric Age: will say that a transmission line with arresters spaced 50 miles apart has practically no protection from lightning and suggest that the line be equipped with a number of good horn-gap arresters placing them at points where experience has shown that trouble is likely to occur.

The approximate charging current for a 46,000-volt, 3-phase, star connected, 100-mile, No. 1. B. & S. line with grounded neutral wires spread 6 feet apart on 12-inch insulators at 25 cycle would be nearly 23.63 amperes. The formula used is:

$$\text{Amperes} = \frac{E \times C \times 2 \pi \times f}{2 \times 10^6} \times 1.155$$

Let C = Capacity in micro farads per mile

E = Line voltage

f = frequency

d = diameter of conductors

and A = distance between conductors and neutral in inches

Calculating for capacity

$$C = \frac{.0776}{2 \log \frac{A}{d}} = \frac{.0776}{2 \log \frac{12}{.289}} = .2022 \text{ micro farads per mile.}$$

For 100 miles, capacity is 20.22.

Charging current per phase is

$$\frac{46000 \times 20.22 \times 2 \times 3.14 \times 25}{2 \times 10^6} = \frac{40,908,839.6}{2 \times 10^6} = 20.454 \text{ amp.}$$

For 3-phase, charging current is 20,454 x 1.155 = 23.62 amp. The current is the same for the same voltage whether star

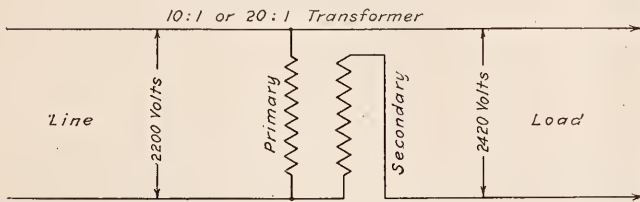
or delta connected, being in each case  $\sqrt{\frac{2}{3}}$ , or 1.155 times the charging current per phase.

E. J. F.

### Boosters, Boosting and Bucking

In answering the question asked in the December issue of ELECTRICAL AGE regarding boosters, it is the function of a booster to vary the voltage. Sometimes the booster may boost or raise the voltage, sometimes do the reverse or lower the voltage. In the last case it is often called "bucking" the voltage. A booster may be used on either alternating or direct current. In the former case the booster usually consists merely of a static or stationary transformer, although a booster may be a rotating piece of machinery. In the case of a direct current booster, the piece of apparatus is always a rotating machine.

The most common type of booster for use on alternating current circuits is the transformer, connected as shown in the sketch. If the ratio of transformation is 10 to 1 the boost voltage will be ten percent greater than that on the line side of the



Alternating Voltage Booster Connections

booster. For example, in the illustration a distributing transformer having a ratio of 2200 volts to 220 is connected across a 2200 volt circuit. Since the secondary voltage, that is the voltage induced in the secondary winding of the transformer, is additive to that of the circuit because the secondary coil of the transformer is in series with the line, the total voltage on the booster side of the line is 2200 plus 220 or 2420 volts. By reversing either coil with respect to the other, that is in other words reversing the polarity of the transformer the transformer will buck or lower instead of boosting the voltage. Since with this arrangement the amount of boost or buck remains constant according to the ratio of transformation of the booster this arrangement has been modified so that instead of the ratio being constant it may be changed. This is done by bringing out taps which may be cut in or out according to the requirements of the load. Such a device is known as a step by step regulator. The induction regulator is simply a modification of this same idea.

The direct current booster consists of a generator which is connected in series with the line. This generator is usually driven by a motor connected to the same shaft. The motor is connected across the line and the generator in series with the line. Change of voltage of the generator—this type of booster permits of variations of the boost or buck voltage—is obtained by varying the generator field current, motor speed remaining constant, or by changing the field current in the motor field and thus its speed, or both of these ways.

Concerning the uses to which a booster may be put. The most common application of the alternating current booster is for raising the voltage of a line which is overloaded, or in any case where higher voltage is desired. In using a distributing transformer for this purpose it must be remembered that the secondary winding is raised considerably above its normal operating potential and thus there is likelihood of its breaking down. On a pole the chance of its doing this is comparatively small but where a booster is placed on the ground it is advisable to insulate the case from earth.

Direct current boosters are used for a greater number of different applications than is the static booster for alternating current, because it is more flexible. It is also much more expensive for the same kilovolt-ampere rating, as well as being less efficient. Direct current boosters are often installed on lines where it is desired to maintain constant voltage with changing load. Sometimes they are installed in the negative return

feeders of railway systems to reduce the drop in them and thereby reduce the likelihood of electrolysis in water mains, etc. The most common application of the direct current booster is for charging storage batteries from constant voltage supply mains.

It can be seen that the term "boosters" covers many different things doing several different functions. The one fundamental object of the booster is, however, to vary the voltage.

K. R.



### Direct Current Booster Connections

One function of a booster is to raise or boost the voltage of the system above the line voltage in order to charge storage batteries connected between the lines. Since the voltage of a fully charged cell is from 2.4 to 2.7 volts, and that of a discharged cell about 2 volts, in order to charge the battery, the charging voltage must be raised about 35 percent above the line voltage.

To raise this voltage by means of the generator is objectionable as this would raise the voltage on the whole system, therefore a booster is used.

A booster should be used upon systems where steady voltage is to be maintained, also on systems where the same generator is used to furnish both, lights and a fluctuating power load.

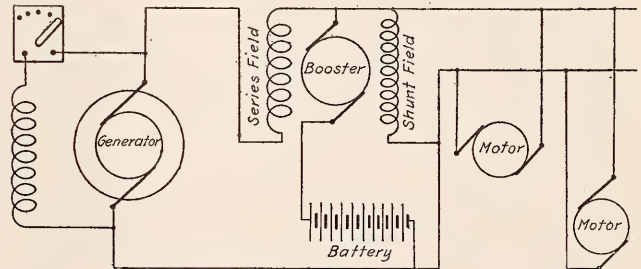


Fig. 1—Reversible Booster Connections

Without a booster, every time the load would fluctuate the lights will flicker on account of drop of voltage. With a booster in the circuit, the lights are not affected by any power fluctuations.

A booster is a dynamo whose armature is in the battery circuit, its voltage being added to or subtracted from that of the battery to produce charge or discharge. This action of the booster may be controlled either automatically or by hand.

Diagram No. 1 shows a reversible booster and No. 2 the non-reversible.

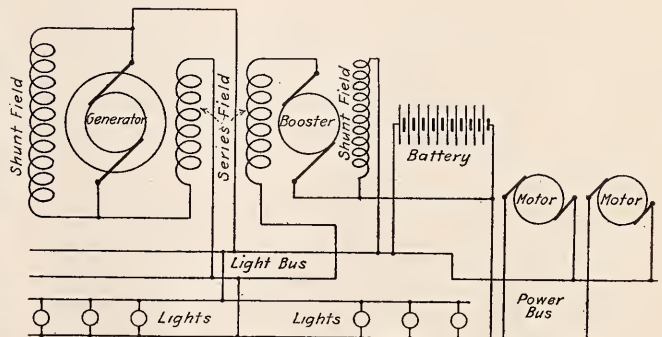


Fig. 2—Non-reversible Booster Connections

In both cases the shunt field winding opposes the magnetism due to the series winding. In the reversible booster, at normal load, the magnetism due to the shunt winding just neutralizes that due to the series winding.

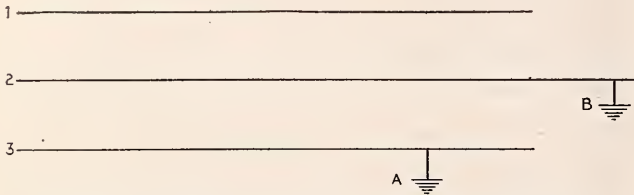
There are several different boosters, but these two diagrams will show the principle of operation.

A. J. K.

**Potential of Grounded Conductor**

In the December issue of ELECTRICAL AGE, U. F. N. inquires regarding potential of grounded conductor.

In a three phase transmission system the current flows between one and two, between two and three and between one and three. If leg three is grounded at A, since current is flowing between it and both one and two, a potential indicator will give no deflection if suspended from three unless one or two is grounded as there will be no circuit formed. The grounded leg may be at any distance from the indicator and a deflection will be shown so long as the voltage is sufficient to overcome the resistance offered by the earth between the ground and the indicator.



If conductors number two and three are both grounded as at A and B, an indicator will give a deflection if suspended from either one, two or three. If suspended from one, the voltage indicated is the resultant of the voltage through the ground between one, two and between one and three. If suspended from two the voltage indicated is not that between two and three through the earth, as the current will divide and part go through the indicator and part through the grounded point at B. The same results will be found if the indicator is suspended from leg three.

Under the conditions assumed there will be no indication by a potential indicator. A potential indicator indicates the potential from ground of the object in which it is in contact or to which it is connected, and has nothing whatsoever to do with the potential between phases. Under certain circumstances, however, the presence of one live conductor in close proximity to a grounded conductor, might influence the potential indicator sufficiently to cause it to indicate. This is not very likely to occur, however.

O. E. H.

\* \* \*

**Potential Indicators**

The ground for the indicator should always be well made so its resistance will be as small as possible in order to get good results.

Potential indicators of the type under discussion are electrometers or electroscopes. They require no current for their operation but utilize the forces of attraction and repulsion between two electric charges. One common form of potential indicator often used in stations to indicate when the wires are alive consists of two disks which can rotate between two stationary disks and which are insulated from each other. With the conductor on which the indicator hangs dead, the two sets of disks coincide, but when the conductor is charged the central disks revolve 90 degrees, and thus permit the station operator to see that current in on the line.

Another well known form of potential indicator, better known as electroscopes, is that for use of linemen and wiremen. It consists of a short length of silver foil in a glass tube, which in turn is fastened in a handle of treated wood. So long as the conductor is dead the electroscopes indicates the fact by making no movement when brought within three or four inches of it, but if there is potential on the conductor the strip of silver foil or leaf immediately stands up. These electroscopes are very sensitive on voltages above 500 volts, and are usable on either direct or alternating current. Usually they are made in two sizes, one for voltage up to about 4,000 volts, the other for higher voltages. The smaller size is about half inch in diameter and five inches long, the large size about one and one-quarter inches diameter and about eight inches long.

These electroscopes are extremely useful for station operators, construction and wiremen, and for linemen, especially trouble-shooters. They are sensitive, but on the other hand are rather delicate and must be handled gently. Since the slogan "Safety First" has become so popular these little devices have come into increasing use.

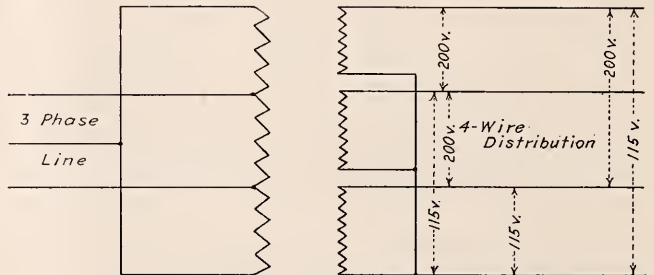
K. R.

\* \* \*

**Three-phase, Four Wire System**

Answering the question of "W. S." in December issue of ELECTRICAL AGE regarding the advantage of 3-phase, 4-wire transmission system: This combination is rarely or never used as a transmission system but merely for distribution. The chief advantage is in that two different voltages are delivered. A typical connection is shown in the sketch.

This shows three transformers, primaries in delta, secondaries in star connection, with neutral connecting to fourth wire.



The voltages are 200 volts between each phase wire and 115 volts between each phase wire and the neutral.

A 200 volt 3-phase motor may be connected across the mains and 115-volt lamps can be connected between the mains and the neutral.

This neutral is similar to the neutral wire in the Edison three wire system and carries current only when the lamp load is unbalanced.

In calculating always use the potential across the mains.

In computing the size of wire proceed as follows:

$$CM = \frac{10.8 \times 2d \times C}{V}$$

CM = Circular mils.

10.8 = Ohms resistance of 1 ft. copper with diameter of 1 mil at 75° Fahr.

2d = Twice the distance one way.

C = Ampere load.

Assume a pump motor drawing 50 amp. located 1,000 ft. away and 15 volts drop.

Then substituting in our formula we have:

$$\frac{10.8 \times 2,000 \times 50}{15} = 72,000 \text{ CM for single phase.}$$

In a three-phase, four-wire system each wire is 16.1 percent of the number of circular mils for a two-wire system. Therefore  $.161 \times 72,000 = 11,592 \text{ CM}$ , or a No. 9 wire.

A. P. B.

The chief reason for the wide-spread and increasing use of three-phase, four-wire systems is that with equal voltage at the lamp and equal losses in the mains, it requires only 29 percent of the weight of copper of a straight two-wire system. This is with the neutral at half size of phase wires.

The original objections as to the regulation of the system have been largely overcome by the installation of improved regulator in each phase.

W. K.

For further discussion of this question see the August issue, —Ed.

### Transmission and Distribution

In partial answer to J. E. M.'s inquiry in the December issue of ELECTRICAL AGE:

For a given locality, the higher voltage for which a transmission line is designed the more immune will it be from the effects of lightning, although the actual factor of safety of the insulation may be, and usually is, lower than what it would be at lower voltages.

• If when the system under discussion was changed from delta to star, that is from 46,000 volts to about 80,000 volts (25,600 and 46,000 volts to ground respectively) the insulators were changed so that their factor of safety for puncture and flash-over was raised more or less in proportion to the increase in operating voltage less trouble from lightning is to be expected. On the other hand if the voltage were raised, but the same insulators were retained in service, more trouble may be looked for from lightning because the lightning now instead of merely arcing over the insulators or puncturing them will in all probability be followed by the dynamic current which may maintain itself and do more extensive damage as the result of the higher voltage behind it. In any case pin type insulators appear to be less desirable than suspension type for voltages of 80,000 volts. Pin type insulators were used for such voltages until the advent of the suspension type, inasmuch as they are now rarely used above potential of 50,000 or even 60,000 volts unless the climate is dry and the altitude low and the lightning comparatively mild.

It is not always known whether the trouble from lightning is due to puncturing of the insulator or flash-over, but in either case the suspension type insulator will reduce the trouble. As steel towers are used there is much greater likelihood of the pin type insulator puncturing through the pin hole and also of arcing over.

The exceptionally high altitude at which the transmission line operates makes it increasingly important that the insulation of the line have a greater factor of safety than would otherwise be the case.

The best way to protect a transmission line from the deleterious effects of lightning is to insulate it as highly as feasible and introduce weakness—namely lightning arresters—at frequent intervals. A ground wire is efficacious in protecting a line against induced charges and accumulations that slowly build up, but is not of much value against direct strokes. To protect against direct strokes the use of insulators having high flash-over and puncture characteristics is the most effective; and when used with lightning arresters located at strategic points. The frequency of lightning discharges is usually so high that the effect is highly localized and thus if the discharge occurs far removed from a lightning arrester it simply flashes over or passes through the insulators, shattering them.

Usually it is found that certain sections of a transmission line are more susceptible to trouble from lightning than are other sections, and this may often be foretold by careful survey of the country, noting the topography, effects of lightning on surrounding objects, etc. At such places special efforts should be made to afford protection. Sometimes this is done by using a ground wire above the line passing through these sections, at other times by installing lightning arresters. In the present instance it is not thought that the cost of a ground wire is justified, because it will afford relatively little protection at such high altitude, and the expense of installing it is considerable. Installing lightning arresters at judicious locations along the line appears to offer the best and most satisfactory solution where moderate cost is an item entering into the problem. Then, later, if this does not reduce the trouble sufficiently it may be possible to change the insulators. The lightning arrester chosen for the purpose must be rugged and capable of giving protection with relatively small amount of attention and inspection; it must not cause service interruptions following lightning nor because of poor voltage regulation of the line; and it must be, comparatively speaking, of low cost. The amount of atten-

tion required and the cost of the electrolytic type arrester precludes its use, and there remains therefore the spark gap utilizing horns and shunted resistance, of which the best known make is perhaps the S. & C. arrester. This class of arrester is essentially an outdoor type, needs no protection nor attention, and is equally applicable to line protection as to indoor and outdoor substations.

For the system under consideration it appears that the insulators are unsuited for the work—the high altitude at which the line operates and the voltage at this altitude. The cost of changing the insulators to those of the suspension type would be high, because not only is it a matter of the cost of insulators but the question of height and clearances of the towers also enters. On the other hand by installing comparatively inexpensive lightning arresters along the line where the trouble occurs most frequently service interruptions may be reduced materially.

K. R.

The line in question is in South America.—Ed.



### A Test for Three-Phase Motor Connections

After connecting the phase induction motors in the process of winding, it is often desirable to make some check to indicate that the connections have been properly made and that the sequence of phases and poles is correct. A common method which gives very reliable results is shown in Fig. 1. When direct current is admitted as shown, a check for polarity with a compass should show three times the number of poles for which the motor is wound, evenly spaced and alternating around the stator. Any other condition, such as a less number of poles or unequal spacing will indicate an error in the original connections.

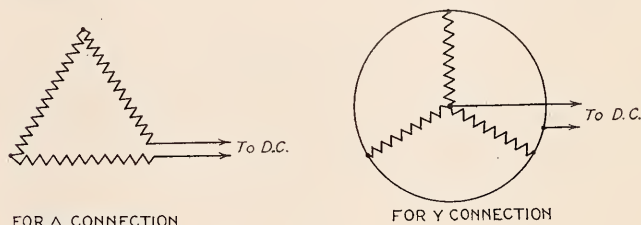


Fig. 1

On moderate sized motors, especially those for low speeds, these phase-poles will be so close together as to make their exact location difficult, at least without an excessive amount of direct current.

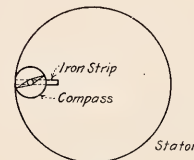


Fig. 2

By holding a strip of soft iron at least as long as the compass needle, under the compass and pointing radially toward the center of the space inside the stator as shown in Fig. 2, the poles can be located with great exactness. These locations should be marked with chalk on the stator iron to prevent error. It is obvious that this test is made before the rotor is in place.

M. M. G.



Similar answers to the Booster query have been received from E. J. F., S. Y. and M. S.

Answers to three-phase four wire system have been received from E. J. F. and S. Y.

F. J. Dubal, Ft. Madison, Ia., would like to correspond with W. S., S. F., and U. F. N., recent contributors to ELECTRICAL AGE.

# Questions and Answers

Please advise as to what size feeder is required for operating the following group of 220-volt, 2-phase induction motors of the squirrel-cage type on a 4-wire circuit.

ARRANGEMENT OF GROUP

No.	Horsepower	Distance From 230-volt generator in feet
2	5	180
1	20	350
2	2	350
2	3	650
1	3 (single phase)	650

all being on the same line. If the distance to the last three motors is decreased, what is the saving in copper? F. S.

Consulting the manufacturer's statements of the current required for each motor operating at full load, we find:

Size Motor	Amp. per Terminal	Amp. per Group	Total Amperes Per Wire
5 hp	13		26
2 hp	5	10	
20 hp	48	48	84
3 hp	7.5	15	99

Thus the total full load 2-phase current in the first section will be 99 amperes per phase and the phase carrying the 3-hp single-phase motor, the total current would be 114 amperes.

Practically it is very improbable that all these motors would be running at full load at any one time, but the lay-out may be made under that condition if desired.

By the Underwriters rules the sizes permissible for weather-proof insulated conductor will be:

- For 1st section of, say, 115 amp.—No. 2
- For 2nd section of, say, 89 amp.—No. 4
- For 3rd section of, say, 30 amp.—No. 10

To find the volts drop, disregarding their inductive, drop for such short distances, we have:

Section	Dist.	Amp.	Size	Ohms per 100 ft.	Ohm	Volts drop
1st.	186	115	No. 2	.016	.0288	3.31
2nd.	176	89	No. 4	.025	.0119	1.06
3rd.	300	30	No. 10	.1	.3	9.00

Whence voltage on 1st group would equal 227.7  
 2nd group would equal 226.6  
 3rd group would equal 217.6

This is the theoretical layout for assumed full load operation. If the matter of insurance need not be considered, the practical layout would be modified and the entire circuit would be run of either No. 4 wire or No. 6 though in the last case the drop on the final group would be rather too much for satisfactory operation at full load. No. 4 for 350 feet and No. 6 for 300 would answer very well. Check up the voltage drops for yourself and see.

The saving in reducing the distance to the last two motors will be, of course, proportional to the size of wire used, multiplied by 4 times the reduction of distance.

(1) What is the highest voltage that can be said to be absolutely safe to human life? (2) What is the lowest voltage known to have killed a horse? (3) Is direct voltage more dangerous than alternating? A. N.

250 volts is claimed to be absolutely safe to all human beings in normal health. If one has a weak heart or is otherwise especially susceptible to electric shock any voltage that can be felt, applied unexpectedly, might be fatal. The danger of any shock is dependent on the conductivity of the contact at the surface of the body. Where the contact is rather poor, touching conductors of as high as 1,000 or 2,000 volts is sometimes not serious. On the other hand, with good contact a comparatively low voltage may prove fatal. The 600 volts used

in ordinary street car systems is occasionally fatal, but often a momentary contact has no serious effects.

(2) Horses, and indeed all hoofed animals, are much more susceptible to fatal electric shock than men. Street railway voltages are almost invariably fatal to them, perhaps on account of the excellent contact made by the shoes and nails. As they do not often come in contact with lower voltages we do not know of any case where they have been killed by anything under 500.

(3) Alternating voltage is supposed to be more dangerous than direct voltage, and any one who has taken 110 volts alternatingly and then 110 volts direct will tell you that the latter is by far the most discomfoting. One of the reasons for this is that with each alternation the peak of the voltage wave is about 40 percent more than the voltmeter shows, as the instrument only registers the equivalent constant voltage usually called the root mean square voltage. Thus a 100-volt two-cycle alternating current reaches 140 volts 60 times a second.

Whether this is more dangerous is not certain, but the inference would be that it is.

Should the series coils of a compound wound, direct current generator be used when the machine is run as a motor? If so, would it not be better to connect the series coils in series with the shunt coils and run the machine as a plain shunt motor? W. L. K.

A compound wound generator may be run as a motor without any change in connections, and running thus the series coils would act as a differential and improve the speed regulation. A differentially wound motor field would probably not help the commutation any and therefore the best performance of the machine as a motor would be with the series coils disconnected.

In an ordinarily compounded generator the number of turns in the series coils would not be sufficient to make it worth while to add them to the shunt field turns.

(1) Please advise me how to rewind a 110-volt direct-current motor to make it operate satisfactorily on a 220-volt circuit. (2) The machine is to be used for driving an exhaust fan. Would the change be simplified by making it one into a series wound machine? C. S.

(1) For rewinding the field use wire of one half the size of the wire you take off, winding the wire to the same depth that the present coils have. The armature can be wound also with wire one-half the size of the present wire, or even one size smaller than that. This will enable you to put in about twice the present number of turns per coil. (2) The machine could be more easily reconstructed if changed to series-wound motor. In this case the field winding might be of about the same size as that now on the armature and the armature winding need not be changed at all. As the load of a fan varies with the square of the speed you may find it necessary to insert a rheostat in series with the motor to control the speed.

How can I approximately determine the safe output of a small 110-volt generator not knowing its rating? A. L.

Approximately it can be done by connecting it up with a motor or lamp load of known wattage and running the machine under this load for a couple of hours, noting the rise in temperature by means of a thermometer or two fastened to the winding. If the rise in temperature after a 2 hours' run doesn't exceed 75 degrees F. above the surrounding air, the machine is not overloaded. By repeated trials you can obtain what output the machine will stand without overheating.

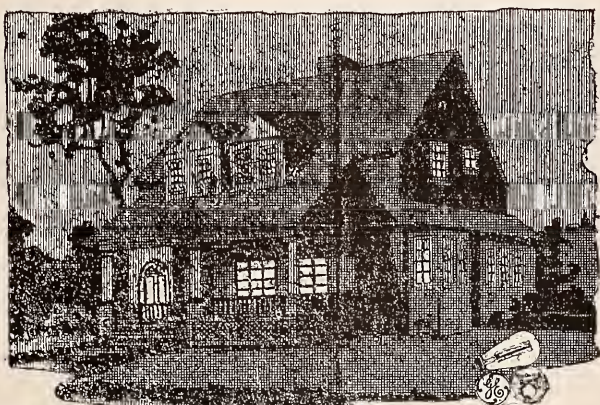
A better way, of course, is to measure the current with an ammeter and the voltage with a voltmeter and thus know exactly what load it takes to heat the machine to about 75 after a run of a couple of hours.

# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## Getting After the Unwired Residences

Few cities outside of the newest built have anything like the total number of houses wired for electrical service. In many Eastern cities the proportion wired is still well under 50 percent. The wide-awake manager knows that around him in most cases lies a wealth of undeveloped territory which it is "up to him" to turn into a revenue producer.



### Ask for our special House Wiring Proposition

When company comes at night, think how cheerful it would be, if, when you hear their ring, you could turn on an electric porch light and usher them into a hall flooded with the next-to-daylight radiance of EDISON MAZDA LAMPS. And then no pause at the door of a dark drawing room—the simple twitch of a switch being the magic which kindles a subdued glow in a shaded electric lamp, while side wall fixtures shed that soft illumination which is the final touch of gentle living.

### EDISON MAZDA LAMPS

Made in U. S. A. and backed by MAZDA Service

It is now possible for you to enjoy all these comforts and conveniences at a third of what electricity formerly cost, because EDISON MAZDA LAMPS give three times as much light as the old style lamps with no increase in cost for current. Our modern system of house wiring is simplicity itself—Inexpensive, Quick, Without Trouble or Disorder. All wires are concealed.

Telephone or call and we will gladly give you full particulars about our special proposition. Have your house wired before EDISON DAY—October 21st—the 36th anniversary of incandescent lighting.

## Freeport Ry. & Light Co

Part of Campaign for Unwired Houses

The illustration shows the persuasive way in which one enterprising middle Western light and power company went after

the quarry. Perhaps the talk might have been then stronger if attention was drawn to the fact that the electric service offered was probably not merely better and more convenient, but also cheaper than the oil or gas light being used. Sometimes when a householder has fallen into a fixed habit as regards his lighting, there is nothing that will hoist him out of the same so quickly as a demonstration that he is really wasting money—paying more for less received.

"Busting" the idea that certain things which are, merely because they have been, are economies, is often the best way in of the world to crack a shell of routine and let a new proposition be driven home.

Perhaps the appeal could be made still stronger by calling attention to the numerous things that electric service will do that gas and oil will not do—but that's another story, and you will find it on another page.

### Originality

An electric company not far from our largest city used the following original card, inserted in the local paper to stimulate its new business. The idea is to get the as yet unserved householder or storekeeper to realize that a "river of power," veritable river whose channel has been made by the service company, is flowing past the property.

**A River of Power**  
**Flows Past Your House**

Are you taking advantage of it?  
Wire your house, or store, or office for electricity  
Estimates free  
Easy payments put this power within the reach of all

Phone 463 Tompkinsville  
Terminal Building St George

**RICHMOND LIGHT & RAILROAD CO**



### Original Way of Setting it Forth

This should—and did—start the inquiry in the mind of the householder as to whether he was living up to the advantages of the situation. This card proved a great puller when properly and vigorously followed up.

The Topeka (Kan.) Edison Company has decided to furnish free electricity for demonstrating purposes at the combined electric show and midwinter exposition, which is to be held in Topeka in January. The company's only charge for energy used at the show will be for that used for general lighting and decorative purposes.

### Emphasizing the Domestic Power Service

The average central station manager, especially those who have been long in the business, often don't realize that a large part of the appeal of electric service lies not merely in the lighting, but also in the domestic power and saving of work.

Mrs. Smith may be well content to get on with gas lighting while Mrs. Jones across the street has electric light, as for some reason, she does not realize how much more convenient and sanitary the latter is.

One fine day Mrs. J. gets a vacuum cleaner or an iron, or both. It doesn't take very long for Mrs. S. to note the difference between the old time sweeping and dusting and up-to-date electric cleaning. The difference in ironing, too, even with an unsanitary gas iron is forcibly impressed on Mrs. S. particularly in hot weather.

## ELECTRICITY

### A Very Few Years Ago Electricity Meant Only Light

**This in itself was a convenience. Not only was it convenient, but was safe, clean, cool and healthful as well. The housewife was not long in finding out the advantages of electric light and adapting it in her home.**

### But Today Electricity Means A Great Deal More Than Light

**it also means heat and power and Milady has again been quick in adapting it to her household duties.**

### Electricity Sweeps, Washes and Does Most Everything

**It is Aladdin's Lamp for the house-wife woman. Just push the button—wonders happen.**

## Kanawha Traction and Electric Co.

These are the features, one of which is emphasized in the advertisement of a West Virginia company that is reproduced. The lesson is that it's well enough to advertise electric light to the milady of the house, but don't forget to, in the language of the immortal Hodson: "Put the power in, Jordan! Put the power in!"

### Co-operation with Inspection Authorities

By G. D. Crain, Jr.,

In a great many parts of the country, especially in the smaller cities and towns, regulation of building construction in general exists either nominally or not at all, and regulation of electrical construction is not in evidence in any way.

In the South, for instance, where the number of large cities in any one state is very small, compared with conditions in the more congested sections of the country, one finds that electrical construction has gone ahead without much attention from the public authorities, outside of these larger cities, and consequently without much regulation of any kind.

It would be a mistake to assume off-hand that this is a condition which the electrical contractor, or anybody else engaged in the electrical business, should be gratified with. It is not a normal nor a healthy condition, and it is not one that is likely to develop permanent prosperity for the business.

Aside from the fact that the public is entitled to safe construction, it is evident that the contractor who takes advantage of his opportunities to put in substandard jobs is in a good position to give the entire industry a bad name. A few fires directly traced to bad wiring will cause a lot of conservative people, especially in the communities where electric service has only recently become available, to determine in their own minds, irrespective of the experience of the rest of the country, that electricity is dangerous, and that they had better go on using gas or oil for lighting purposes.

Again, the contractor who is doing the work the easiest way, and taking all the short cuts because there is no representative of the city standing over him with a club, and no danger of anybody wearing an inspector's badge coming along and ordering him to rip his work out, has an opportunity to save money the wrong way. Knowing how cheaply he can manage the installation, he will bid low every time. The result is that unregulated conditions of the sort referred to make for poor workmen and poor business men—and they are bad competition for good workmen and good business men.

Now, it may be, and probably is true that in a great many small places it would be out of the question for the town to establish a building inspection department with a properly qualified man in charge of electrical construction. The cost of the work would be out of proportion with the service, because the amount of building done in that community would not be great enough to justify the organization that would be involved. Hence it is hardly practicable to look to the municipalities themselves for the solution of this problem of poor electrical construction.

One of the big interests involved in anything which has to do with the fire hazard—and a poor job of wiring is just about as mean a hazard as anyone could imagine—is the fire underwriters. They have a direct interest in better construction, and in preventing the wrong kind of material from being used and the wrong kind of installation from being made. They are as much interested, too, in keeping electrical conditions in Podunkville, where there are only 1,000 people, up to the proper point, as they are in having everything in this line properly done in Metropolis, the biggest city in the state, where there is municipal inspection work being done.

For this reason the state inspection bureaus maintained by the fire insurance companies for the purpose of rating and inspecting property that is likely to be offered for insurance against fire have electrical departments, which are charged with the special work of dealing with electrical construction and the hazards growing out of it. In the larger cities, which have their own inspectors, this is a comparatively simple job as co-operation with the city enables the field to be covered easily, and co-operation with the contractors enables moot questions to be taken up and disposed of in the shortest possible time.



While some of these electrical departments are not completely organized, most of them have enough men to enable them to get out in the state in the smaller towns, and wrestle with the contractors in these communities, to the end that the latter's methods may be improved, and the fire hazard reduced or eliminated, making the business safe for the fire insurance companies to write.

One of the purposes of this article is to suggest to the electrical contractor of the small town, as well as elsewhere, that he give the inspector of the insurance bureau his hearty co-operation. The latter has no authority of law, and he cannot compel obedience to his mandates, except by reporting to the owner that the building will not be accepted for insurance purposes unless wired in such and such a manner. But no matter whether the inspector has any authority or not, and no matter whether his club is stuffed or the real thing, it will pay in every way to co-operate with him.

In the first place he is an expert. Sometimes men get out on such work who are not, but most of them get into a suit of overalls and put in a wiring job with ease and dexterity. Their purpose usually is to give you the advantage of their knowledge, by showing you just how the work ought to be done. A good many mistakes are made not through intention and desire, but simply because the standard provisions are not understood, and the correct method not comprehended. When the inspector comes around you have a chance to get from him the meat of the National Code, and to find out just where your shortcomings are, and where you need to correct the methods which you have been using.

Few inspectors have any ardent desire to make work for the electrical men, or to require jobs to be done over unnecessarily. Nevertheless, they are compelled by the nature of their work to scrutinize a wiring job from the standpoint of its safety or danger, and if the hazard is excessive, alterations must be made which will reduce that hazard. And the contractor who is asked by the inspector to change a piece of work to conform with the regulations ought to feel that he is simply getting a valuable bit of experience, that is going to help him in his work, as he goes along, instead of that he is being imposed on, and made to revise a job which would have got by, in the absence of inspection, every time.

In this connection, reference was made above to the fact that the contractors of the large cities usually are able to improve conditions by co-operating with the inspectors. In many communities this has been worked out in interesting fashion. Once a month the contractors have a conference with the inspectors, the latter including both the city and insurance men, and those whose jobs have not been approved, and who do not understand the reasons for the action, state their cases. The inspectors give their reasons, and there is a general discussion, which leads to everybody present seeing exactly why it was not possible to pass the job in the form in which it was offered.

The contractors in the small towns, where there is no resident inspector, miss the benefit of work of this kind, which can be made exceedingly helpful. On the other hand, whenever the inspector does get around to look things over, it would be an excellent idea to get together the members of the trade in the town, or several adjoining towns, so that the inspector could state, for their general guidance, rules to be followed in doing the work, making it, as a were, a kind of round table for the discussion of electrical construction work, and the standards which would have to be met.

Many of the best electrical contractors in the country started under adverse conditions, in small towns, where they lacked the benefit of supervision, and had to teach themselves by experience, some of it exceedingly costly. There is hardly a successful man in the business whose early career was under such conditions, who would not admit that it would have been a fine thing for him if he could have had the co-operation of some inspector, who would have pointed out the pitfalls and possibly prevented the contractor from making some expensive mistakes.

This being the case, there is every reason why the man in the smaller community, especially if he is just breaking into the game, should not resent, but rather welcome inspection, and why he should co-operate with the authorities in every possible way. It is to his advantage that all of the electrical work in his town should be put in the right way, and not the wrong way; the safe way, and not the dangerous way.

Incidentally, the owner pays the cost of every job, and any additional labor or extra quality material required will simply make the work that much more expensive, as well as that much better. There is no opportunity for the contractor to lose by getting together with the inspection authorities, no matter where he is located.

\* \* \*

### Electrically Operated Motion Signs on Horse Driven Trucks

A unique method of advertising has been developed by the American Sugar Refining Co., of New York, utilizing the large number of trucks their Brooklyn plant operates.

Fifty of these trucks are now equipped and they plan to have about twenty-five more within about two months.

There are three types of signs. No. 1, illustrated herewith advertises Crystal Domino Granulated Sugar. This sign has a revolving disc which illustrates the sugar flowing from the carton to a bowl.



*Electric Sign on Horse-Drawn Truck*

Another sign shows the well known "Little Miss Crystal Domino" emptying a carton of Crystal Domino Sugar tablets into a sugar bowl. Around this sign is a revolving disc with spiral colored stripes which give a rainbow effect.

The third sign advertises both granulated and tablet Crystal Domino Sugar. The picture of the carton of the tablet sugar appears. Then this picture disappears and the granulated sugar carton appears in its place.

The mechanism of the signs is driven by a six-volt, ball bearing motor, made by The Robbins & Myers Co., Springfield, Ohio. The motor runs at 1,000 r.p.m. and takes 10 amperes. A 120 ampere-hour lead battery supplies the current. The usual arrangement is to mount motor and control on the back of the sign. The battery is supported at the rear of the truck under the body.

The batteries are charged each night, twelve batteries being charged in series across 115 volt mains. Six sets of twelve charging receptacles are provided, permitting 72 batteries to be charged at a time.

Four men are employed to maintain the batteries and signs, two on day and one at night. Considering the distribution obtained, this method of advertising has proven very inexpensive.

**Effective Central Station Post Card**

The Pacific Light & Power Corporation, operating at Los Angeles, California, and vicinity, has issued an interesting and effective post card for general distribution, setting forth concrete data relating to its extensive electric power system in Southern California.

One side of the card carries a reproduction of the Big Creek power station, known as Power House No. 1, Cascada, as shown in the accompanying illustration, and incorporates tabulated information regarding general operations and extent of activities; this relates to capacities of steam and hydraulic plants, total miles of transmission system and territory served, as will be noted.

<b>PACIFIC LIGHT &amp; POWER CORPORATION</b>	
Capacity of steam plants	59,819 HP
Capacity of hydraulic plants	3,938 HP
Total capacity	63,757 HP
Number of substations	25
Miles of 110 KV Transmission lines	482
Miles of 15 KV Transmission lines	887
Number of cities served	103
Population served	125,000

LOS ANGELES, CAL.  
 59,819 HP  
 3,938 HP  
 63,757 HP  
 25  
 482  
 887  
 103  
 125,000

Static Head ..... 2100 Feet Capacity ..... 125000 HP

..PACIFIC LIGHT & POWER CORP.. ..POWER HOUSE NO. 1..  
 ..CASCADA CAL..

*A post-card advertisement wrinkle*

The reverse or address side of the card gives a map reproduction of Southern California, on which is indicated by heavy lines the company's transmission and main distributing systems, reaching from the Big Creek district, about 225 miles from Los Angeles, to the smaller auxiliary stations at Riverside and Mentone. At a glance the extensive domain covered by the company is evidenced.

This novel card has been widely distributed by the company to all parts of the country. It not only carries a comprehensive suggestion of the operations of the corporation in its territory, but conveys the broad general message of electricity to all recipients, and affords the company distinctive publicity at small cost.



**Notes**

Electric power is almost entirely used by butchers and grocerymen for grinding bone to be used as chicken feed. Chicken fanciers and breeders purchase great quantities of meat scrap and ground bone for winter feeding. Not so many years ago bones were thrown away or sold in bulk to fertilizer plants. By installing a small electric motor and a grinder waste bones can be ground into chicken feed and turned into a profit instead of a loss.



A large quantity of wolfram, the source of tungsten from which the filaments of Mazda lamps are made, has been discovered in Siam.



During a recent advertising campaign nearly 3,000 electric flatirons were added to the service in Boston.

**Locating Fire Alarm Boxes at Night**

The great trouble in getting help when a fire has started is locating the nearest means of communication with the fire department. In this age when nearly every one has a telephone this is used to call the firemen, there are cases where a phone is not available or it may be out of order. Then, a great many fires are seen by passers-by in the street. In order to make the location of the fire box known to all without the necessity of locating it in the day time and remembering its location, and to make its location known to strangers the City of Chicago adopted the plan of marking the location of the box on the globe of the nearest street lamp. In the greater part of the city the poles are as shown and the lamp is mounted about 25 feet above the street. The method of lettering the globe with "Fire Box" was adopted only after a trial of several other plans.

To be a success the method used in any case must show at a considerable distance the reason for the marking. The light flux must not be distorted so as to cause deep shadows or other illumination faults. It must not be confusable with other signal or patrol lighting. Small lights can not be seen very far and red is practically the only color that will show in contrast to any night background without fail. Red is also used quite universally as indicating danger or trouble and for this reason is well adapted as a symbol to mark the location of fire protection apparatus.



*Chicago Fire Alarm Lamps*

In Chicago the big red globes are used by the boulevard systems to mark corner and turning points for traffic and on this account could not be used to mark a fire box. The attempt was made to mark the boxes by a red band around the upper third of the nearest lamp globe. The consequent flux of distortion and poor color of the light far from the lamps caused this plan to be abandoned in favor of the letters as shown. These are red, 1/2 in. thick and 6 in. high and can be read for many feet and seen for several blocks. By a little newspaper publicity the boxes are now so well located that little is to be feared from people not being able to locate the box. This or a similar plan should be adopted in every safety first community. Commercial filler



Chattanooga, Tenn., is planning to adopt a new sign ordinance which will favor electric signs by restricting the use of any other kind which extend out over the sidewalk. Mayor Littleton stated at a meeting of the commissioners that "the dynamo of Dixie," as the city is called, ought to have more electric signs, so as to live up to its name, and added that a big electric sign over the city hall would be a means of arousing interest in the proposition. This matter is now being investigated.

# New Products And How to Use Them

**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

*The Names of Manufacturers, not appearing in this Section, will be gladly supplied on Request*

## Adjustable Flexible Grinder

The doing of all kinds of abrasing, grinding and polishing work, in any section of the shop and in practically any position, is cheapened and hastened by the new flexible shaft electric grinder being introduced by the Stow Manufacturing Company, Binghamton, New York. This tool is designed and built especially for the steel industry and allied trades. The motor shaft combination is mounted on a truck making it easily transported to any part of the shop, eliminating the necessity of taking the work to the tool, thus saving time and cutting cost.



*Adjustable Flexible Grinder*

In the direct current equipment the variation in speed is secured by means of a plunger in the pole piece which operates to change the reluctance of the magnetic circuit. No power is lost in this operation as is the case in most variable speed motors and the full load efficiency remains practically the same at all speeds. This speed variation allows for the consuming of worn emery wheels down to the minimum, insuring proper cutting speed regardless of size and giving the highest efficiency. Another important characteristic of the motor is its ability to stand sudden over-loads, which it does without dangerous sparking. The motor is so balanced on the truck that it may be adjusted to the proper angle for all purposes and to meet all grinding conditions. The weight of the flexible shaft is taken off the operator.

The tool is also furnished for alternating current, but motor does not regulate to any cycle or phase. It is built in several sizes according to the capacity of the wheel desired.

\* \* \*

## Vacuum Suction Washing Machine

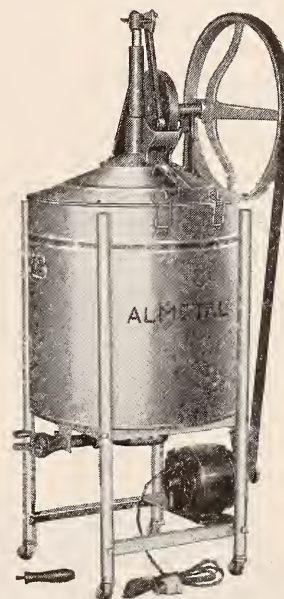
It is well known that the common hand operated vacuum cup washing device is a great improvement on the old style wash-stand. Nearly all of the power driven domestic size

washers are operated on some modification of the old rubbing and trailing action of the washboard.

The machine shown is designed after the new vacuum suction principle. There is one vacuum plunger which is operated by a crank belted to the motor.

A gas jet burner is mounted directly under the tub and a fountain of boiling suds and steam from the bottom of the boiler forces its way upward through the clothes, while the stroke of the plunger forces it back again.

All parts are made of metal—copper or galvanized aluminum finish as desired.



*Vacuum Suction Washing Machine*

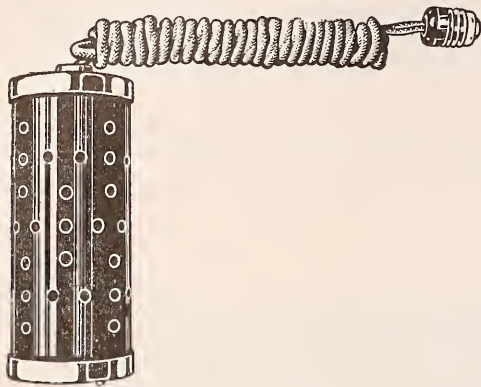
The motor, which is mounted on a plate under the tub, has a capacity of 1-5 horsepower and operates at 1750 r.p.m. is made by The Robbins & Myers Co., Springfield, Ohio.

\* \* \*

## Automobile Engine Warmer

The almost universal use of automobiles during the winter period has brought forth conditions which have to be met before the continuance of winter motoring can be insured. One of these obstacles is the cold garage. There are thousands of automobile owners who keep their cars in their own garages which are, as a rule, quite as cold as the surrounding winter atmosphere. Most of these who have become "winter fans" have found that to allow their cars to stand in the garage for any length of time presages a frozen radiator and a hopelessly cold engine. To avoid the former evil, the radiator can be

drained, but that means a great amount of work and trouble; the latter evil is unavoidable no matter how many rugs are piled on the radiator.



*Automobile Engine Warmer*

The Western Electric Company, of New York, has put on the market an electric heater that solves the last winter problem of the autoist. The heater is 7½ inches long, and comes with 10 feet of cord, the plug of which can be attached to any lamp socket. The heater is simply placed inside the hood of the automobile and the current turned on. No further attention is necessary, but cold engines and frozen radiators are entirely eliminated. The cost of the heater is small and its current consumption low, giving the motorist complete protection against the worst obstacle to winter motoring.



**Self Starter for Small D. C. Motors**

A new self starter for small direct-current motors in sizes ½ up to 3-hp, 115 and 230-volts, has been designed for constant speed, machine tool or similar service where frequent starting is required. The starter consists of a line switch, line contactor, accelerating contactor and resistance. These units automatically regulate the speed of acceleration and open the circuit in case the voltage falls. Fuses protect the motor against overload.



*Small Motor Starter*

The switch is totally enclosed in a cast iron case and is arranged with certain safety features which protect the operator from injury. The cover over the switch parts can be opened only when the line switch is open. The line switch, operated

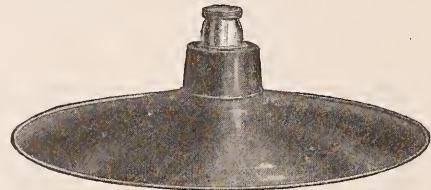
by a lever outside of the case, can be closed only when the cover is shut. In addition, the cover can be locked shut or the switch can be locked open.

The starter can be operated by push buttons located at convenient points or by the line switch handle on the right-hand side of the starter. It is manufactured by the General Electric Company, Schenectady, N. Y.

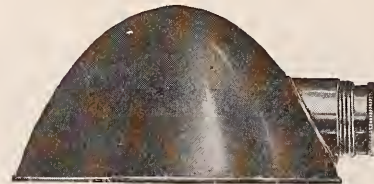


**New Enamel Reflectors**

A substantial and scientifically designed line of well-ventilated porcelain enamel reflector has lately been put on the market by a Connecticut manufacturer.



*Fig. 1*



*Fig. 2*

The illustration shows several of the types. No. 1 shows the larger size of distributing type reflector for all type of high candle power lamp. No. 2 is the parabolic type side reflector valued the most of the light in a limited field.



*Fig. 3*



*Fig. 4*

Nos. 3 and 4 are the bowl type contracting, and the parabolic angle reflectors.

All this line is made of steel with green baked or porcelain enamel finished on the outside and aluminum, white enamel or porcelain inside finish.

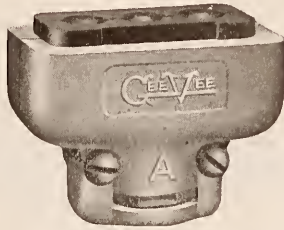
These shades with improved holders are made by the A. A. Electric Company, Bridgeport, Conn.



**Conduit Terminal Cap**

A neat and reliable terminal for conduit work has lately been brought out by one of the well-known makers of electric specialties. It consists of two galvanized castings, held together by clamping screws, as shown in the illustration and con-

tains a two-piece, three-hole molded insulator. It is turned out in three sizes. The holes in the two smallest insulators are 5-16 in. in diameter and will take three No. 8 rubber-covered stranded wires. The holes in the largest insulator are 0.5 in.



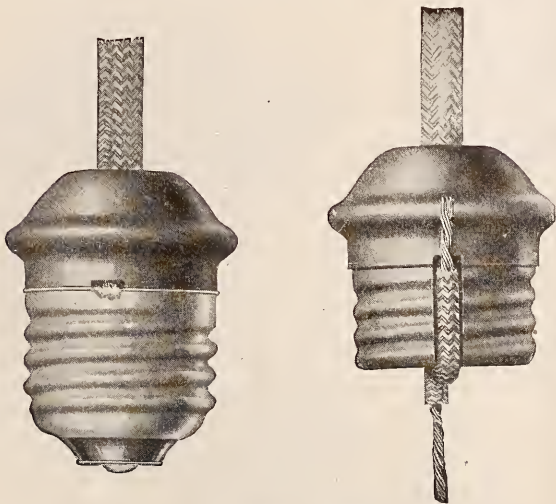
Conduit Terminal Cap

in diameter and will take three No. 4 rubber-covered stranded wires. A lock-nut is screwed on the end of the conduit before placing the terminal in position. The castings of the device, which is designated as the "Gee Vee" terminal, are galvanized.



**A Strong Attachment Plug**

A form of attachment plug, for which superior strength is claimed, is that shown below, in which after the insulation has been removed from the terminals, they are thrust through the plug, as shown in the right-hand view.



Attachment Plugs

The ends of the cord are then soldered to the shell and the disk at the end of the plug. The maker claims that this method of connection is considerably more rapid than screwing wires under binding posts. A saving of time is effected to the advantage of any manufacturer of electrical devices who installs "Attacho" plug in preference to higher priced plugs which cost, in labor of connecting alone, upwards of \$10 per thousand.

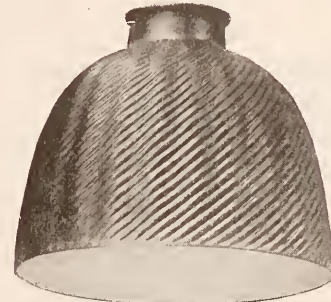
They also claim a much stronger and more "foolproof" job than any type of plug involving the use of screw connection. The device is made by R. S. Mueller, Cleveland, O.



**Reflector for Industrial Lighting**

The 200-watt gas-filled tungsten lamp when equipped with an efficient and broadly distributing reflector, gives general lighting of ample intensity for ordinary manufacturing operations in a 20 x 20-foot bay, or unit area. This means good lighting is obtainable for an energy consumption of 0.5 watts per square foot, which is a material reduction over what is ordinarily employed in an industrial plant.

A new type of silvered reflector has been developed for use with this lamp. It is of the "Beehive" type, gives a broad distribution of light and effectively conceals the lamp from direct view along the ordinary line of vision and a remarkably uniform illumination on the working plane. The dual system of corrugations shown on the illustration effectively breaks up the light from the concentrated filament of the 200-watt lamp, eliminating images of the filament, streaks and stria in the illuminated field.



"Beehive" Reflector

This reflector may also be used with the 150-watt vacuum lamp. It is the first of a complete line of industrial reflectors for all sizes of gas-filled lamps, that is being placed on the market in the near future.



**New Portable Lamp**

A handy portable lamp is the new patent grip type brought out by the Wallace Novelty Company, of New York. It is claimed to be the only lamp that can be collapsed and packed away in a satchel.

Concealed in the base is an automatic spiral clamp spring by means of which you can hang or clamp it instantly to bed-rod, dressing table, desk or chair. It is also provided with a rubber suction cap by which it is attached to a window-pane, mirror, or other smooth, non-porous surface.



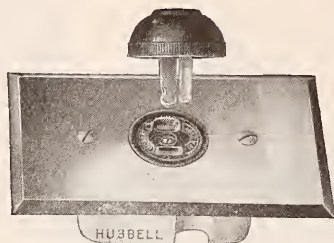
New Portable Lamp

When not in use, the shade and base clamp together as shown in the accompanying illustration. In the collapsed form it is conveniently carried and not liable to injury. The rubber vacuum cup is made so as to be easily removable when its life is gone so that a fresh one can be attached.

Altogether a very ingenious device that has succeeded in creating its own demand. It is handsomely finished in nickel brushed brass and bronze, and is supplied with socket and cord.

### Polarized Attachment Plugs

Very often both alternating and direct current is used in the same building, requiring some distinctive means of differentiating between the two for certain types of apparatus. This is very ingeniously done by means of the polarized attachment plugs shown in the illustration which is being brought out by an enterprising manufacturer.



*Polarized Plugs*

To produce the polarized feature one knife blade contact has been made smaller than the other in both length and width and the slot in the base reduced proportionately. As the opposite blade is the standard size it cannot be inserted in the small slot, making it essential that the cap be inserted in the base one way only—the right way. This assures absolute polarity. This variation in length is also of assistance in making rapid connection as by rotating the cap the longer blade is led into the proper slot by the bevel and at the same time the opposite blade is automatically engaged. The concealed contact feature, which commends itself to those who desire electrical safety, is retained in this line of plugs.

### X-Ray Dental Device

An improved device for x-ray dental work is shown in the accompanying illustration. It has advantage of being simple and rapid in action, safe for patient and operator and requires



*X-Ray Dental Machine*

no previous experience in x-ray work on the part of the dentist, nor any special wiring or dark room.

By its use a great deal of work that has hitherto been largely by guess on the part of the dentist can now be done with full assurance. Thus he can determine if he has completely filled root canals and so unerringly located concealed defects in the tooth and jaw structures. The apparatus has absolutely no moving parts.

\* \* \*

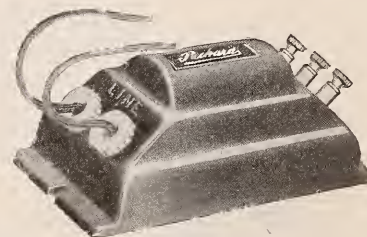
### Porcelain-Clad Bell-Ringing Transformers

The use of small low-voltage, secondary transformers for operating door-bells, door openers, buzzers, annunciators and all kinds of signalling devices, is constantly growing.

A line of these transformers has been developed by a Western manufacturer in which some of the smaller units have the active elements entirely enclosed in a porcelain case which is filled with insulating compound. These transformers are furnished in three colors of porcelain, blue, brown and white. They are very small in size, light in weight and have an extremely pleasing appearance. They take the place of dry batteries. And when once connected to an alternating current electric light circuit of the proper voltage and frequency they are practically indestructible and will last a lifetime. They are shown in Fig. 1.

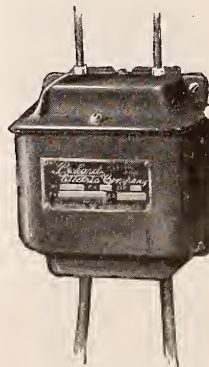


*Fig. 1*



*Fig. 2*

A "heavy-duty" size, adopted to the ringing of large gongs in schools and factories as shown in Fig. 2. It has a cast iron case, is of 10 watts capacity and gives 6.12 and 18 volts on the low-tension side.



*Fig. 3*



*Fig. 4*

The sizes shown above are for operating electrical toys. Fig. 3 is of fixed voltage and has a capacity of 50 watts and is housed in cast iron. Fig. 5, by shifting the lever, gives a range of from 0 to 30 volts and a permanent 6-volt tap. The case is made of beautiful blue glazed porcelain equipped with nicked hardware. The body is constructed of an aluminum spinning with satin finish and the base is made of a malleable spider casting. These instruments have a capacity of 125 watts and are furnished for all commercial frequencies and voltages.

The instrument illustrated in Figure 5 is adapted to tungsten sign lighting. The active element is housed in a cast iron case, treated with two coats of baked enamel. Both primary and secondary terminal wires are porcelain bushed and weather-proof. These instruments are furnished for all standard volt-

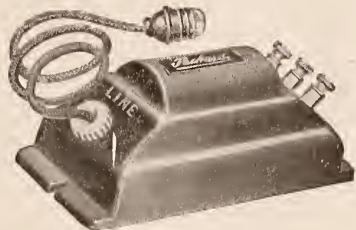


Fig. 5—Transformer for Tungsten Sign Lighting

ages and frequencies and in capacities ranging from 100 watts to 2500 watts. The prime function of the transformer is to reduce the pressure from 100 or 220 volts to 11 volts, which allows the use of the 11 volts Mazda filament high efficiency lamp in the electric sign.

\* \* \*

### Lifting Electric Magnets

Since the first spectacular feat of salvaging a boat-load of barbed wire and nails from a sunken barge on the Mississippi River by means of a commercial electro-magnet there has been few changes in their design or capacity.



Lifting electro-magnets unloading iron

A firm well-known for their development of this device has recently announced a new series of magnets of the same rugged and water-tight construction but having lifting capacities ranging from 20 to 60 percent greater than before. The lifting capacity, for instance, of the 62-inch magnet as given up to the present was

about 2,600 to 3,000 pounds, but now this is increased to 4,000 and over. This increase in the lifting capacity allows the handling of more material in the same time or the same amount in shorter time. It also reduces the number of magnets, cranes and crane operators needed, since in many cases two of the new magnets can do the work formerly done by three. The fewer trips a magnet must make, the fewer times its dead weight must be lowered, raised and conveyed, to more efficiently and quickly the material can be handled. Because of the labor shortage and the demand for speed at the present time the increased capacities are of particular importance.

\* \* \*

### Wireless Telephone Outfits

The recent record-breaking "wireless" telephone performances, when the words spoken into a transmitter at the Government station near Washington were heard simultaneously in Paris and Hawaii seems to have been made possible by the invention of audion receiver.

The company bringing out this receiver has developed a line of moderate range transmitters also which is bringing radio telephones to a practical commercial basis. They are made in sizes of from ¼ to 5 kilowatts and are dependable for overload transmission for 85 miles per kilowatt and about twice as good for over water. With longer and higher antennae these distances may be doubled.

\* \* \*

### Rural Electric Plant

Electricity need no longer be classed as a luxury obtainable only by those living in thickly settled communities reached by central station circuits. The little generating plant illustrated here makes it possible for anyone to enjoy the conveniences of electricity for lighting, heating and power purposes, no matter how far removed from power lines he may live. They are useful in country homes, on farms, and in small manufacturing establishments in rural districts where they furnish power for lights, for operating fans, vacuum cleaners, sewing machines, washers, heating appliances, and motors driving pumps and small farm machinery.

The plant consists of a Westinghouse low-voltage generator and control panel and an Hyray Exide storage battery all of which are mounted on a skids, rendering the outfit portable. The generator may be driven by any ordinary oil, gas, or gasoline engine or, if the water power is available, it can be used and the electricity will cost practically nothing.

The operation is simple. The generator is driven by an engine and the current is either usefully expended or else accumulated in the storage battery for use at some future time. The engine can be run when it is most convenient during the day and the current stored up for use in the evening. An automatic switch on the control panel maintains a steady voltage on the battery when charging, and an ampere-hour meter shows at all times the exact amount of reserve energy in the storage battery and indicates when to start and stop the charge.

The battery is fully charged when shipped and is ready for immediate use and the outfits are sold complete without the engine by the Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pa.

## NOTES

### Electric Expansion and Rates in London

The energy sold in London, exclusive of that used for traction, has increased from 14,206,900 kw.-hr. in 1894 to 334,442,700 kw.-hr. in 1914. The average rate per kilowatt-hour in 1894 was 12 cents, and in 1914 it was 4 cents.



### New Platinum Deposits in Spain

Professor Orueta stated in an address before the Society of Civil Engineers of Spain that he had discovered in the Ronda Mountain Range, in Spain, platinum deposits of greater extent and richness than those of the Ural Mountains, in Russia, which now furnish about 90 per cent. of the world's supply of platinum. The metal is now worth over \$100 an ounce.



### Sending Radiograms from Automobiles

A report from Stockholm announces that two Swedish army officers have invented an apparatus with which wireless messages may be sent from fast-moving automobiles or trains.



### Proportional Cost of Electric Drive in Cotton Mills

Complete cost of electrical equipment for textile mills, according to J. R. Olnhouse, is about 10 per cent. of the complete cost of the mill. The annual cost of power is from 4.5 to 5 per cent. of the total cost of manufactured products. Experience with up-to-date motor drive shows an increased production over mechanical drive of from 5 to 7.5 per cent.



### Steel Tower Wrecked by Sleet Storm

A sleet storm in Winnipeg, Canada, early last month, resulted in the breaking down of one tower on the lines of the city's municipal transmission system, about 30 miles from the city, and caused about 2 miles of wire to be thrown off the towers of this system. The transmission line of the Winnipeg Electric Railway Company was broken in two places, but the damage, which was not serious, was repaired in a short time. The weather conditions were exceptional for that region, the sleet being of such thickness on the wires that the over-all diameter exceeded  $2\frac{1}{2}$  in. The insulators are of the pin type and the wires spaced on 6-ft. centers, there being six conductors per tower. The damage to the municipal system was such as to take twenty-three hours to repair it and place it in service.



### A Lead-Eating Beetle

The discovery of a bug which bores holes in lead-covered cable has been recently reported by Albert Schuler, of the Home Telephone Company, of Santa Barbara, Cal. This trouble-maker is said to be a slender black beetle with hard wings about  $\frac{1}{4}$  in. long and equipped with two small scoops at its mouth which it effectively uses in boring holes in cables. The family name of this beetle is said to be *Sinoxylon declive*.



### Employee's Benefit Expenditures

In the last year there were 20,915 cases on which the relief fund of the Bell Telephone system expended \$1,481,402, according to John S. Kennedy, secretary of the benefit committee of the Eastern section of the system. During the same period there were 231 deaths, as a result of which dependent relatives received \$228,296. Female employees furnished 71 per cent of the sickness cases, while the greatest number of accident cases occurred among the male employees.



### Data on Cost of Electric Heating

Electric heating has been seriously tried in a great many places in Norway, and reports made by a royal commission indicate that a pleasant, even temperature is possible with an expenditure of from 30 watts to 35 watts per cubic meter of space—35 cu. ft. This will keep the temperature of a room at 64 deg. Fahr. with auxiliary heating when the thermometer registers as low as from 10 deg. to 5 deg. Fahr. Under these circumstances electric heating is assumed to be cheaper than

other fuel when the energy can be supplied at \$7 to \$8.25 per horsepower per annum on maximum demand.



### Cost of Developing Norwegian Waterfalls

A royal commission has collected a great deal of information bearing upon the waterfalls of Norway. Its report fills 267 pages and states the height of falls, whether the fall in question is owned by the municipality, its capacity at low water and after storing the water, whether exploited, and if so, what the rated capacity is, and what is the cost of installation, all told and per horsepower. The cost of installation per horsepower varies to an almost amazing extent. Some small power stations cost as little as from \$11 to \$15 per horsepower, while another with a rating of 250 hp. costs in the neighborhood of \$280 per transmitted horsepower. On the other hand, a 2,700-hp. plant costs approximately \$32 per horsepower, while seventeen power plants were laid down at approximately \$29.50 per horsepower. The Bergen electric station, having a rating at present of 7,000 hp., cost \$81 per horsepower, while the full exploitation of the available 20,000 hp. will bring the cost down to \$39 per horsepower.



### Electrolytic Iron Factor Design of Magnetic Circuit

Pure iron has now been produced electrolytically on a commercial scale. There are great possibilities in the use of such iron, not only the manufacture of thin tubing, but for rolling thin sheets. It may possibly be useful for magnet and power transmission service. In fact there are indications that the design of light-weight generators and motors for vehicle and similar purposes may obtain some valuable results. Some of this iron has a magnetic resistance of from one-eighth to one-tenth that of ordinary magnetic iron.



## Legal Notes

### Consumers Not Required to Purchase All Power Used From One Company

An interesting and important decision regarding a proposed restriction that all electric power used by a consumer should be obtained from a single company has been recently handed down by the Appellate Division of the New York State Supreme Court. In the case at issue, it was set forth that plans were formulated by the tenant of a building to obtain electric power from the owner of the building during the day and from electric company at night. The company refused to render this latter service on the ground that it was not obliged to do so unless the consumer purchased all the electric energy required from its system, and in such contention was upheld by the Public Service Commission. In reversing this ruling the Appellate Court decides that a requirement in the contract furnished by an electric company to its consumers that the customer must obtain all the electric power he uses from such company is not a reasonable regulation, stating as follows:

It is, of course, the rule that such a company may establish reasonable regulations respecting the use of the service which it proposes to furnish, and each customer requiring the service is called upon to comply with such regulations. In our opinion, however, the requirement that a consumer must take all of his electric energy from one company or receive none at all is not in any proper sense a regulation respecting the use of the service, but is a purely arbitrary attempt on the part of the company to insure itself a monopoly of furnishing electrical current.



In a suit brought by the Wallace Novelty Company, Inc., against H. C. F. Koch & Company, Inc., of New York City, for infringement of patents covering the portable electric lamps, known as the Wallace Lamps, the United States Court for the Southern District of New York has held that these patents are valid and were infringed by the defendant. This is the third time that the United States Courts have sustained these patents.



# TRADE LITERATURE

# Catalogs and Books

## A Review of the Latest Publications

An adjustable, portable, electric lamp and various other lamp and shades, the product of the Wallace Novelty Company, of New York, are well set forth in three folders, "Why? Because," "The First and the Best" and "Accessories."

\* \* \*

A large variety of apparatus for the measuring of low resistances and conductivities, including the well-known standard resistance and bridges of Leeds & Northrup Company, Philadelphia, Pa., is covered by catalog No. 40.

\* \* \*

Poles in stock for the demands of the winter season, form the subject of a folder from the Naugle Pole & Tie Company, Chicago, Ill.

\* \* \*

Graphic Recording Meters of the latest improved type are the subject of Bulletin No. 365 of the Esterline Company, of Indianapolis, Ind. The fine points of this line of moderate priced recorders are brought out in this publication which is beautifully finished.

\* \* \*

"Seeing Things in the Right Light" is the title of a folder on factory lighting, just issued by Harvey Hubbel, Inc., Bridgeport, Conn. Well-gotten up half tones of up-to-date factory lighting give point to title. The folder also describes various Hubbel reflectors.

\* \* \*

A Useful Wall Hanger showing conduit charts as adopted and recommended by the National Electrical Contractors Association, is being distributed by the National Metal Molding Co., Pittsburg, Pa. It shows the sizes of conduits required for various sizes of conductors by the National Electric Code, and is sent on request.

\* \* \*

Modern Improved Motor Cables for power, lighting and ignition service on motor boats, motor cycles, aeroplane and stationary gas engines, are the subject of Bulletin No. 540-1 of the Standard Underground Cable Co., Pittsburg, Pa. Colored illustrations add interest to the description of the various styles of cable shown.

\* \* \*

Reflectolyte Fixtures for Indirect Lighting; the latest development of this well known line are described in a violet-covered pamphlet, Catalog No. 2, sent out by Frank Adam Electric Co., St. Louis. A great deal of useful illumination data and curves is included.

\* \* \*

A blue and white folder covering its small motor output; a leaflet on small portable test meter, mainly for automobile service; and leaflets, Nos. 3742-H and 3859 devoted respectively to motor-generator sets "from 2 to 200 kw. capacity and mine suspensions and clamps," form the latest literary output of Westinghouse Electric & Manufacturing Company, East Pittsburg, Penna.

\* \* \*

A folder showing new designs in tandem boxes for exposed conduit or metal molding work comes from the Fancleave Specialty Company, Jamaica Plains, Mass., U. S. A.

The 1916 Catalog of the Bryant Electric Company, Bridgeport, Conn., said to be the largest one on wiring devices ever issued, is being distributed. It is very handsomely gotten up, containing about 160 pages of abundantly illustrated information about the company's output.

\* \* \*

High-Voltage Horngap Switches are the subject of an illustrated folder published by the Railway & Industrial Engineering Company, Pittsburg, Penna.

\* \* \*

Up-to-date Boiler Room Practice is the subject of a paper entitled "Establishing and Maintaining Boiler Room Economy" read by G. H. Gibson before the Ohio Society of Steam, Electrical and Mechanical Enterprises, reprints of which have been issued by the Harrison Safety Boiler Works, of Philadelphia, Penna.

\* \* \*

From Allis-Chalmers Manufacturing Company, Milwaukee, Wis., comes Bulletin No. 1075-A on belted alternating-current generators, types AB and AH. The former type is made only in sizes up to 200 kilovolt-amperes and is of self-contained or bracket-bearing construction, especially adapted for high-speed machines. The type AH alternators are of the pedestal-bearing class and are built standard for ratings up to 625 kilovolt-amperes or still larger. The general construction of these machines is described.

\* \* \*

A booklet on suspension insulators has been issued by R. Thomas & Sons Company, East Liverpool, Ohio. Their new insulator No. 1141 is of improved design and incorporates many features, giving added safety in long-distance high-tension power transmission. Sectional and perspective illustrations are shown.

\* \* \*

## Book Review

Inventions and Patents, by Philip E. Elderman, who has made a reputation for himself as a writer on wireless subjects, is a work that any inventor, or in fact, anyone interested in our patent system will find a good investment. As is well known, thousands of inventors who have brought their idea up to the point of patentability, go on the rocks in getting it properly patented. The advice and information given in this book, if acted upon, will prevent this.

The writer gives a sketch of the evolution of the patent system and an interesting history of the Patent Office. He also defines the functions and duty of the patent attorney.

Chapters on "The Terms of Invention," "The Field of Invention," "Patentability and Practicability" are packed full of meaty information. The points brought out relative to the structure and nature of patent specifications and claims; on protecting on invention and disposing of patent rights and the "Thoughts on Invention and Inventors" are valuable contributions to the none too abundant literature on this subject.

The appendix of 70 pages contains hundreds of digests and abridgements from important legal decisions in patent cases as well as charts for draftsmen and models for drawing up the legal forms involved in getting a patent. Size, 5 by 8 inches, 288 pages. Price, \$1.50 net. Technical Journal Company, Inc., 233 Broadway, New York.

# Review of the Month

## A Complete Record of Important News Edited for Busy Readers

"Self-advancement" was the title of an address by Dougless Burnett, commercial manager of the Consolidated Gas, Electric Light and Power Company, of Baltimore, at the November meeting of the Philadelphia Electric Company section of the N. E. L. E. The meeting of the Commercial Department Branch was addressed by E. S. Pelling on the subject "Sign Leads," and R. L. Lloyd, on "Charging Sets" and "Refrigeration." Robert J. Milligan, addressed the Engineering Branch at its December meeting on "The Electrical Design of Our Stations."

\* \* \*

The New York Section of the Illuminating Engineering Society held its monthly meeting on December 8th. The subjects taken up were: "Outdoor Illumination of Store Fronts" by Charles Hodgson, Brooklyn Union Gas Company; and "Residence Lighting by Gas," by M. A. Combs, of the Consolidated Gas Company, New York.

\* \* \*

The meeting of the Philadelphia Section of the Illuminating Engineering Society, on December 17th, was addressed by Dr. Charles P. Steinmetz on the subject of "Illuminating Engineering." The meeting was held jointly with the Engineers' Club.

\* \* \*

The Pittsburg Section of the Illuminating Engineering Society, at its meeting on December 17th, listened to a talk on "Design of Illuminating Glassware" by S. G. Hibben.

\* \* \*

It is announced that the next Executive Committee meeting of the National Electrical Contractors' Association will be held at Richmond, Va., on February 7 and 8.

\* \* \*

The American Society of Mechanical Engineers held its annual convention in New York City, December 7-10. The registered attendance was 1210. Officers elected to serve for the ensuing year are: Dr. D. S. Jacobs, president; George W. Dickie, Henry Hess, James E. Sague, W. B. Jackson, J. S. Bancroft, Julian Kennedy, vice-presidents; William H. Wiley, treasurer; Calvin W. Rice, secretary. Managers: A. M. Greene, Jr., John Hunter, Elliott H. Whitlock, Chas. T. Main, Spencer Miller, Max Toltz, John H. Barr, J. A. Stevens, and H. De B. Parsons.

\* \* \*

The National Independent Telephone Association, and the Independent Telephone Association of America, long time rivals, have united forces. At a meeting held in Chicago, December 8, 9 and 10 it was decided to unite the enrolled members of both associations under the name of the United States Independent Telephone Association. The following officers were elected: President, C. Y. McVey, Cleveland; first vice-president, W. H. Bryant, Mobile; second vice-president, G. W. Robinson, St. Paul; third vice-president, F. B. MacKinnon, Washington; secretary-treasurer, W. S. Vivian, Chicago.

\* \* \*

The Western Association of Electrical Inspectors, it is announced, will hold their eleventh annual meeting at the Hotel Sherman, Chicago, January 25, 26 and 27. The program, which has been arranged, contains many interesting papers, among

which are, "The Electrical Safety Code," by Dr. E. B. Rosa, of the Bureau of Standards, Washington, D. C.; "The Legal and Ethical Responsibility of the Electrical Inspector," by Leon Hornstein, assistant corporation counsel for the city of Chicago; "Fuses, the Electrical Safety Valves," by Prof. H. E. Clifford, of Harvard University.

\* \* \*

The American Institute of Electrical Engineers, at an executive meeting held recently, decided to hold the usual midwinter convention in New York City on February 8 and 9. Tentative plans were also made for a Pacific Coast convention, to be held in Seattle, in 1916, under the auspices of the Seattle Section of the Institute.

\* \* \*

M. Luckiesh, of Cleveland, spoke on "School Lighting" before the December meeting of the Chicago Section of the Illuminating Engineering Society. In the course of his talk he laid down a tentative code for the daylight and artificial illumination of all school buildings.

\* \* \*

The following officers were elected by the Winnipeg Jovian League, at a recent meeting: President, J. F. S. Madden; vice-president, E. H. Smith; secretary, Wm. H. Reynolds.

\* \* \*

The New York Electric Vehicle Association recently announced the winners of the two silver cups offered by Arthur Williams for the best selling records in the two month's campaign of the Ward Motor Vehicle Company, in marketing its new 750 pound electric delivery wagon. The cups were offered to incite friendly competition among the salesmen of the various lighting companies. The first cup, which is the team prize, was won by the New York team comprised of central station salesmen of Greater New York. The New Jersey team came in second. The second cup, which is the individual prize, goes to Edward Friend, a salesman in the Harlem office of The New York Edison Company, for the greatest number of cars sold by one man. Henry S. Reilly and H. J. Garnier received honorable mention.

\* \* \*

The American Gas & Electric Company, of New York, has started construction, through a subsidiary organization, of a \$2,500,000 steam-electric plant on the Ohio River, near Wellsburg, West Virginia. It is announced that the initial installation will be 60,000 K. W., with provision for ultimate development of 180,000 K.W. The Foundation Company, of New York, is in charge of the construction, and Sargent & Lundy, of Chicago, are the engineers. The plant, it is expected, will furnish electricity for light and power to cities within a radius of 60 miles of Wheeling, including Canton and Newark, Ohio.

\* \* \*

The Waynesboro Electric Light Company, of Waynesboro, Miss., on petition of its general manager, J. A. Leggett, has been placed in the hands of a receiver. The plant is practically new, having been erected in the early part of 1914.

\* \* \*

It was announced recently that permission had been granted the Light Development Company to erect electric wires in the west end of St. Louis. The company purposes to sell electricity

to resident consumers at a maximum rate of 5½ cents, in competition with the Union Electric Light and Power Company, which has a maximum rate of 9 cents.

The Adirondack Electric Power Corporation, of Albany, N. Y., has filed a statement, showing net earnings for the 10 months to October 31, of \$438,278, and surplus of \$226,929 against \$109,020 in 1914.

The Consumers Power Company, whose principal office is at Portland, Maine, has purchased the holdings of the Au Sable Electric Company, of Jackson, Michigan, which operates many transmission lines in lower Michigan.

The Maine Public Utilities Commission has granted the petition of the General Maine Power Company, asking for authority to purchase the capital stock of the Bath and Brunswick Light and Power Company, and also the petition asking for authority to issue \$275,000 bonds.

The St. Joseph Railway, Light, Heat and Power Company, of St. Joseph, Missouri, has announced that they will reduce their rates for electricity on January 1st, and that under the new schedule their customers will save between \$15,000 and \$20,000 over the present rates.

The Kentucky River Power Company has completed surveys and all preliminary work in connection with the large power plant which it will erect near Hazard, Ky. It is planned to install initial equipment aggregating 2,000 H. P.

The Dayton Power and Light Company, of Dayton, Ohio, has purchased the plant of the Miami Light, Heat and Power Company, of Piqua, Ohio.

The Union Electric Company, of St. Louis, Mo., has made a reduction in electric rates for residence lighting from 10 cents per k.w.h. to 9 cents. It is also stated that the company will reduce its rate to 8 cents, as soon as the increased number of consumers warrants.

The statement of the Northern Texas Electric Company, for the twelve months ending October 31, shows net earnings of \$692,522, and surplus of \$362,403.

The Galveston-Houston Electric Company, of Texas, has filed a statement for the twelve months ending October 31st, showing net earnings of \$792,476, and surplus of \$359,514, a decrease of \$307,993 from the surplus for the same period last year.

The affairs of the old Northern Colorado Power Company have been cleared up to the satisfaction of both the bondholders and the stockholders of that concern through the sale of \$2,100,000 of 5 per cent. first mortgage bonds of the Western Light and Power Company to a New York syndicate headed by William Morris Imbrie & Co.

The town of Hull, Mass., has voted to abandon the present municipal lighting plant, and to buy electricity for illumination purposes. It is believed that the Weymouth Electric Lighting Company will receive the contract.

The Central Maine Power Company has asked permission of the Public Utilities Commission of that State to take over the properties of the Greenville Light and Power Company, of Greenville, Maine, and the Penobscot Bay Electric Company, of Belfast, Maine.

It is reported that the Beverly Gas and Electric Company, of Beverly, Mass., has reduced its rate to 10 cents per kilowatt,

which means a saving to the citizens of Beverly of about \$8,000 per year.

Cathay Development Corporation has been incorporated at Portland, Maine; purpose given is to conduct electrical industrial enterprises of all kinds, general lighting, heating, power, railway, telephone and telegraph business. The capital stock is \$1,000,000.

The Day Electric Corporation, of New York, has increased its capital stock from \$20,000 to \$200,000.

The Potomac Electric Power Company has reduced the light rates in the city of Washington, D. C., to 10 cents per kw. for the first ten hours, with a charge of 3 cents per kw. for excess current. The former rates were 10 cents per kw. for the first 120 hours, with an excess charge of 5 cents.

Clarence H. Geist, of Philadelphia, president of the Northern Indiana Gas and Electric Company, has purchased the holdings of the Indiana Lighting Company, which supplies power, light, gas and water to twenty Indiana cities.

The Tennessee Power Company has started work on their new hydro-electric development at Great Falls, on the Caney Fork river, about two miles from Rock Island, Tenn. It is estimated that the work will cost somewhere in the neighborhood of half a million dollars.

In connection with the development of power for the proposed hydro-radial lines to be built by the Provincial Hydro Commission, of Canada, in connection with the \$10,000,000 diversion of Chippewa Creek, plans are now being made to take over the entire plant of the Dominion Power and Transportation and the Cataract companies, at a cost of \$12,000,000. The object of the plan is to secure control of the big generating plant at Decews Falls, near St. Catharines. It is also said that the interests of the powerful Mackenzie-Mann syndicate will be purchased about the Falls.

The Great Western Power Company, of California, organized on November 23 to acquire the properties and securities of a part or all of the corporation known as the Great Western system, has applied to the California Railroad Commission for permission to issue capital stock to the amount of \$27,498,600, which is to be exchanged for a like number of shares of stock of the Great Western Power Company. Permission is also asked to issue and sell to the Great Western Power Company all or any part of \$5,000,000 face value of its ten-year, 6 per cent. convertible gold debentures at 91 per cent. of the face amount and accrued interest.

The Buffalo General Electric Company has awarded the contract to Walker & Stone for the erection of the immense power plant on the river front in the town of Tonawanda, N. Y. The plant will cost \$1,500,000 and will develop 200,000 H. P., steam power being used.

The name of the Fort Wayne Electric Works, owned by the General Electric Company, effective the first of the new year, will be changed to the General Electric Company, Fort Wayne Works. All credit and collection work for the Fort Wayne institution will be transferred to the Schenectady offices.

On January 1st, 1916, the name Holophane Works, of General Electric Co. was changed to Ivanhoe-Regent Works of General Electric Company. This change was made necessary by the expiration, on that date, of the contract through which the General Electric Company possessed exclusive right to manufacture and sell Holophane prismatic glass. The General Electric Company will continue to manufacture and sell Regent

glass and Ivanhoe metal reflectors; and although its right to handle Holophane prismatic is no longer an exclusive one, it will continue to furnish this line also. In its organization the Ivanhoe-Regent Works of General Electric Company is in every respect the same as that hitherto known by the name of Holophane Works of General Electric Company.

\* \* \*

The Consumers Power Company has acquired the property of the Dell Rapids Light & Power Company, Dell Rapids, South Dakota, and is now operating it as a portion of the Sioux Falls Division of the company.

\* \* \*

The Morse Chain Company, Ithaca, N. Y., manufacturers of silent chains for power transmission, have appointed G. W. Pritchett, as their representative in the territory including North and South Carolina, with headquarters at 805 Ashboro street, Greensboro, N. C.

\* \* \*

The Stone and Webster Engineering Corporation is erecting an extension to the Lowellville Power Station, at Youngstown, Ohio, for the Republic Railway and Light Company. The new station will develop 15,000 kw., doubling the capacity of the plant.

\* \* \*

The Railway & Industrial Engineering Co., the manufacturers of Burke Horn Gap Switching & Protective Apparatus and Out-Door Sub-Stations, have moved their sales office to the Peoples Bank Building in Pittsburgh.

\* \* \*

A. N. Ross, formerly New England representative of Pass & Seymour, Inc., and Geo. H. Brown, formerly with Belcher & Loomis, have established an electrical jobbing business in Springfield, Mass., under the firm name of Brown & Ross, Inc.

\* \* \*

The San Francisco office of the Robbins & Myers Co., which is in charge of C. R. Hunt, has been moved to 701-702 Rialto Building.

\* \* \*

Kelly, Cooke & Co. have recently opened offices in the Drexel Building, Pa., to conduct a general engineering practice in the public utility and industrial fields. William F. Kelly, senior member, was a member of the staff of Ford, Bacon & Davis for the past nine years, acting as engineer in charge of several of their larger operations. Charles B. Cooke, Jr., was also connected with Ford, Bacon & Davis, specializing on financial engineering reports, and rate developments and reports for public utility companies.

\* \* \*

The action brought in 1912 against the City of New York by the Edison Electric Illuminating Company of Brooklyn, and the Amsterdam Electric Light, Heat and Power Company, to restrain the city from declaring void the franchise upon which the Amsterdam company was doing business, has finally been concluded. De Lancey Nicoll, referee, has filed a report in the Supreme Court recommending that the Amsterdam company receive an injunction. The Edison company, as the holding company of the Amsterdam, is found to be not entitled to the injunction.

\* \* \*

The state of Wisconsin has commenced an action against the Milwaukee Electric Railway and Light Company for penalties aggregating \$1,860,000, charging violations of an order of the railroad commission of that state, issued December 25, 1913, fixing standards for street railway service in Milwaukee.

\* \* \*

The DePere Electric Light and Power Company, of DePere, Wis., has adopted a new schedule of rates, effective February 1st, showing a minimum rate of 80 cents per month, or 75 cents if paid on or before the 10th of the month. The charge of 25 cents per month for meter rental is discontinued.

## Personal

Frederick W. Ballard, formerly commissioner of light, heat and power for Cleveland, Ohio, has resigned his position there and will go to Philadelphia, where he has been retained as expert electrical engineer in making a new appraisal of the Philadelphia Electric Company.

\* \* \*

J. S. Pevear, of the United Gas and Electric Engineering Corporation, of New York, has taken active charge of the Birmingham (Alabama), Railway, Light and Power Company, as president. The Birmingham company is a subsidiary of the American Cities Company.

\* \* \*

E. G. Connette, president of the International Railway Company, of Buffalo, N. Y., has been elected vice-president of the United Gas and Electric Corporation, and president of the United Gas and Electric Engineering Corporation.

\* \* \*

J. W. Worthington, of Sheffield, Ala., has been withdrawn from active detail work for the Alabama Power Company, and has gone to Washington, where he will join in the work of promoting the Muscle Shoals power project, as representative of the Muscle Shoals Power Company, which is owned by the Alabama Power Company.

\* \* \*

E. P. Steen has resigned as manager of the electric light plant in Broken Bow, Neb., and succeeds F. H. Brooks as manager of the Red Oak Electric Company, Red Oak, Iowa.

\* \* \*

V. S. Hillyer, formerly superintendent of the Carquette Co. (Mich.) road commission, has resigned to accept a position with the Wisconsin and Minnesota Light and Power Company.

\* \* \*

A. D. Furlong has resigned as manager of the Saginaw and Bay City Railway, Gas and Electric Company, being succeeded by John A. Cleveland, vice-president of the company.

\* \* \*

## Obituary

William Clafin Andrews, advertising manager of the Edison Storage Battery Co., Orange, N. J., died in New York City on December 21st. He was for two years secretary of the Rae Company, New York City, leaving to join the Edison Storage Battery Company in April, 1913, where he was advertising manager until his death. Mr. Andrews enjoyed an unusually large acquaintance among electrical men, and was particularly active in the Electric Vehicle Association of America and in the Jovian League, of which he was Statesman-at-large for New Jersey.

\* \* \*

William Andrew Conner, of Plainfield, N. J., vice-president of the Standard Underground Cable Co., died suddenly Monday, December 6th, at his office in Perth Amboy, N. J. Mr. Conner was born in Baltimore, September 12, 1859. In 1885 he took charge of the first plant built by the Standard Underground Cable Co. in Pittsburgh, and from then to the time of his death he was head of the manufacturing business of that company, including large plants planned and built by him in Pittsburgh, Pa.; Perth Amboy, N. J.; Oakland, Cal.; and Hamilton, Canada. He was a director for 10 years and first vice-president since 1909.

\* \* \*

James I. Ayer, former president of the National Electric Light Association, and manager in Cambridge, Mass., of the Simplex Electric Heating Company, died suddenly on November 26th, at the age of sixty-two.

\* \* \*

Lawrence McNeil, president of the Savannah Lighting Company, died late in November, at his home in Savannah, Georgia, aged sixty-six.

# BUSINESS OPPORTUNITIES

## ALABAMA

Birmingham.—Martin J. Lide, Consulting Engineer, of this city, is desirous of obtaining two direct connected 250 to 275-volt D.C. units, preferably 75 K.W. each.

Florence.—Lauderdale Power Company, Jefferson Building, this city, want data and prices on electrical equipment, construction materials, etc., for \$130,000 hydro-electric plant.

Georgiana.—McGowin-Bennett Milling Co., W. M. McGowin, Pres., will establish electric plant; 3 mi. transmission; develop 100 hp; cost \$10,000; J. H. Berry, Contr.

Moulton.—Moulton Water-works contemplate establishment of electric plant.

New Decatur.—City will install electric light and power plant.

## ARKANSAS

Booneville.—Booneville Light & Power Company; capital \$50,000; incorporated by C. S. Greenway, Robin Harvey, R. M. Harvey.

Dodd City.—Bear Hill Mining Company, T. H. Braley, Mgr., wants prices on electric light equipment.

Hartford.—City contemplates constructing electric-light plant.

Ozark.—Ozark Light & Power Company will operate the electric light plant here which they recently purchased. They will make some additions and improvements in the equipment.

## DISTRICT OF COLUMBIA

Washington.—Christmas Aeroplane Co., 1617 Hobart St. N. W., wants various motor-driven woodworking machinery, also D.C. 150 kw. generator unit.

Washington.—Potomac Electric Power Co., of this city, is to erect a 2-story brick shop on 14th Street; estimated cost \$3,500.

## FLORIDA

Jacksonville.—Eagle Film Manufacturing and Producing Co., of Chicago, will construct an electric light plant here.

Lake Worth.—City is to issue \$15,000 bonds for electric light plant.

Okeechobee.—City is to issue \$50,000 bonds for electric light and water plant. Southern Utilities Co., Jacksonville, is preparing plans.

Orange Springs.—Florida Farms and Homes, Jas. R. Murphy, Pres., Palatka, Fla., will install electric light plant here.

Tampa.—Palma Ceia Golf Association, care T. E. Bryan, Pres. of Tampa Auto and Golf Club, plans construction of electric-lighting system in connection with land development.

## GEORGIA

Coolidge.—City is installing electric light system, to include 3 mi. transmission.

## ILLINOIS

Arlington.—Arlington Electric Company has been incorporated here with a capital stock of \$10,000 by A. B. Harris, F. E. Cottingham, W. P. Cottingham.

Elkhart.—City contemplates installation of new lighting system.

Gary.—Lighthouse Electric Company has been incorporated here with a capital stock of \$10,000 by A. B. Harris, F. E. Cottingham, W. P. Cottingham.

Goshen.—The Hawks Electric Company, of this city, has increased its common stock from \$150,000 to \$200,000.

Indianapolis.—The Welsh Manufacturing Company; capital \$50,000; to manufacture electrical appliances, etc.; directors, John H. Welsh, Joseph L. Gasper, L. S. McEnamey.

Noblesville.—Olive Branch Lighting Company; capital \$1,000. Incorporators: C. D. Zimmer, M. Jessup, Adam Kepner.

Plymouth.—Midwest Supply Company; capital \$10,000; to purchase and sell mechanical and electrical supplies. Incorporators:

S. Tomlinson, L. E. Daniel, A. B. Diggs, F. C. King, W. S. Daniel.

## KANSAS

Sharon Springs.—City is erecting a \$12,000 electric light plant. W. E. Hulse & Co, Hutchinson, architects.

## KENTUCKY

Carlisle.—Carlisle Electric and Power Company has increased capital stock from \$15,000 to \$30,000. Will make some additions to plant.

Georgetown.—City is considering construction of electric light plant and water works.

Hazard.—Kentucky River Power Company, R. L. Cornell, Mgr.-Engr., has completed surveys and preliminary work for \$300,000 electric plant to install 2,000 hp steam turbine; 5 mi. transmission system.

Henderson.—Melton Electric Company; capital \$2,000. Incorporators: M. C. Melton, R. A. Day and E. W. Melton.

Lexington.—Fisher Electric Company; capital \$4,000. Incorporators: J. D. Sousley, J. G. Fisher and M. E. Fisher.

Louisville.—D. H. Ewing's Sons will install 22 motors aggregating 110 hp; will probably purchase engine and generator.

Mater.—Wiley W. Gibson will construct electric light system, at this place.

Mt. Olivet.—Mt. Olivet Light and Power Company, W. S. Chandler, Mgr., are to erect electric light plant here. Want equipment.

Whitesburg.—Wiley W. Gibson, of Mater, Ky., will build power station in this city and electric light system in Mater.

## LOUISIANA

Church Point.—City contemplates erecting municipal electric light plant and water works.

Crowley.—City will issue \$35,000 electric light and water works bonds.

Washington.—City contemplates constructing electric light plant.

## MASSACHUSETTS

Lynn.—The Davis Storage Battery Company, recently incorporated here for the manufacture of electrical equipment, has taken a factory on Chestnut Street and plans to commence operations about Feb. 1.

Westfield.—City has voted \$14,000 for light plant and transmission line.

## MISSISSIPPI

Columbus.—City is reported as contemplating voting on \$10,000 bonds for electric light plant.

Forest.—Bienville Lumber Company has taken over the Forest Electric Plant from R. J. Knoblock, Propr., and will operate in connection with its own plant, enlargements to be made.

Marks.—Jas. Fitzel has franchise to install and operate electric light system.

Oxford.—City will issue \$6500 bonds to improve light and water plant.

Summer.—Southern Electric Service Co., A. S. Carl, Mgr., Winona, Miss., will re-equip present d.c. plant with 2300-volt a.c.; proposed cost, \$14,000. Will construct 6 mi. transmission to Tutwiler, Miss., and 2 mi. to Webb, Miss.

Wesson.—City is to construct electric light system and water works early in January.

## MISSOURI

Branson.—Branson Light and Power Co., C. C. Bradshaw, Mgr., will install electric light plant here. Construct 2 mi. transmission line to Hollister, Mo. Voltage 2300.

## NEBRASKA

Omaha.—The Alamo Farm Light Plant Company; capital \$100,000. To manufacture and sell electric lighting plants for farms. B. LeBron and F. L. Tubbs, of Omaha, and Geo. E. Tubbs, of Hillsdale, Mich., are the incorporators.

## NEW JERSEY.

Jersey City.—The New Jersey Power and Light Company; incorporated capital \$2,000,000. To manufacture electricity for light, heat and power. Address 75 Montgomery St.

## NEW YORK

Brooklyn.—Primo Electrical Manufacturing Co., Inc.; incorporated capital \$5,000. C. P. Liotta, Rosario Morello, S. S. Celano.

Buffalo.—Wellsville and Buffalo Railroad Corp., incorporated capital \$850,000. To operate railroad, electric, steam, etc., power. Incorporators: C. A. Finnegan, 83 Ellicott Road, Depew; A. Weber, Inter-Southern Boulevard, Louisville, Ky., and T. Hofeiler, 59 Ashland Avenue, Buffalo.

New York.—Thistle Electric Company; electric equipment; incorporated capital \$10,000. Incorporators: W. D. Bass, Richard H. Fessler, Boyd Thistle, 340A Monroe Street.

New York.—Kilmer Lighting Co., Inc.; \$5,000. W. S. Kilmer, R. L. Kent, J. H. Gibson, all of New York.

New York.—Red Top Electric Co., Inc.; capital \$500,000. To manufacture electric toasters, stoves and other appliances. Incorporators: H. J. Lucke, J. E. A. Konigsberg, S. H. Daeder, 2 Rector Street, New York City.

Olean.—The Olean Electric Light and Power Company is doubling the capacity of its plant.

Port Ewen.—The Holland Nitro Lamp Co., Inc.; mfg. lamps. Capital \$25,000. Incorporators: W. P. Graham, 60 Bay 31st St., Brooklyn, N. Y.; F. A. Schwabmayer, 111 Waverly Place; M. Roy, 104 Fifth Avenue, New York City.

Sanborn.—The Sanborn-Perkin Power Company has been incorporated by H. B. Treichler, J. B. Hudson, B. L. Hudson, and others. Will generate and sell power to surrounding towns and villages.

## NORTH CAROLINA

Kernersville.—City contemplates constructing electric light system. Will probably secure power from Southern Power Company's plant, in which event station will be built in city.

Granite Falls.—City is erecting electric light and power plant, to cost \$4,000. Comstock Electric Co., High Point, N. C., Contr.

Newborn.—Brighton Light and Power Company; capital \$25,000. Incorporated by J. C. Irving, J. V. Blades, E. D. Blades and others.

Statesville.—Southern Power Co., Charlotte, N. C., will build electrical transformer station here.

Zebulon.—City is expending \$10,000 to install lighting system. Comstock Electric Co., High Point, N. C., Contr.

## NORTH DAKOTA

Bismarck.—Woodruff Electric Light and Power Company; incorporated capital \$25,000. Incorporators: W. G. Woodruff, G. F. Dullan and E. E. Woodruff.

## OKLAHOMA

Dacoma.—Dacoma Light and Power Company; capital \$3,000; incorporated by Levi O. Le Dou, G. E. Selfridge, Ed Hurt and others.

Galtry.—City is planning to install electric light and telephone system. W. L. Benham, engr., Oklahoma City.

Heavener.—City will construct electric light plant; cost \$20,000. About 2 mi. transmission.

Ringling.—Bert Foster, of Ardmore, Okla., will construct electric light system in this town.

Tulsa.—Oil Fields Gas and Electric Co.; capital \$20,000. Incorporated by W. A. Moore and J. T. Lantry, of Tulsa; C. F. Hopkins, Sapulpa; J. A. Frates, Springfield, Mo., and others.

## OHIO

Cincinnati.—The Cincinnati Electrical Tool Company has increased its capital stock from \$50,000 to \$75,000.

## PENNSYLVANIA

Philadelphia.—It is reported that the Philadelphia Electric Company is considering the erection of a big new powerhouse at Beach and Palmer Streets.

Renovo.—The Noyes Electric Light Company has been incorporated here with a capital stock of \$5,000.

## SOUTH CAROLINA

Greenville.—City is installing a new white way system here. Southern Public Utilities Co., contr.

Hartsville.—Coker College has let the contract to Perry-Mann Electric Company, of Columbia, S. C., to install electric generating plant.

## TENNESSEE

Winner.—The Winner Gas and Electric Company; capital \$25,000. Incorporators: Geo. Drake, A. Drake, C. F. Robbins, all of Platte.

Chattanooga.—The Tennessee Power Company of this city will build an additional power plant, the first unit to be 10,000 hp, with an ultimate capacity of 40,000.

## TEXAS

Dallas.—Dallas Union Terminal Co. is erecting power plant here.

Jacksonville.—J. R. Keller, of this city, is in the market for a 150-175 kw. 220-volt, 3-phase belted generator.

Kenedy.—Kenedy Light Company is contemplating installing 75-kw. generator in electric light plant here.

McKinney.—City voted to sell municipal electric light plant to Texas Power and Light Co., of Dallas. Latter under contract to improve property at cost of \$100,000.

Pampa.—Pampa Water, Light and Power Company; capital \$5,000. Incorporated by A. E. Davis, M. E. Davis and E. Cantler.

## VIRGINIA

Newport News.—Newport News Light and Water Company has been authorized to issue \$6,000,000 of bonds.

Norton.—Norton Electric Supply and Equipment Co.; incorporated capital \$15,000. Incorporators: W. H. Keller, M. B. Keller.

Pennington Gap.—Electric Transmission Co.; incorporated capital \$100,000. Incorporators: Arthur Hardgrave, Chicago, Ill.; B. F. Mays, Washington, D. C.

Richmond.—Hopewell Electric Supply Co.; incorporated capital \$10,000. Incorporators: M. A. Finn, Petersburg; William M. Mulligan, Richmond.

## WEST VIRGINIA

Mason.—Ohio River Salt Company is to install electric light plant here.

Wellsburg.—American Gas and Electric Co., 30 Church Street, New York, is to organize company to build electric power plant here. Initial expenditure, \$2,500,000; initial installation, 60,000 kw., with provision for ultimate development 180,000 kw. Plans to furnish electricity for light and power to cities within radius of 60 miles of Wheeling, including Canton and Newark, Ohio.



## YAGER'S FLUXES

Have you tried YAGER'S SOLDERING SALTS in the new enameled screw top can container? Same price as for the bottles. Packs better; ships lighter; keeps its dry granular salt form, and will not corrode. Ask to see YAGER'S in its new dress. It does the work for others. It will do yours. Use YAGER'S SOLDERING PASTE in collapsible tubes for your kit; in tin boxes for the bench. Yager's Paste means no waste.

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HUDSON, N. Y.

# ELECTRICAL AGE

*The National Monthly of Electric Practice*

Formerly ELECTRICAL ENGINEERING

*Technical Journal Company, Inc., New York*

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Vol. 48

FEBRUARY, 1916

No. 2

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## The Jordan River Electric Plant

*A High-Head Plant on Vancouver Island*

*By Frank C. Perkins*

The Jordan River Plant of the Vancouver Island Power Company, Limited, a company subsidiary to the British Columbia Electric Railway Company, Limited, is situated at the mouth of Jordan River, which flows into the Straits of San Juan de Fuca about 40 miles west of the City of Victoria, Vancouver Island. The Jordan River is a mountain stream flowing in a southerly direction through a deep and precipitous valley. The source of the main river is in Jordan Meadows, which lie about midway between the east and west coast of the Island, and at an elevation of about 1,700 feet above sea level. Several large creeks join the river in the upper ten miles of its course, the principal streams being Bear Creek, Wye Creek and Alligator Creek. The total drainage area is about 75 square miles, the greater part of which lies at an elevation of over 1,200 feet above sea level, and this entire area is covered by a growth of heavy timber.

The precipitation is very heavy, averaging about 90 inches per year over the whole watershed. During the winter months there is a generous fall of snow varying from 4 to 11 feet in depth in the higher parts. This snow, protected by the heavy timber and underbrush, often remains on the ground until well on in June or July, thus forming a splendid natural reservoir.

This development is of particular interest on account of the high head utilized, the static head at the power house being 1,145 feet. The power house is situated on the beach near the mouth of the Jordan River, with the main floor 7 feet 6 inches above high tide level. Water is conveyed to the water wheels in the power house from a forebay reservoir through steel pipe lines 9,290 feet long.

The Bear Creek dam, situated on Bear Creek, about a mile above the junction of that stream with the Jordan River is an earth embankment built by the hydraulic process. The greatest height above the bottom of the foundation is 57 feet and the length on the

crest is 1,020 feet. The crest has a width of 15 feet; the downstream slope is  $2\frac{1}{2}$  to 1 and the upstream slope 3 to 1. The spillway is excavated from the solid bedrock at the north end of the dam. The volume of material in the dam, as measured in the embankment, is 148,000 cubic yards.

In order to ensure watertightness and provide a secure foundation, not only for the initial structure 57 feet high, but for an ultimate structure 87 feet high for developing the reservoir to its full capacity, steel sheet-piling was driven to bedrock, thus forming a curtain wall across the valley. This dam forms a lake 285 acres in extent and provides storage available for power purposes amounting to 328,000,000 cubic feet. The area of Bear Creek watershed above the dam is 8 square miles, and is at an elevation exceeding 2,000 feet above sea level.

Regarding Jordan River dam, the survey showed that immediately below the junction of Wye Creek and Jordan River the canyon narrows and is crossed by a ridge of bedrock which extends well up on both sides of the canyon. This site was recognized as the best for a dam of a permanent character. It was originally intended to place the diversion dam at this point, but owing to the limited time, the lack of a ready supply of material for concrete near the site, and also in view of the probability of using the site at some future time for the construction of a high dam which would, in addition to diverting the stream into the flume, form a large reservoir, another location was chosen for the temporary diversion dam about 2,000 feet further up stream.

So as to utilize the runoff from Wye Creek, a small diversion dam was also built on this creek and a branch flume was built to carry the water from Wye Creek dam to the main flume on the east bank of the Jordan River. The temporary Jordan River diversion dam was a substantially built rock-filled crib structure sheeted with two thicknesses of 2 inch planks.

It was founded on bedrock and the bottom edge of the upstream sheeting was set in a concrete sill. The length on the crest was 128 feet and the width 8 feet. Both faces were built on 1 to 1 slopes and the maximum height was 18 feet above bedrock.

The flume intake was located at the east end of the dam and was also constructed as a rock-filled crib and lined with two layers of 2 inch planks. The regulation of the flow of water was controlled by three timber



Fig. 1.—Dam under construction

headgates operated by rack and pinion. These gates discharge directly into an intake basin depressed 2 feet below the floor of the flume and provided with sand gates through which the silt and sand which might collect in the basin could be discharged. The Wye Creek dam was of similar construction, but the crest length was only 90 feet. The storage provided by the Bear Creek reservoir was sufficient to supply the demands of the first two units installed in the power house, but on account of the rapidly increasing demand for power the construction of a high storage dam on the Jordan River was finally commenced.

It may be noted from the illustration that the Jordan River dam is a hollow reinforced concrete structure of the Ambursen type, with crest 1,268 feet above sea level. The dam is 891 feet in length along the crest. A spillway is provided. The dam is 891 feet in length along the crest. A spillway is provided near the east end of the dam with curved crest and rollway apron which enables water overflowing the spillway to fall clear of the toe of the buttresses; the spillway is 305 feet long the crest 8 feet below the top of the dam and provides for a discharge of 23,000 cubic feet per second. The extreme height of the dam is 126 feet above the lowest point of the foundation on the centre line. This dam is believed to be the highest dam in Canada, and it is the second highest dam of the Ambursen type so far constructed.

As may be seen, the Jordan River dam consists of a reinforced concrete face or deck inclined at an angle of 45 degrees and supported on concrete buttresses spaced 18 feet center to center. These buttresses are 12 inches thick at the top and increase, by steps or lifts 12 feet high, to a thickness of 42 inches at the bottom of the highest buttress. The upstream edge is built on a slope of 1 to 1; the downstream edge has a batter

of 1 to 4 from the base to a point 18 feet below the crest, above which point it is vertical. At the upstream edge a heavy reinforced haunch or shoulder is built on either side of the buttresses and the decks are supported on these haunches. The buttresses project beyond the haunches a distance equal to the thickness of the deck, and a bonding groove or key is cast in this projection. No vertical reinforcement is used in the buttresses excepting along the downstream edge and in the haunches, where heavy reinforcement is provided to carry the decks; horizontal reinforcement is used along the top and bottom of each of the 12-foot lifts or steps.

There are provided horizontal tie beams, which are reinforced top and bottom, run between the buttresses at various elevations and give them lateral supports. The reinforcement in these beams is continuous through each three consecutive buttresses but is not carried continuously through the dam on account of possible strains set up by expansion and contraction. Only two sizes of reinforcing steel were used in the entire dam, these being  $\frac{7}{8}$  inch and  $\frac{5}{8}$  inch square corrugated bars;  $\frac{7}{8}$  inch bars were specified for all the main reinforcement, and  $\frac{5}{8}$  inch bars for vertical reinforcement. The total weight of steel used in the dam was 380 tons.

It is stated that practically all the material in the dam was handled by a cableway spanning the valley on the centre line of the dam; the length of the span was 920 feet.

The flume is built entirely of timber, and was designed for an ultimate carrying capacity of 175 cubic feet per second. The box is 6 feet by 6 feet in section, allowing for a depth of 5 feet 6 inches of water, and has a grade of 1 foot in 1,000 feet. As originally built the sides were only boarded up to a depth sufficient to carry 75 cubic feet per second and the bents were placed 15 feet centre to centre. In order to support



Fig. 2.—Another view of dam under construction

the additional weight of water, it was necessary to erect intermediate trestle bents, making the bents 7 feet 6 inches to centre; during the summer of 1913, the necessary additions to the flume were made to complete it to its ultimate carrying capacity.

The railroad which runs parallel to the flume for its entire length, greatly facilitated the work, as all lumber and other construction materials were delivered at the points at which they were to be used. Five gates are provided along the length of the flume.



These are set in short boxes formed by dropping the floor of the flume about 3 feet below grade, and serve to catch all sand and silt which enters the flume. The gates may also be used to empty the flume quickly in case of emergency. The flume discharges into the forebay reservoir, which is a small artificial lake of 4,350,000 cubic feet capacity, formed in the flat between two hills by two earth fill dams built across the valleys immediately to the north and south of the ridges. These dams, or embankments, were built of the material excavated from the higher ground lying between them, thus adding to the capacity of the reservoir.

The north embankment, which is the smaller has a length of 560 feet on the crest and contains 24,290 cubic yards of material. The south embankment is 700 feet long and has a volume of 26,560 cubic yards. The slopes of both embankments are  $2\frac{1}{2}$  to 1 on the water side and 2 to 1 on the outer side. The maximum height of both dams is 35 feet. A spillway, with crest 5 feet below the top, is built in solid ground near the east of the north dam embankment. Two riveted steel pipes pass through the south embankment; the inner ends of these intake pipes are fitted with 54 inch diameter hand operated roller bearing sluice gates, and protected with trash racks. To the outer ends of these intake pipes the pipe lines which convey water to the power house are connected; one of these outlets provides water for Units Nos. 1 and 2, and the second opening serves No. 3 unit.

The pipe line connected to the first outlet is 44 inches in diameter, and 3,000 feet long. It is of riveted steel construction and varies in thickness from  $\frac{1}{4}$  inch to 5-16 inch. At its lower end, a Y pipe is provided. To the west branch of this Y, No. 1 pipe line is connected; this pipe line is of lap welded construction, 36



Fig. 3—Completed Dam

inches in diameter at the upper end and tapering to 30 inches at the power house, and is 6,280 feet long. The upper end of the pipe line serving No. 2 unit is connected to the east branch of the Y. No. 2 pipe line is of riveted construction, and varies in diameter from 36 inches at the top to 30 inches at the power house, the thickness ranging from  $\frac{1}{2}$  inch to 1 inch at the lower end. Both pipe lines are controlled by gate valves placed just below the Y pipe. The pipe line for No. 3 Unit is connected to the second intake pipe in the south dam at the forebay reservoir. This pipe

line has a total length of 9,290 feet and is located parallel to pipe lines No. 1 and 2.

For a distance of 2,508 ft. below the intake, No. 3 pipe line is of riveted steel construction 64 inches in diameter at the top and tapering to 48 inches in diameter at the lower end where it connects with a lap welded pipe  $\frac{1}{2}$  inch thick and 48 inches in diameter; this diameter is maintained except for a length of 130 feet at the back of the power house, where the di-



Fig. 4—Jordan River Power House

ameter is reduced to 44 inches; the thickness at the power house is  $1\frac{1}{8}$  inches. The pipe lines are liberally provided with manholes, and air valves are placed on the pipes at frequent intervals. In excavating the pipe trenches, all surface soil was removed and the pipes rest on a firm foundation of rock, hardpan or gravel, throughout their length. Drainage is provided for by packing small rocks and gravel around the bottom of the pipes, and numerous concrete deflecting walls built at intervals across the pipe trenches turn seepage water into natural drains along the hillside.

The electrical equipment of the Jordan River power house is of special interest. The original power house building completed in 1911 was a concrete structure 91 feet 6 inches long and 47 feet wide, in which two units of 4,000 kilowatts capacity were installed with the necessary exciters, low and high tension switches and transformers. On account of the rapidly increasing load on the company's system, the original installation has been added to. The attentions necessitated the extension of the power house building to accommodate a new 8,000 kw. unit with space for a fourth unit, and an entirely new high tension switchboard for the completed plant behind the power house. The completed power house is a reinforced concrete building founded on concrete piles 12 inches in diameter, which penetrate to bedrock lying at a depth of 45 feet to 75 feet below the surface. The floor of the older portion of the building is 7 feet 6 inches above high tide level; the floor of the new portion is placed at an elevation 5 feet higher.

In this power plant the completed generator room, shown in the illustration is 211 feet 6 inches long and 47 feet wide, in which are installed two identical 4,000 kva. units made up of Allis-Chalmers-Bullock 3-phase, 60 cycle, 2,200 volt generators driven direct at a speed of 600 revolutions per minute by a single double water-wheel of 6,000 H. P. mounted on one end

of the shaft, and overhanging the bearing at that end of the unit. The shaft is a nickel steel forging 14 inches in diameter and supporting in two bearings 40 inches long.

The water is conveyed from the terminal end of each pipe line through a cast steel flanged taper pipe which is bolted to the flanged end of the pipe line. This taper piece decreases in diameter from 30 inches to 24 inches at the outlet end, where it is bolted to a hand operated, 24-inch single disc, steel body, rising stem gate valve which is provided with a by-pass. The



Fig. 5—Generator Room

steel nozzle casting is bolted to this valve. The jet of water is projected on to the wheel through a Doble needle regulating nozzle and the governing is done by a type Q Lombard governor, operating the needle gear by means of an oil pressure cylinder.

There were surges or rams in the pipe line caused by the quick closing of the main nozzle and they were minimised by the Doble auxiliary relief nozzle. This nozzle is similar to the main nozzle, but is placed below it and the stream is discharged freely down the tailrace. This relief nozzle is operated by the governor through links connected to a dashpot on the relief needle stem. The gradual closing of the main nozzle does not operate the relief, but in case of quick closing the relief nozzle opens. Heavy coil springs bring about the gradual closing of the relief nozzle, and the time of closing can be regulated by adjusting the dashpot by pass valves. Oil pressure for the operation of the governor is supplied by a motor-driven oil pump which automatically maintains the pressure in the supply tank.

The No. 3 unit is made up of one 8,000 kva. Canadian General Electric 3-phase, 60-cycle, 2,200-volt generator, driven by two Pelton-Double water wheels, one mounted on each end of the shaft and overhanging the bearings. The water wheels are rated at 13,000 hp. The shaft is a hollow nickel steel forging 16 inches in diameter in the bearings, which are 60 inches long; these bearings are of the single shell type similar to those on No. 1 and No. 2 units. The two wheels on this unit are supplied with water through a flanged cast steel Y pipe which is bolted to the terminal end of the pressure pipe line immediately behind the unit

foundation. The entrance connection of the Y is 44 inches in diameter and the branches are 34 inches. To these branches are bolted cast steel taper pipes, reducing to 24 inches, and to these are bolted 24 inch single disc steel body gate valves. These gate valves are operated by small reversible water wheels mounted on brackets on the yokes of the valves; the water motors operate a bronze nut on the rising stem of the valve through a system of spur and bevel gearing. Water is supplied to the wheels through short pipes connected to the hood of the valves, and an automatic device is provided which prevents over-running. The cast-steel nozzle bodies of the main and relief nozzles are bolted directly to the gate valves.

It is pointed out that each wheel is provided with an entirely separate direct motion oil operated, relay type Pelton-Doble governor; the piston of the governor motor cylinder is mounted on the extended needle stem of the main nozzle, and from this stem the auxiliary or relief nozzle is operated by double levers connected to the dashpot on the stem of the auxiliary needle. This direct application of the motive powers of the governor to the needle stems of the water wheel, without any intermediate connections, is a great improvement over the old system of applying the power through a system of links, with their inherent lost motion and backlash. These governors have given exceptionally good regulation without causing any appreciable surges in the long pipe line.

The oil pressure for the operation of the two governors is provided by a water motor driven gear type pump with a welded steel oil pressure accumulator tank. The pump motor is controlled by a float in a chamber connected with the accumulator tank. The governors may also be controlled by hand. Three ex-

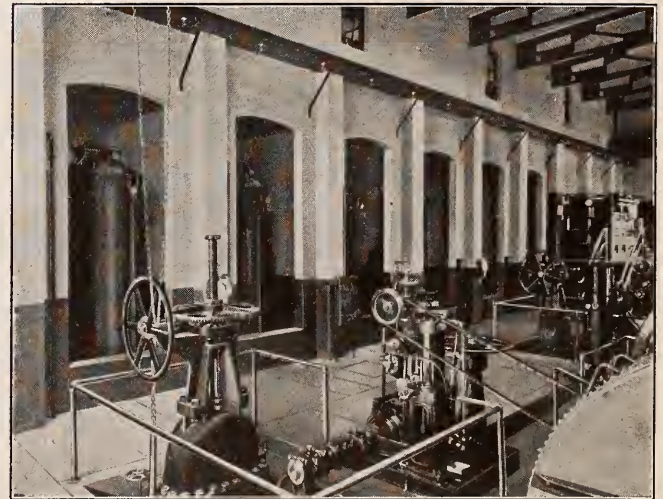


Fig. 6—Transformers and Governors

citer units are provided. Two of these consist of one 100-kilowatt, 125-volt direct-current generator, with a 150-horsepower water wheel at the other end. The third exciter set consists of a 200-kilowatt, 125-volt direct-current generator on the shaft of which are mounted a 300-horsepower induction motor and a 200-horsepower water wheel.

# Central Station Demand and Diversity Factors

By W. T. Ryan

"Demand Factor" is defined in the Standardization Rules of the A. I. E. E. as the ratio of the maximum demand of any system or part of the system, to the total connected load of the system, or of the part of the system under consideration. Thus if a residence has a connected load of twenty-five forty-watt Mazda lamps and the maximum demand of the residence is fifteen forty-watt lamps, the demand factor would be 600 watts divided by 1,000 watts or 60 per cent. The demand or Hopkinson system of charging for electrical energy seems to be the least worst of the various systems which have been proposed. In a recent institute paper on "Rate Making," Mr. Paul M. Lincoln makes the following statements: "Since Hopkinson's first suggestion there has been much discussion of this question of rates. Papers almost without number have been written on this subject of rates and every phase of the matter has received critical attention. For the last five years the National Electric Light Association has issued a weekly bulletin entitled 'Rate Research' and devoted to nothing else but a discussion of rates and closely applied subjects. Without exception, all authorities have recognized the correctness of Hopkinson's main contention, viz., that any logical rate for electric service must, in some manner, recognize maximum demand as well as the total of kilowatt-hours of energy used, thereby taking the load factor into account."

Unquestionably it is pretty well agreed that at least two items should be known, viz., the kilowatt-hours and the maximum demand. There is sold in the United States and Canada about one million watt-hour meters every year, whereas less than one per cent. of this number of maximum demand meters are sold. Classification of customers and of demand factors is usually depended upon to take care of demand factor, except in the case of very large users. The cost of obtaining all the items necessary to render a small customer a logical bill is so large that it is at once apparent that classification is the preferable horn of the dilemma.

Mr. H. B. Gear, of Chicago, made a very extensive study of demand and diversity factors in Chicago some years ago. The first question he considered was the determination of the consumers maxima in per cent of the connected load for residences where the connected load was less than one kilowatt. He studied this problem by averaging the results of 20,000 residence consumers. Mr. Gear found that if a residence consumer had only three 50-watt equivalent lamps, his maxima would be 150 watts, i.e., he would turn on all three lamps at once some time during the year. He found that if his connected load were 19 50-watt equivalent lamps his maximum demand would be 10 50-watt equivalent lamps; in other words, on the average such a customer would never turn on more than ten lamps at one time during the year. The results of Mr. Gear's complete study is given in Table I.

TABLE I  
RESIDENCE LIGHTING

Connected load in watts	Maximum Demand	Demand Factor
150	150	100%
250	250	100%
350	300	85%
450	325	72%
550	375	68%
650	400	61%
750	425	57%
850	450	53%
950	500	52%
Average 550	.....	72%

The general use of tungsten lamps has effected this problem somewhat by reducing the connected load per outlet, but cheaper

lighting has encouraged the use of more units and freer use of lights.

According to the last edition of the Standard Handbook the demand factors used for computing rates of small Chicago lighting consumers are as follows:

Kilowatt connected load	Demand Factors	
	Commercial (per cent)	Residence (per cent)
0.25	100	100
0.30	100	89
0.35	95	86
0.40	91	83
0.45	89	74
0.50	87	73
0.55	85	67
0.60	83	67
0.65	82	61
0.70	81	61
0.75	80	57
0.80	79	57
0.85	78	55
0.90	78	55
0.95	77	53

The following table shows the demand factors compiled by the Wisconsin Commission from companies using Wright demand meters.

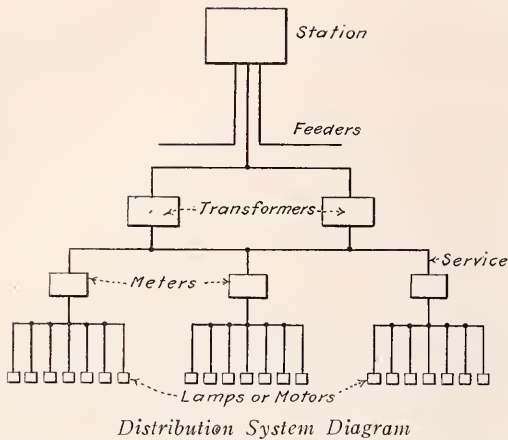
	Per Cent		Per Cent
Stores	40 to 100	Laundries	60 to 75
Offices	57 to 87	Livery stables	52 to 58
Saloons	62 to 92	Lodge and dance halls	68
Restaurants	32 to 62	Depots	75 to 95
Factories	53 to 56	Theatres	49 to 89
Churches	36 to 85	Shops	55
Hotels	28	Machine shops	37 to 54
Clubs	28	Blacksmith shops	66
Schools	37 to 52	County and Federal bldgs.	31 to 33

The term "Diversity Factor," which has come into general use in the last few years, has recently been defined in the Standardization Rules of the American Institute of Electrical Engineers as follows: "Diversity factor is the ratio of the sum of the maximum power demands of the subdivisions of any system or parts of a system to the maximum demand of the whole system or the part of the system under consideration, measured at the point of supply." Thus, if 100 residences were served by one transformer, and maximum demand meters were placed in each residence and on the transformer, and if the sum of the maxima of the 100 residence meters were 100 kilowatts and the maxima indicated by the transformer meter 30 kilowatts, the diversity factor would be 100 divided by 30 or 3.33.

The study of diversity factors for various classes of customers is a matter of great importance to the financial success of a central station business, as it is intimately involved with the design of the distributing system, and in the determination of the rates for the various classes of customers.

Diversity factors are usually determined with maximum demand ammeters as there are no good inexpensive maximum demand wattmeters on the market. The kilowatts are then obtained by multiplying by the nominal voltage. For motors, arc lamps, etc., which have a power factor considerably less than unity the kilovolt-amperes is all that is obtained.

In the ordinary distribution system there is first a diversity factor between the individual consumers and the transformer serving a group of such consumers because the maximum demands come at different times. There is next a diversity factor among their feeders for the same reasons. The elements of the usual distributing system is shown by Figure 1.



customers each demanding one kilowatt, and we put in one transformer for each customer, our total transformer capacity would be 30 kilowatts, and the diversity factor about 3.35 among transformers; whereas, if we put in one transformer for the 30 residences, one ten-kilowatt transformer would suffice, and the diversity factor among transformers would be about 1.30. It is probably necessary to connect at least ten or twelve consumers to one transformer in order to get approximately the highest diversity factor. One ten-kilowatt transformer would cost approximately \$93.00, whereas 30 one-kilowatt transformers would cost approximately \$600.00. The core loss of a ten-kilowatt transformer is 90 watts, whereas, the core loss of 30 one-kilowatt transformers is 720 watts. Of course, on the other hand, the secondary distribution system will cost more and a nice balance must be struck between the two; the tendency, however, is put in too many small transformers. Ordinarily an economic balance is obtained when the transformers are placed from 500 to 800 feet or usually about two city blocks.

Mr. Gear found a diversity factor of 1.35 among transformers used for general power purposes, and 1.30 among transformers used for commercial lighting. The average of Minnesota cities that reported to me was about 1.6, due probably to more scattered load and smaller transformers. One of the larger cities, for example, reported that they provided separate transformers for each power consumer, and figured upon a diversity factor of 2.50. It appears from Mr. Gear's report that in Chicago the average diversity factor among transformers is about 1.33, whereas, the replies I received from the various Minnesota cities would seem to indicate 1.60 as the value. The difference is probably mostly due to the fact that the load is more scattered, hence, fewer customers on one transformer.

Diversity Among Feeders: The diversity factor among feeders is usually not very large. In Chicago, the diversity factor among feeders during the week of maximum load was 1.15. Mr. Gear concluded that the diversity factor among residence lighting feeders, commercial lighting feeders and general power feeders, were all approximately 1.15. I received only seven replies to my question regarding diversity factor among feeders in Minnesota cities. The answers are given in Table III.

TABLE III  
DIVERSITY AMONG FEEDERS  
(Minnesota Cities)

City	Population	Diversity Factor among Feeders
A	220,000	1.00
B	7,000	1.60
C	7,900	1.25
D	79,000	1.60
E	7,600	1.00
F	3,800	1.00
H	3,000	1.00
Average	.....	1.21

Demand Factor of Power Consumers: About the only information available on this subject is Mr. Gear's study in Chicago. The demand factor will be expressed as the ratio of kilovolt-amperes demanded by the consumer, to the kilowatts in connected motor load. The distribution system must be designed for the current to be carried regardless of the power factor, and maximum demand meters measure current from which is calculated the kilovolt-amperes.

A group of 18 customers in Chicago having a connected load of 45-kw. in single-phase, and three-phase motors, showed 40-kva. as the sum of their maximum demands. This would give an average demand factor of 89 per cent. for this group.

Another group of eleven consumers having a total connected load of 97.3-kw. showed 90-kva. as the sum of their maximum demands. This gives a demand factor of 92 per cent.

A third group of 25 consumers whose connected kilowatts was 112.5, gave 100 kilovolt-amperes as the sum of their maximum demands. This gives a demand factor of 89 per cent.

A fourth group of 29 single-phase consumers whose con-

Diversity Factor Among Residence Lighting Consumers: The next problem we are concerned with is the diversity factor among the consumers for residence lighting. Mr. Gear took a residence block supplied by one transformer, in which there were 34 consumers having a connected load of 18 kilowatts or an average of 530 watts per consumer. The sum of the consumers maxima was 12 kilowatts, while the actual maxima as measured on the transformer was 3.600 kilowatts. The diversity factor of the consumers in this block was 12.00 divided by 3.60, or 3.33. Another block having 185 consumers, whose total connected load was 95 kilowatts gave the following results: sum of consumers maxima, 68 kilowatts; maximum load on the transformer, 20 kilowatts; diversity factor among lamps, 98 divided by 68, or 1.44; diversity factor among consumers, 68 divided by 0, or 3.40.

As a result of his complete investigation, Mr. Gear found that, the average diversity factor among meters for residence lighting was approximately 3.35.

In order to get some data on diversity factor in Minnesota, I sent a diversity factor questionnaire to 37 cities in Minnesota whose population was 3,000 or over. Although I was told by a live wire central station man that he doubted very much whether any operator in Minnesota with the possible exception of those in the Twin Cities, ever kept any records of this kind, I received replies to several of my questions from approximately one-third of the cities. The replies regarding residence customers are given in Table II.

TABLE II  
RESIDENCE LIGHTING  
(Minnesota Cities)

City	Population	Diversity Factor among residence consumers
A	7,000	3.00
B	220,000	4.00
C	7,900	3.33
D	3,800	3.00
E	80,000	4.00
F	7,600	2.50
G	3,700	2.00
H	3,000	3.33
Average	.....	3.14

Diversity Factor Among Residence Lighting Transformers: The next question is the determination of the diversity factor among transformers. The diversity factor among transformers, all of which are used for residence lighting, will not be very large. As a result of his very elaborate investigation, Mr. Gear found an average value of 1.30 for the value of the diversity factor among residence lighting transformers. The average result of the answers received for Minnesota towns as a result of my questionnaire was considerably higher than this, indicating that the number of customers per transformer is probably considerably smaller than in Chicago. There is a tendency in the smaller towns to use too many small transformers, instead of only a few large transformers. If we had 30 residence

nected load was 27.7-kw., showed 30-kva. as the sum of their maximum demands. This would give us a demand factor of over 100 per cent. The low power factor of the small single-phase motors probably accounts for this.

In small cities, a large percentage of the power consumers may have only one, two, or three motors, which as a rule, are very liable to be all operated at once, and at times some of them may be heavily overloaded. Therefore it would seem that for this particular class of power consumers a demand factor of about 90 per cent. should be used. A very pronounced exception would be in a shop where individual drive is used. The demand factor might be as low as 35 or 40 per cent. for such an installation. The demand factors of Chicago power consumers classified by size and obtained as the results of a very elaborate investigation are as follows:

H.P. Installed	No. Consumers	Demand Factor, per cent.
1 to 5	2900	75.4
6 to 10	456	64.5
11 to 20	237	64.7
over 20	307	42.9

**Diversity Factor Among Power Consumer.** The first group of power consumers referred to above were connected to one transformer and their maximum demand amounted to 25-kva., whereas, the sum of the individual maximum demands was 40-kva. The diversity factor is therefore 1.6. The diversity factor of the second group was found to be 1.39; of the third group, 1.43; and of the fourth group, 1.43. The average diversity factor among the above power consumers was found to be 1.46.

As pointed out before, the diversity factor among the transformers used for general power purposes was found to be 1.35, and among the feeders, 1.15.

**Demand Factor of Commercial Lighting Consumers:** As the result of a similar very elaborate investigation among four different groups of commercial lighting consumers, Mr. Gear obtained an average demand factor of 78 per cent.

**Diversity Factor Among Commercial Lighting Consumers:** An investigation by Mr. Gear of the four different groups of commercial lighting consumers referred to above resulted in his obtaining an average diversity factor of 1.42.

**Diversity Among Classes of Consumers:** There is a still further diversity factor between classes of customers. Stores use their light in the late afternoon and early evening, whereas hotels use their light mostly in the evenings. In Chicago, for example, Mr. Gear found that there was a diversity factor of 1.35 between the power and lighting loads.

**Total Diversity:** The total diversity factor of each class of consumers is the product of the diversity factors among consumers, among transformers, and among feeders. There is a further diversity among the classes of consumers under consideration.

For residence consumers, the total diversity factor is (3.35) (1.30) (1.15). This amounts to 5.00. For commercial lighting it is (1.42) (1.30) (1.15), which amounts to 2.12. For general power purposes it is (1.46) (1.35) (1.15). This amounts to 2.27.

TABLE IV  
DIVERSITY FACTORS

	Residence Lighting	Commercial Lighting	General Power
Among consumers	3.35	1.42	1.46
“ transformers	1.30	1.30	1.35
“ feeders	1.15	1.15	1.15
Total diversity	5.00	2.12	2.27
Kw. station capacity per 100 Kw. connected load	14.4	36.6	40.

The kilowatt station capacity per 100 kw. connected load is obtained by dividing the total diversity factor by the demand factor and then dividing 100 by the result. For example, the total diversity factor for residence lighting is 5.00 and the de-

mand factor is 78 per cent. 5.00 divided by 0.78 is 6.92. 100 divided by 6.92 gives us the value 14.4.

It will be noted particularly that the above figures indicate that only 14.4 kw. of station capacity is required for each 100 kilowatts of residence lighting connected load, 36.6 kw. in station capacity is required for commercial lighting, and 40 kw. for general power purposes. It shows that the old assumption which was frequently made that the maximum demand on small central stations in about one-half the total connected load probably requires considerable modification. In Minneapolis, whose population is 325,000, the ratio between the maximum load on the station and the total connected load is approximately one to three.

The answers to the writer's questions regarding kw. station capacity per 100 kw. of connected load are given in Table V.

TABLE V  
TOTAL DIVERSITY FACTORS  
(Minnesota Cities)

City	Population	Kw. Station Capacity per 100 Kw. Residence Lighting	Kw. Station Capacity per 100 Kw. Commercial Lighting	Kw. Station Capacity per 100 Kw. General Power
A	7,600	25	70	65
B	220,000	20	40	50
C	7,900	20	75	50
D	3,700	35	90	60
E	79,000	9	17	6
Average		21.8	58.4	46.2

The writer believes that diversity factor, as well as demand factors and load factors, should be taken account of in making up a system of charging for electrical energy.

A portion of the fixed charges, such as interest, insurance, depreciation, and taxes should be apportioned among the various classes of consumers in inverse proportion to their diversity factor. In addition to the remainder of the fixed charges, they should pay their share of the variable charges, such as fuel, oil, lamp renewals, etc., which are fixed by the quantity of electricity generated. If 14.4 kw. station capacity will take care of 100 kw. residence lighting, it is at once obvious that these residence lighting consumers should pay part of the fixed charges on only a 14.4-kw. unit of the station, whereas, a power customer should pay a portion of the fixed charges on a 40-kw. unit of the station. However, the total investment per kilowatt of connected load will usually be considerably larger for residence lighting than for power purposes, because of the fact that it is so scattered that the feeders, mains, transformers, meters, etc., are much more expensive than for the denser commercial lighting and general power load. And again, because of the diversity between the residence lighting and power peaks, much of the kilowatt station capacity which must be provided for lighting can in most stations be used for power purposes, thus making it unnecessary to provide any additional station capacity to take care of a certain portion of the power load. This should be credited to the general power class. *The result must be class rates.* There will be a certain amount of injustice done to certain individuals within each class, but this can not be avoided and should not be objected to by the public.

The investment and cost if operation to serve lighting customers, commercial lighting customers, and power consumers can be determined with a degree of accuracy that is fair and equitable to each class. The individual within each class can not be given a rate which is proportional to the cost of serving him, any more than the same rate per ton mile can be charged a 100 pound man for hauling him from Chicago to New York, as for hauling a 250 pound man. They both pay the same fare.

The writer believes, therefore, that there should be a fixed charge and an energy charge, and that these charges must be worked out for the various classes of customers who are using the electricity, and that it is impractical to try to charge each individual customer within a class in proportion to the cost to serve him.

## Science and Invention

### Electric Ore and Water Finder

A German electrical device that bids fair to have a wide use in mining is the electric explorer. This instrument is based on the varying conductivity of the different layers of rock, soil and water in the earth's crust. In the ground, insulating substances which transmit electrical waves alternate with conducting substances which impede these waves.

The methods first employed were based on the reflection, refraction and interference of these waves and required both sending and receiving apparatus. The location of the conducting bodies, such as water or ore, was deduced from the variations the strength of the received waves. The depth of the conductor was calculated from the inclination of the sending and receiving wires that gave the maximum strength in the received waves. Later methods of locating the bodies are based on variation in the emitted waves caused by the electrical properties of the ground near the sender. No receiving device is necessary.

This device enables much prospecting for ores or water to be done without boring. It is quite portable and has been used with great success in Germany where the indication given have proved to be very reliable.

\* \* \*

### Automatic Lighting

The automatic regulation of electric lights is the object of a recent invention of Dr. F. C. Brown. Not long ago the device perfected by Dr. Brown for enabling the blind to read print was announced. It has attracted the interest of the blind throughout the world. Changes in the resistance of a crystal of selenium caused by variations in light are the basis of its operation. The same principle applied to the opening and closing of an electric circuit is used in the new invention.

With the device attached to a lighting system the bulbs will begin to glow at the coming of night fall, the gathering of heavy clouds overhead, or the settling down of heavy smoke, and no hand will need be touched to a switch. In a big department store or in a whole city, for that matter it will control the lighting so that there will be artificial light whenever it is needed.

Another and perhaps more important possibility of use for the machine is in explosion of mines in warfare. A mine might be placed in a doorway ahead of advancing troops. No sooner would the troops begin passing than the cutting off or lessening of the light would cause the machine to close an electric circuit which would discharge the mine. Representatives of the war department are investigating this possibility of the invention.

\* \* \*

### Magnetic Method of Packing Nails

Nails are now being packed in boxes by a machine of Swiss invention. The result is a greatly decreased bulk as compared with the old loose method of packing and much greater convenience in handling. A box of 100 lbs. of packed nails takes up but little over half the space required for the same quantity of loose nails, as may be seen from the illustration.

The operation of the electric nail packer is based on the fact that relatively long pieces of iron when placed in a magnetic

filled will try to take a position parallel to the lines of force. The machine is a combined magnetic paralleling mechanism and a shaking device. With the shaker operating, the nail turn gradually into parallel with the lines of force and pass into a tray from which they are emptied into the boxes.

By shifting the position of the moveable pole piece on the magnet, it may be instantly adjusted to any size of nail.

This device requires about half a horse power for its mechanical drive and runs at about 2,000 r.p.m. The magnet coils are excited by direct current at 110 or 220 volts and use about 1.5 kilowatt-hours per day.

The principle on which it operates could be equally well used for packing all lengthy iron articles, such as knives, pens, screws, hair pins or wire rods.

\* \* \*

### Universal Electric Supply

As a forecast of the coming expansion of the supply and marketing of electric power, the address recently given by the head of the Commonwealth Edison Company of Chicago, Mr. Samuel Insull, is of very wide interest.

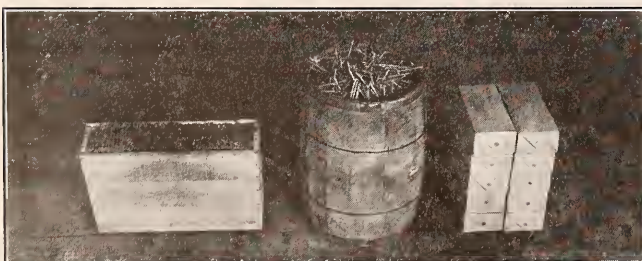
Basing his remarks on a comprehensive knowledge of the past and present of the electric supply industry, Mr. Insull drew attention to the recent rapid growth of area served by electric companies and the central station power plant capacity necessary for the increased service, which he estimated amounts to at least 10,000,000 kilowatts at this time.

The chief cause of the fast growth of the industry in the last few years comes from the improvements in generators, transmission and distribution apparatus. The efficiency of the steam turbine has increased 35 per cent. in the last two or three years. A few years ago only 8 to 10 per cent. of the energy of coal was delivered to the line. The early Parsons and Curtis turbine raised the plant efficiency to 12.5 per cent. Improvements in the past two or three years have increased this to 17 per cent. How far that efficiency can be increased by other means, such as gas turbines or the production of electrical energy direct from some mineral, is a matter of conjecture. The industry is in so vastly improved a condition compared with ten or fifteen years ago that the possibilities of extending service over very much greater areas are becoming more and more apparent to those who are conversant with the facts.

At Chicago, 500 kw.-hr. per capita is generated yearly, compared with about 74 kw.-hr. in the county of London, or, say, 150 kw.-hr. in Greater London, for a fairer comparison, including electric railways. The electrification of steam railroads at Chicago is a pressing question. The politicians assume that it is only necessary to ask the railroads to accomplish this and it will be done, but 3,500 miles of track are involved, and the solution of the problem requires years of experience, since a comprehensive and not a piecemeal solution is desirable. The speaker said that he did not assert that the electrification of railroads is an economic proposition to-day, that being a question which must be determined by the railroads themselves.

He added that if the railroads in the Chicago district should be electrified they would add 125,000 kw. to the present load, and that one system would be obliged to carry 728,000 kw. if no account was taken of the diversity factor. Owing to overlapping peaks, however, the service could be rendered by 577,000 kw. through centralization. This represents a capital saving of \$30,000,000, and the saving in fuel consumption would be 5,900,000 tons yearly on a total assumption of 11,000,000 tons.

"Now suppose," said Mr. Insull, "that we carry this idea farther afield, considering the electrification of all the railroads in the country. It takes about 2,800,000 tons of coal yearly to operate the railroads in the Chicago district by steam locomotives. Applying the same figures to the entire country and correcting by figures of the Interstate Commerce Commission, we find that 135,000,000 tons of coal are yearly required for steam railroads in this country. If the same process is followed with the diversity factor as in Chicago, we find that if we



Comparison of bulk of packed nails with nails in keg.

could marshall all the energy requirements of central stations, railways, manufactories, mines, street cars, etc., the 43,000,000 hp. now required for separate operation would be reduced to 30,000,000 hp. if operated under one system of production and distribution. I am not suggesting a single system for the United States—that, of course, is impossible—but I do suggest a series of state-wide organizations where the density of use is sufficient for all the energy requirements of one territory to be met by one system per territory. One might embrace Boston and New York, another New York and Philadelphia, a third Philadelphia and Pittsburgh. The savings of such group systems would be almost fabulous, amounting to from 12,000,000 hp. to 15,000,000 hp. at, say, \$200 per horsepower. The annual saving in fuel consumption would be about 250,000,000 tons, or \$500,000,000.

## Recent Electrical Patents of Interest

**Centrifugally Controlled Coasting Indicating Device for Cars or Trains.** It is well known to those familiar with the operation of electric cars or trains that considerable economy in power can be effected by taking advantage of the proclivities to coast on down-grade or under the inertia of the train after the power has been shut off. The careful motorman always takes advantage of this, using his brakes to a minimum extent and so avoids putting power into his train merely to be dissipated in the brake shoes. It is the object of patent to Messrs. Walter A. Hall and Charles W. Hall, of New York, N. Y. to provide a means whereby the extent to which an operator has availed himself of the coasting advantages as indicated above, may be shown. To this end an indicator is provided which is electrically operated, the operating circuit being controlled by a centrifugal device driven when the car is in motion, and by the turning on or off of the power current. When the centrifugal device is in operation and the power current turned off, there is the condition of coasting and the indicator circuit is closed. When, however, either the car is at rest or the power current is turned on, either of which conditions is inconsistent with coasting, the indicator operating circuit is broken and there is no coasting indication. The result is that an indication is afforded of when there is and when there is not coasting. Patent No. 1,165,592.

**Electrically-Propelled Vehicle.** The difficulty of handling the great weight of storage batteries has been one of the greatest draw-backs to the extension of the use of electric trucks, etc. According to a patent to Joseph M. Klingensmith, Chicago, Ill., the handling of storage batteries for propelling trucks is facilitated by providing a compartment on the truck having rails adapted to receive a car carrying the battery. The car and battery can be run out of the compartment for charging or repair and a new battery can be run into the compartment. This permits the exchange of batteries without a large amount of labor and with comparatively short delay. Contacts are provided so that the running of the battery car into position on the truck automatically effects the desired connections which eliminates another source of delay and possible duplication. Special provision is also made for ventilating the battery compartment. Patent No. 1,165,784.

**Removable-Unit Oil-Switch.** It is a most difficult and dangerous matter to remove or repair oil switches on high tension systems without disconnecting adjacent apparatus as well as the switch itself in question and, where repairing of the switch is undertaken without removing it, serious shut-down of the plant is likely to be caused. To avoid these difficulties, Mr. George A. Burnham, Cliftdale, Mass., proposes to build oil-switches in units which are separately removable so that they are readily replaceable with minimum delay when accident or necessity for inspection renders such a course necessary. The connections of the switches are automatically made and broken as they are moved into and out of position, the contacts being carefully protected by insulation. The switch units are locked in position by locking devices controlled from the operating

"The coming of a universal system of electrical supply is as inevitable as day and night. It will mean enormous savings to manufacturers of transportation, a very large saving in labor, interest, depreciation, general capital charges, the preservation of natural resources, lower relative consumption of copper, lead and other metals, and will lead to a lower cost of production, and so to a lower unit price to the smallest user, corresponding to the most efficient mobilization of the business. There would be a gain to all classes down to the occupants of the smallest city flat—cheaper power and low-priced light for rich and poor alike. Although it does not seem possible to try this out on a national basis, the unification of electrical supply is steadily proceeding, and in adding to the wealth of the country and as a factor in reducing costs it is putting us in a better position to compete in the markets of the world."

board so that the unit can be neither locked in position or unlocked for removal without going to the operating board. This is a safe-guard against approaching the switch unit to remove or replace it while there is high potential on the contacts. Patent No. 1,156,843.

**Alternating-Current Magnet.** Considerable interest has recently been manifested in electromagnets for operating switches and the like, deriving their energizing current from single-phase circuits. Owing to rise and fall of the magnetic pull with the current alternations this pull has not been uniform and chattering of the contacts has resulted. Aside from any question of the annoyance produced by noise, this chattering is liable to produce small arcs which cause rapid deterioration of the contacts. Various proposals have been made as to the prevention of this chattering. A patent has been issued to Mr. William T. Lutz, Allendale, N. J., which provides for immersing the magnet in oil which is also admitted to the plunger passage, and valves are provided which give a dash-pot action which prevents the chattering of the plunger in response to the current alternations. Patent No. 1,166,699.

**Automatic Control for Ignition Devices.** According to a patent issued to Lewis T. Rhoads, Mont Clare, Pa., wasteful discharge of current and possible overheating and wear and tear on apparatus is prevented when the timer contacts stop in engagement with one another. This is accomplished by Mr. Rhoads by employing a thermostat which, when the closure of the timer contact is unduly prolonged, opens the circuit thereto. Mechanical means is provided for closing the circuit when the timer is started up again. Patent No. 1,167,839.

**Suspension-Type Insulator.** A great deal of attention has recently been given to insulators of this type. The insulating links of which they are composed are generally of a fragile nature. Mr. Karl C. Randall, Edgewood Park, Pa., in a patent recently issued to him, describes an insulator of this type wherein the different links are each located within a metal bell-shaped canopy. Lower bells enter into the mouths of the ones above them so that from one side an unbroken metal armor protecting the insulating links is presented and the links are also very completely protected from the weather. Patent No. 1,168,031.

**System for Distributing and Regulating Electrical Energy in the Form of Alternating Currents.** The operation of split-phase motors from single-phase circuits, invented by Tesla many years ago, has long been familiar to everyone. On January 11, however, there was issued to Mr. William M. Fairfax, Washington, D. C., a patent disclosing the operation of split-phase motors from a single-phase circuit with provision for automatically maintaining proper phase relations of current in the motor regardless of change of load, etc. upon the line. This maintenance of proper phase relation, of course, increases the efficiency which would be reduced by shifting of the relative phases owing to change in load, reactance, etc. It is interesting to note that the original application for this patent was filed on December 24th, 1897. Patent No. 1,168,065.

## A New Incandescent Arc Lamp

Some years ago there was considerable discussion, particularly abroad, of an improved type of lamp, whose general characteristics should be similar to that of the ordinary incandescent lamp, as to operating in a bulb of the usual size and shape, filled with an inert gas, but in which the source of light should be an arc between tungsten or other conductors of a nature refractory enough to stand the high temperature involved.

It was decided to make some experiments along this line and recently the results of what has been done were described in a paper read before the British Institute of Electrical Engineers by representatives of the Edison & Swan Electric Light Company of London. In this paper the many difficulties to be overcome in the development of the lamp were brought out and the methods that were finally successful are clearly described.

The first lamps constructed were made with the electrodes in contact, one of the electrodes being connected to an expansion strip constructed of a strip of molybdenum, to one side of which was welded a thin strip of copper or other suitable material having about the same coefficient of expansion. A spiral filament of tungsten or molybdenum was mounted close to the strip and wired in series with the arc circuit. To prevent the strip moving too far and the arc breaking, a thick wire was sealed into the glass support; this wire acted as a stop and maintained the correct length of arc gap.

For alternating-current lamps the electrodes were constructed of fused tungsten and were of equal size.

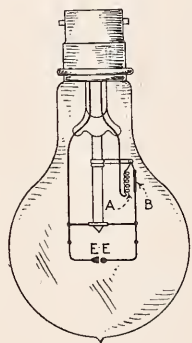


Fig. 1.—First form of lamp

For use with continuous current, in one form of lamp the positive electrode was constructed of a globule of fused tungsten, while the negative electrode consisted of a number of tungsten wires or filaments mounted in the form of a brush. The whole of the parts were assembled as shown in Fig. 1, and sealed in an ordinary incandescent lamp bulb, which, after being thoroughly exhausted of air, was filled with nitrogen at a pressure of approximately two-thirds of an atmosphere.

When connected to a continuous-current circuit through a suitable resistance the current passing through coil A produced sufficient heat to cause the expansion strip B to warp, thus separating the electrodes E, E, and striking an arc between them. The temperature of the heating coil then dropped to a very dull-red heat due to the added resistance of the arc itself. The heat from the arc was more than sufficient to keep the expansion strip hard against the stop F, and thus to maintain the requisite length of arc gap.

The arc burned steadily and the electrodes emitted an intense white light. The lamp had, however, many disadvantages, the most important being the tendency of the electrodes to stick together, with the result that the expansion strip failed to separate them slowly. Again, a considerable amount of sputtering took place when the electrodes separated, which, in consequence, shortened the life of the lamp. However, in the

course of development, principally by altering the shape and size of the electrodes, a lamp was evolved from which a life of over 100 hours was obtained. Other attempts to overcome the sticking of the electrodes included altering the physical state of one electrode, also the use of a short-circuiting piece placed between them, which on the current passing was removed. These and other devices did not entirely overcome the troubles of sticking and sputtering.

It seemed that these defects were such as would prevent the perfecting of the lamp. Just at this time it was decided to work along an entirely different line that would, if successful, dispense with electrodes in contact.

It is well known from the experiments of Sir J. J. Thomson, Dr. Fleming, and others, that the filament in an incandescent lamp gives off a strong negative discharge, and if an additional electrode sealed adjacent to the filament be charged to a positive potential, a current passes between the filament and this electrode. This principle was applied to overcome the difficulties encountered in making an arc incandescent lamp.

The first attempts on these lines were made with a lamp suitable for an alternating-current circuit. This lamp consisted of two small globules of tungsten fixed at a definite distance apart. As a means of breaking down the resistance of the gas within the arc gap, a filament was mounted adjacent to the electrode; this filament, when made to glow brightly for a few seconds, acted as an ionising agent and made the arc gap conducting.

As used in the lamp, this ionising circuit was connected in parallel with the arc circuit through an auxiliary single-pole switch and suitable resistance. On starting, the ionising circuit was completed for a few seconds and then broken by means of the switch. This resulted in an arc being momentarily struck between one of the electrodes and the filament, this being followed by an arc between both electrodes, the filament which acted as the ioniser being now entirely out of the circuit.

This lamp showed great improvement as regards both facility in striking and life.

Efforts were then directed to make a lamp for continuous-current circuits. At the start, the construction of this lamp was similar to that used for alternating current, with the exception that the negative electrode was smaller. To start the lamp the filament acting as the ioniser was brought to high incandescence and then cut out by means of a switch in the positive lead. Difficulties were experienced in inducing the arc to leave the tungsten-filament ioniser and pass to the negative electrode. This trouble was due to bringing the negative electrode to a temperature high enough to form an arc. In the alternating-current arc the electrode which momentarily formed the arc with the ionizer helped to form the arc proper, but with the continuous-current lamp the arc persisted in passing between the positive electrode and the ionizer.

Later on, negative electrodes were made, to which in the majority of lamps the arc would strike, but it was felt necessarily to provide thoroughly for the protection of the ionizer. This was desirable, inasmuch as the prolonged action of the arc tended to damage the ionizer, which after a time added to the difficulty of striking.

To try and obtain an ionizer which had a longer life than the previously used tungsten filament and which retained its activity throughout the life of the lamp, a study was made of the action of other materials than tungsten for use as an ionizer. It is well known that several refractory oxides possess to a very high degree the property of emitting electrons; experiments were therefore made with mixtures and combination of tungsten with zirconia, yttria, thoria and other oxides of the refractory class.

As a result of continued experiments, a satisfactory filament



giving powerful ionization properties was evolved, it being found that if the filaments were carefully made they were not destroyed by the action of the arc and that they lasted considerably longer than a filament made of pure tungsten, this being no doubt due to the difference in the physical state of the two filaments. However, difficulties still remained in the matter of restarting. The action of the arc after a time naturally destroyed the ionizing properties of the filament, and in some cases difficulty was experienced in restriking after 200 hours' burning. This deterioration of the ionizing properties of the filament was only local, being merely around a short length directly opposite the anode.

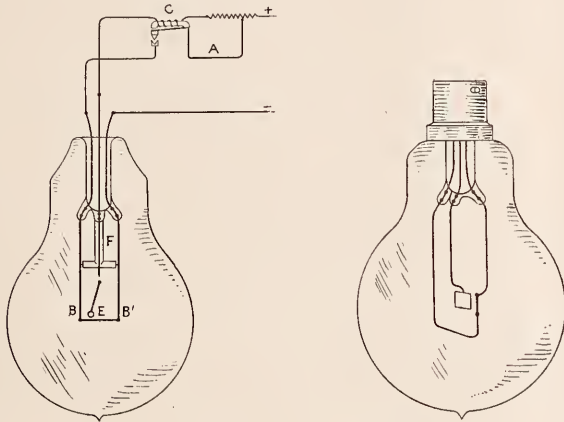


Fig. 2—Lamp with expansion strip Fig. 3—Lamp without expansion strip

To overcome this objection, a short length of expansion strip similar to that used in Fig. 1 was linked between the anode and its stem lead. A lamp constructed in this manner is connected as shown in Fig. 2, which illustrates a lamp suitable for a continuous-current circuit. Three leads are necessary through the lamp stem; on one is mounted the electrode E, while the other two hold the filament, acting as an ionizer, B B'. The positive main lead is divided into two circuits, one of which, A, passes through a resistance and the contacts on the electromagnetic switch C to the pole of the ionizer B, the other being taken through a resistance and the coil on the electromagnetic switch to the positive electrode of the arc circuit E. The negative main lead is connected to the remaining ionizer lead B'.

In operation, the current first passes through the ionizer circuit, causing the filament to incandesce at a temperature sufficient to ionize the gas between it and the positive electrode. At first a current flows in the arc circuit, this current rapidly increasing until the cut-out is operated. This breaks the ionizer circuit and the arc is "struck," the striking being assisted by the removal of the ionizer circuit, which, of course, shunted the arc circuit. The heat rising from the arc causes the expansion strip F to warp, and this moves the arc to another position on the ionizer.

On switching off the current the electrode returns to its original position, having left the inactive part and coming to rest opposite the still active portion of the ionizer. By this means the lamp may be restarted at any period of its life without difficulty.

In this lamp practically the whole of the intense white light emanates from a small globule of fused tungsten one-tenth in. in diameter.

Any size or shape of electrode may be made, the construction of the higher candle-power lamps being arranged as shown in Fig. 3. Here the expansion strip is dispensed with, use being made of the fact that in the more powerful arcs there is a greater tendency for the arc to pass across the shortest gap. In this case, after striking from the filament to the edge of the

electrode, the arc rises to the thickened portion immediately opposite.

Another method adopted for controlling the arc stream in lamps of high candle-power is to employ an extra lead through the stem, holding a smaller electrode fixed between the positive plate and the filament, and situated at a definite distance from the former. By the operation of change-over switches in the circuit an arc is first struck between the filament as cathode and the small electrode as anode.

On this electrode becoming brightly incandescent the change-over switch quickly operated brings into the circuit the large plate electrode, at the same time breaking the negative connection to the filament and changing the polarity of the small white-hot electrode. This latter now being negative, an arc is immediately formed between it and the large positive plate. This arrangement enables electrodes of any size to be used, and the filament being out of the circuit is completely protected.

A flat electrode is also employed. To obtain the best results a definite relation of surface to volume must be maintained. This type of lamp is made in sizes of 500 to 1,000 c.p., the maximum intensity being given in a direction at right angles to the plane of the electrode.

Comparison with Arc and Incandescent Lamps—As compared with the carbon arc lamp no regulating mechanism is required, and there is therefore a saving in the initial cost of production. The loss of light due to obstruction by the electrodes is small compared with that in the carbon arc, and there is no trouble from flickering or from the arc wandering. The arc is completely closed, so that there is no danger from fire. No re-carboning is required, and the lamp needs no attention whilst in use. The light-giving surface for the same output is greater than the crater of the carbon arc, and the electrodes can be so arranged as to concentrate the light in any desired direction.

Filaments of incandescent lamps are always distributed round the stem and thus occupy a fairly large area, whereas in the new lamp the light-giving surfaces are concentrated in the center of the bulb. In the same way that a carbon lamp appears yellow in comparison with the ordinary half-watt lamp, so does the latter appear yellow when contrasted with the new incandescent arc. For high candle-power lamps the bulbs are much smaller than for metal-filament lamps of corresponding candle-power, e.g., electrodes to give 500 c.p. can be placed with safety in a bulb 4 in. in diameter.

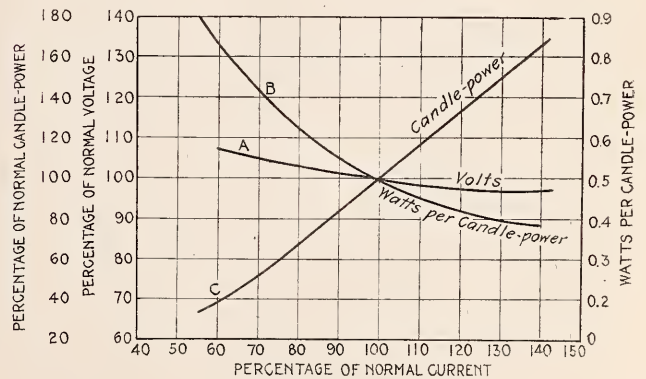


Fig. 4—Performance Curve

Characteristics of Lamp, etc.—Curve A (Fig. 4) shows the percentage variation of pressure with current. As will be seen, the curve is similar to that for an ordinary carbon arc, though showing greater stability. The pressure across the arc steadily decreases with an increase of current, and if this is continued until the sputtering point is reached, the pressure suddenly drops.

A representative efficiency curve is given by B in Fig. 4, which shows the efficiency for the normal working current to

be about 0.5 watt per International c.p., or 2 c.p. per watt. The current may be increased until the tungsten reaches the sputtering point, at which the efficiency is about 0.3 watt per c.p. or 3.33 c.p. per watt.

Curve C in Fig. 4 shows the variation of c.p. with current.

Some experiments to determine the effect of varying the pressure across the supply mains show the arc to be very stable. A voltage drop of 20 per cent. in the case of the small lamps, and 25 per cent. in the larger sizes, was necessary before the arc was extinguished.

As compared with the carbon-filament lamp (3.5 watts per c.p.), with an intrinsic brilliancy of about 375 c.p. per square inch, and metal-filament lamps giving 1,000 c.p. per square inch, the intrinsic brilliancy of the new lamp at an efficiency of 0.5 watt per c.p., or 2 c.p. per watt, is approximately 10,000 c.p. per square inch. The color of the light can be made to vary from a bright yellow when running at low efficiencies, to a very intense white light when the lamp is run to the sputtering point of the electrodes. The range of intrinsic brilliancy between these limits is approximately 400 to 30,000 c.p. per square inch.

Comparison with the spectra of various lamps clearly shows the continuity and strength in the visible spectrum of the new lamp, the other sources of light showing weakness in the green and at other points.

A great advantage of a lamp of this type is its adaptability (by altering the shape and position of the electrodes) for so varying the light distribution as to make it most suitable for the particular purpose for which the lamp is required. Where even illumination is required in all directions, spherical electrodes are most suitable. Electrodes can be made of any desired shape, however, and a flat plate or disk mounted vertically is an ideal light source for projection purposes.

The lamp is made for both alternating and continuous-current circuits, and the present intention of the Edison and Swan Co. is to put forward only the continuous-current lamp in its present form for optical projection and general scientific work where a concentrated point source of light is required. The lamp is so suitable for projection work that there is every reason to believe it will supersede all other sources of light for this purpose. It gives constant, uniform screen illumination, whilst there is no flickering and no danger of fire in cinematograph work, as there often is from the intense heat of the ordinary carbon arc. The bulb of the lamp, although smaller, does not become so hot as those of the half-watt metal-filament lamps. Moreover, the lamp requires no attention whilst burning, so that the whole of the operator's time is free to attend to his apparatus. Lamps of 1,000 to 2,000 c.p. are suggested as very suitable for cinematograph projection, and lamps of 200 to 300 c.p. for ordinary lantern work.

Lamps have been made with a life of 500 hours, and it is hoped that further experiment will make it possible to obtain a true half-watt lamp with a life of 800 hours. During life the average decrease in c.p. is about 10 per cent.

The lamp is very suitable for use in small search lights, for daylight and night signaling and as projection arcs for stage matching for artificial light.

Experiments have shown that it burns satisfactorily in series on high voltage circuits, and a wide field for future development is its adaptation for street lighting and illumination of purposes. It should also prove useful in photography and color large halls and inside spaces.

\* \* \*

### A Simple Microphone

A fairly good microphone can be made by a single carbon resting across two old safety razor blades. If such a microphone is connected in series with a battery and telephone receiver, and a watch is placed on its baseboard, the ticks can be heard on the telephone, even if it is some distance away. The little jars which the ticking watch give the baseboard, shake the

carbon so that the resistance at its point of contact with the razor blades varies, and thus changes the strength of the current. The varying current then pulls the telephone diaphragm back and forth and sets the surrounding air in motion.

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### Electric Construction Costs in New England

Some interesting data as to the costs of standard electrical construction of a transmission line, substation and a high-class street-lighting installation were given at a recent hearing on a petition of the Edison Electric Illuminating Company of Brockton, Mass., for approval of an issue of \$211,000 capital stock by the Massachusetts Electric Light Commission. One recent addition to plant was the construction of a brick transformer house. The building is of one story, 37 by 44 feet, with steel and concrete roof, concrete floor and foundation, with six transformer bays. The cost of erection was \$3,846.60, and of apparatus installed, as follows:

2 12,500-volt aluminum lightning arresters .....	\$ 524.00
6 choke coils .....	141.00
2 charging current indicators .....	12.00
Miscellaneous material .....	15.00
Meters, current and potential transformers .....	1,557.00
Switches .....	377.00
Cable .....	108.00
Copper wire .....	78.00
Cable taps .....	70.00
Pipe .....	67.00
Labor .....	501.00
Miscellaneous material .....	120.00
Freight, carting and incidentals .....	70.00
Installation of an ornamental street-lighting system in Brockton, with 75 luminous arcs of Lundin ornamental iron posts with wood shafts, involved the following costs:	
19,000 feet of No. 8 steel armored cable @ 20 cents....	\$ 3,800.00
75 posts @ \$40 .....	3,000.00
75 6.6-ampere luminous arc lamps @ \$35 .....	2,625.00
3 25-light transformers and rectifier outfits complete with switchboards @ \$830 .....	2,490.00
Labor, setting, wiring and painting poles, 75 @ \$15....	1,125.00
Trenching, laying cable, refilling and repairs to sidewalk, 75,000 ft. @ 5 cents .....	1,875.00
Contingencies .....	1,485.00
Total .....	\$16,400.00

Construction of a 13,200-volt transmission line from the Brockton substation to a proposed substation in Campello, including right of way and transformer house, cost, \$19,895.88, made up of the following items:

Right of way and substation lot, 65 by 125 ft. ....	\$ 4,670.84
Brick transformer house, stucco finish, concrete foundation, tile roof; space for six transformers .....	3,238.62
54 35-foot poles and one 40-foot pole .....	336.50
5,949 pounds No. 1 bare stranded copper wire @ 15 cents .....	893.76
Labor .....	727.72
Miscellaneous material .....	550.47
Freight .....	38.61
3,576 feet lead-covered underground cable @ 84.5c....	3,022.43
Pipe .....	106.02
Miscellaneous material .....	79.17
Labor .....	192.93
Freight .....	36.06
Substation equipment: switchboard and control, two 550-volt feeders, switchboard, 13,200-volt feeder, two 13,500-volt lightning arresters .....	1,427.00
2 50-kilovolt-ampere transformers .....	412.29
3 300-kilovolt-ampere transformers .....	2,800.00
Labor, miscellaneous material and freight .....	1,277.46
Blue prints and supervision .....	76.20
Total .....	\$19,895.88

## Here and There

### Copper Production in United States

The production of copper in the United States has increased more than twenty-five-fold since 1880. The production in 1913 was 1,652,000,000 lb., valued at \$225,500,000. The world's production of copper is approximately 2,110,000,000 lb., of which the United States produces 60 per cent., Europe 13 per cent., Canada and Mexico 8 per cent., South America and Cuba 7 per cent., and all other countries 12 per cent. In 1913 the United States consumed about 41 per cent. of the world's output of copper or about 65 per cent. of her production from native ores.

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### Electric Railway Mortality

Reports on the troubles of electric railway companies during 1915, as compiled by the *Electric Railway Journal* show that nineteen electric railways, the largest number since 1911, were sold on foreclosure. The figures for these railways as given were: total stocks outstanding \$30,508,817, total funded debt \$16,759,997, total track mileage 308.

Consideration of these figures shows a total capitalization for these unfortunate nineteen railways of \$47,268,814. Dividing this sum by 308 gives a little over \$153,400 per mile. Has this figure anything to do with the fact that these railways succumbed?

\* \* \*

### Efficient Generating Plant

The Connor's Creek plant of the Detroit Edison Company, which is one of the latest and most highly developed generating stations in the country reports that for the six months ending with November the station delivered an average of 9,000,000 kw.-hrs. per month to the transmission system at a coal consumption of 1.47 lbs. per kw.-hr. The maximum load was given as 20,000 kw., showing a monthly load factor of 66 per cent.

The coal used was from the West Virginia fields, averaging 13,606 B.t.u. per lb. and from \$2.20 to \$2.40 per short ton, f.o.b. station.

This makes fuel cost of the kilowatt-hours delivered outside the plant of from 1.6 to 1.76 mills. It would be interesting to know if this figure has ever been surpassed by any of the large producers. So far as we have observed it is a record.

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### Electrical Material Advancing in Cost

Prices of generators, motors, rotaries, transformers and other similar electrical equipment are beginning to move upward, many manufacturers having already made an advance of 10 per cent. This, from all indications, is only the initial step in greater advances to come shortly, due to increases in cost of material and labor. Those well informed expect a rise in prices of about 25 per cent. before many months have passed.

Steel is hard to get, copper has been steadily increasing in price, and labor is restive in spite of higher wages and shorter working hours. Moreover, there is a demand for better deliveries on top of depleted stocks, so that conditions are ripe for a rising market. On the other hand, manufacturers claim that for some years now the profits have not been remunerative but have dwindled away almost to the vanishing point. In view of the present high prices for all raw materials and the difficulty in obtaining them even at these prices, and considering also the demands of labor for better wages and fewer working hours and ever-threatening labor strikes, it is impossible, it is stated, to continue the old prices and still leave a profit.

There has also been an advance in wire and cable, which has been caused almost entirely by the increasing price of copper.

### Lighting Up Niagara Falls

A project to construct a great illuminating plant at Niagara to flood-light the Falls at night has been under consideration for some time. In the autumn of 1907 somewhat over a million candlepower were turned on the Falls for a few weeks, and the magnificent spectacle presented has never been forgotten.

It is now proposed to purchase the forty-eight great reflectors used in lighting of the Panama-Pacific Exposition at San Francisco and install them permanently at the Falls.

Apparatus to transform 12,000-volt alternating current to 125-volt direct-current is necessary. The projectors operate at 110-125 volts direct current and take 110 amperes each. The total power required for the installation is about six hundred kilowatts, or eight hundred horsepower. The Falls could be illuminated from one point, but the best results are secured from two stations, and hence a gorge battery and a hill battery will be erected, and houses for each will be built. The cost of the entire installation may run from seventy-five thousand dollars to one hundred thousand dollars, and the annual cost of operation and maintenance would be in the neighborhood of seven thousand dollars.

The money is to be raised through appropriations made by the cities of Niagara Falls, New York and Niagara Falls, Ontario and by private subscription.

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### The Gas Turbine

The well-known advantages of the steam turbine over the reciprocating engine of the same size; the greater simplicity, the even turning moment, the enormous saving in size, weight and cost are just as true of the gas turbine. Much ingenuity and many costly experiments have been devoted to turning out a gas turbine that would really run.

Some idea of the field that is waiting for this device may be grasped from the fact that a gas turbine should have less than one-fourth of the weight and size of a gas engine of equal power and occupy one-third of the space. Imagine the possibilities for automobiles alone in connection with electric drive transmission.

The power plant of the future self-moving vehicle, where not operated by a storage battery, will consist of a high-speed gasoline or alcohol turbine with a built-in electric generator, making a unit that can replace the battery as a motive power.

Some years ago a very simple device, brought out in Paris, consisting of a single pear-shaped combustion chamber, and a projecting pipe and nozzle that expelled the exhaust against the buckets of an encircling wheel, somewhat like a De Laval steam turbine ran at 10,000 r.p.m. with an economy in gasoline, comparable to that of the old Lenoir gas engine of the vintage of the sixties.

Now we are told that the gas turbine problem is on the eve of solution and that a machine of 1,000 hp. was built in Germany in 1914. This machine had ten combustion chambers, each equipped with entry valves for air and gas. It was complicated with auxiliary fan, air and gas pumps, but at that it would be no worse than the larger steam turbines. These auxiliaries were operated from steam produced by the turbine exhaust.

No figures were given as to the economy reached and it is said that valve troubles interfered with satisfactory operations. Efforts are being made to obtain more detailed information as to what has been done to improve it. When the war is over it is certain that some surprising advances in invention and construction are going to come to light, both in Germany and among the Allies.

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The total available water-power of the United States excluding Alaska is said to be 28 million, of which 7 million are already utilized.

It is not generally known that silver bars, if heated to 130 degrees C and kept in a strong magnetic field become permanently magnetized.

# Electrical Fathers

## Andre Marie Ampere

Andre Marie Ampere, whose name was given to the unit for measuring the strength of electric currents, was born near Lyons in France, January 22, 1775. His father was a small merchant who earned a comfortable living for his family and was highly esteemed.

Not long after his birth his parents gave up business and retired to a little place in the country. Here young Ampere grew up and soon showed evidences of a wonderfully active mind. His memory was marvellous and it is said that when he reached an advanced age he was able to quote long passages from books he had devoured when a boy of thirteen. Back in those youthful days he had set himself about reading a twenty-volume encyclopedia. Everything was grist that came to his mental mill.

As he grew into boyhood, he became more precocious, and his passion for learning was so great that his mind soon outgrew the ample family library. His continued neglect of exercise and companionship of boys of his own age soon undermined his health, and he was forced to forego his beloved studies.



He inherited a small income from his father and for some years supplemented it by giving private lessons in mathematics, physics and Latin in Lyons. One summer evening, walking in the country along a brook, he met the young lady who afterward became his wife. They were married in 1799. Before long, Ampere was appointed professor of physics at Bourg. In 1804 he became professor of mathematics in the Lyceum at Lyons. In the same year his wife died, leaving an infant son who later became distinguished as a writer.

Ampere now became more of a student than ever and in 1809 his reputation as a scientist was such that he was elected professor of mathematics at the famous Polytechnic school in Paris.

Here he wrote important papers on electricity, magnetism, light and sound and in 1814 became a member of the Institute of France—the supreme honor of French scholarship. Ampere's great work in electrical science was in showing the connection between electricity and magnetism, and inventing the electromagnetic theory of magnetism.

The brilliant discovery of another distinguished scientist was

what led him to turn his attention to this particular question. There seems no doubt that, up to this time, he thought electric and magnetic action were due to causes in no way related.

The Danish scientist, Oersted was the man who first showed that such a relation existed. An ardent student and experimenter with Volta's battery, he was, one day, lecturing to his class in Copenhagen when, by one of those inspirations that have so often caused the great discoveries of the past, he said: "Gentlemen, if there is a relation between these forces of nature, the magnetic needle should be affected by an electric current. Let us try it."

Thus saying, he took up a small compass and, when the needle had come to rest, he held a conductor above it and closed the battery circuit. Instantly the needle swung around, striving to place itself across the wire. The professor was so overjoyed that he at once gave his class a holiday. This was July 20, 1820.

By noon, the next day it was announced that an electric current passing through a wire, held above and parallel to a magnetic needle, would cause the needle to swerve east or west according to the direction of the current in the wire.

This discovery, which lies at the root of most of the telegraphic and telephonic instruments of to-day, as well as of all the electric generators and motors now doing the work of the world, reached Paris and Ampere on the 11th of September. The experiment was repeated before the Academy of Sciences.

Just seven days later, Ampere announced to the Academy a still more important discovery, namely, that "two parallel conducting wires attract each other magnetically when electric currents flow along them in the same direction and repel each other when the currents are in opposite direction."

He also announced that iron filings were attracted by a current carrying conductor just the same, as by an ordinary magnet; that a common sewing needle could be magnetized by the action of the current, and last, but not least, that the coiled or spiral form of the wire produced the strongest magnetizing force.

These basic, practical discoveries were followed up by even more important work in the realm of theory. Seizing on the facts as shown by experiment, Ampere's eager mind was not long in working out a mathematical theory of electric currents and magnetism. His papers and lectures on these subjects formed the basis on which the genius of later men built up, gradually, the electromagnet, the theory of electric induction, the generator, or dynamo, and the electric motor.

These epoch-making discoveries in the new field were hailed everywhere by the world's ever-increasing brotherhood of science, and Ampere soon came to be acknowledged as the leading light of his time in electrical work. He was honored as such by most of the scientists of Europe.

He lived for a long time to enjoy his honors. He was noted for his simplicity, his piety and broadmindedness. Kindly and genial, he was never more pleased than when he was helping young men. He was greatly beloved by all who knew him.

He was greatly interested in the struggle of the South American countries for liberty and kept open house for patriots from those countries in Paris. He died, universally regretted, in his 62nd year at Marseilles, June 10, 1836.

Ampere's experiments and theories on electric currents and their reactions and magnetic effects rendered it almost inevitable that when the International Electrical Congress in 1881 came to give a name to the unit of measurement for these currents, the kindly French philosopher was the one to be so honored. Most of the early devices for measuring electric currents and nearly all those in use to-day, were based on the magnetic effects of the current which he was among the first to discover and to attempt to explain.

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# EDITORIAL

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## Contractor and Central Station

The growing tendency toward cooperation between the central station and contractors is a good sign. It argues well, not only for the two classes of interest directly affected, but for the entire electrical industry. Lincoln said: "A house divided against itself cannot stand." While there is rarely an open breach between the lighting company and the electrical contractors in any community, nevertheless there is often to be detected a strained relation which sometimes needs but a few malicious words to fan it into expressions of grievance or hostility.

This is not as it should be. There are always persons who are willing to foster contention and strife, in the foolish hope that some benefit will redound to themselves. The central station men and the master electrical contractors who are wise have come to recognize this fact and draw closer in bonds of mutual interest.

Every industry should study the subject of the public sentiment toward itself. If a healthy regard and estimation of the industry exists in a community, that industry may well congratulate itself. If, on the other hand, a feeling is prevalent that one branch of the industry is seeking to "put it over" on another branch, or feels that the other fellow is getting the lion's share of the fruits of enterprise and toil, then one may be sure that the whole structure is not so strong and virile as it ought to be.

Sharp competition for wiring contracts, between the lighting company and the local contractors, is a fruitful source of such unpleasantnesses as we have alluded to. There may be conditions where a fair and free contest for this sort of work is justifiable. But we can appreciate that in many cases the situation is something like this: the central station is strong and aggressive; it is impatient to procure more and more lighting business; it finds the contractors unprepared, for reasons of lack of financial backing or want of initiative, to prosecute a vigorous wiring campaign. Hence the lighting company decides to actively solicit and secure the business. In doing so, it thrusts aside the contractor. He is peevish and cries out against the ruthlessness of the heartless corporation. A body of public opinion is created thereby that becomes distinctly disadvantageous to the central station.

Who, then, is the gainer in the long run? In a majority of cases, neither. The lighting company will fail to get contracts that might otherwise be procured, while the contractors gain nothing, except perhaps popular sympathy—a rather empty recompense.

The better way, pointed out by the action of many of the most progressive central-station companies, is a plan by which all contracts are executed by contractors, on standard specifications and at unit prices, with

the lighting company financing the work in cases where the customer wishes to meet the cost of the installation in partial payments.

By this plan, the traditional friction between the contractor and the lighting company will soon cease to be even a memory.

\* \* \*

## The Tungsten Gas-Filled Arc Lamp

The English have not played a very prominent part in the invention and perfection of the incandescent lamp. It is, therefore, the more notable that the latest improvement in high candlepower lighting comes from the laboratory of an English firm. Elsewhere we give a description of the lamp which shows great ingenuity in reaching complex results by simple means. It will be noted that it consists essentially of an arc between tungsten and carbon electrodes in a nitrogen bulb. The tungsten is in the form of a small ball and the carbon, mixed to a certain extent with rare earths in order to increase its ionizing power, is in the form of a thick filament.

The striking feature of the lamp is that the electrodes do not have to be brought into contact to start the arc. The warming up of the filament causes it to give forth enough of ions to render the space between it and the tungsten ball sufficiently conducting to carry the current. Nearly all the light comes from the tungsten ball, as the carbon is hardly heated to more than a dull red at any point.

The practical interest of the lamp is that it shows an efficiency of half a watt to the candlepower, and, at over-voltages even less than .4 of a watt. It does not heat as much as the nitrogen-filled lamp of the same candlepower and operates in a smaller bulb. The lengthening of the useful life, which as yet is not much over 500 hours, will doubtless come with increased refinement of construction. The fact that, although the lamp is already operating on alternating as well as direct-current circuits, it is only intended for the present to exploit it commercially for direct-current work, indicates that there is still a good deal to be done to perfect it.

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## Stability of Electric Lighting and Power Investments

The movement among the large lighting and power companies to encourage the purchase of their stocks by their employes and customers is as salutary for the latter as for the former. The fact is that there are few classes of investments that are comparable to electric light and power for stable and constantly growing earnings.

There's a reason. One of the country's captains of industry recently remarked, "As great rivers have affected population or railroad trunk lines have marked out the courses of industrial growth, so is the seaming of the country with distribution lines of electrical energy for the spread of cheap power, affecting our future growth."

This is strictly true. Everywhere the spread of electric power and light has reached into the homes and roots of community life, with the resultant stimulation of business prosperity and comfort. In brief, it has become essential to the civilization of to-day. Its use, and consequently, the earnings of the electric companies supplying it, are based on the actual necessities of the people.

If electric service were cut off in one of our great centers, the very pulse of industrial life would stop. Social and economic activity and development would be at a standstill. The service given is of such a nature that it has become vital. It is paid for before almost any other commodity. It is said that the average citizen of to-day spends more money for his electric services than for his daily bread, and these are paid for monthly. They are paid in advance of almost any others.

All this penetration of electric service into the foundations of living is the underlying cause of the surprising steadiness of the electric utilities as money earners—in the light and power business. This is easily proven by statistics. Such statistics, sometimes worked up in the form of curves, are constantly being published by those who are interested in marketing electric securities. The records show that next to banking, electric light and power form one of the soundest and strongest investments. It and the banking industry are almost the only ones that have not shown a single year of decrease in the last thirty years, which practically covers the life of all light and power companies in existence.

Panic years merely check the growth—never turn it into a decline. Where earnings from railroads, mines, industrial and even electric railways show a positive decrease over previous years, electric light and power properties merely show lessened excess earnings.

Measured by proportions of investment in the hands of receivers former figures have shown that for every \$100 in securities outstanding, the amounts in receivership are:

National banks .....	\$0.32
Electric light and power properties.....	0.37
Railroads .....	1.87
Industrials .....	2.04

Late figures would undoubtedly show an increase in the proportionate safety of the electric utilities:

Put another way: Last year the earnings of the four classes showed:

Banking increase .....	6.2%
Electric light and power properties increase	4.9%
Railroads decrease .....	4.6%
Industrials decrease .....	18.9%
Why?	

There are many reasons. These companies have not been so subject to labor troubles as have railroads,

traction companies and industrials, for they are not large users of labor and what labor they do use is generally high class. They escape injurious Federal legislation and governmental attack for, as a rule, they are not interested concerns. They have the protection and regulation of the Public Service Commission, which now exists in forty-five States. This regulation is usually used for the best interests of the investor as well as the public.

Thirty years ago \$50,000,000 represented the investment in electric; to-day electric power companies are using over \$6,000,000,000 of the public's money. This phenomenal growth has been so rapid that their securities have had but little opportunity to become entrenched in the public's favor. The demand of \$6,000,000,000 by a single industry, the largest portion being called for during the last ten years, is without precedent. There is nothing philanthropical about the high rates of interest these electrical utilities pay. It's a matter of supply and demand. However, these conditions are rapidly changing, but while they last it is the investor's opportunity.

If it is true that the ability of any corporation to pay its obligations or obtain further credit is generally based upon earning power at the time its obligations become due, then electrical utility companies are in an enviable position, as their earnings depend upon the lives of the population; while the earning power of a railroad or industrial depends upon current and general prosperity. Cities will still have to be lighted and electricity used, no matter what the future holds for railroads, individuals or the private business of individuals. This is a point which seems to have been given but slight attention by the investing public, and surely the record of some of our railroads and industrials makes it obvious the point is one well taken.

From records, extending now over the best part of a life time, the electric utilities are shown to present a maximum of yield with a minimum of investment risk. While, like all other human concerns, they are dependent upon honest and skillful management, they do seem to offer about the most desirable characteristics as a class of any line and, therefore, we believe, the public as well as the companies are well benefited in the improvement for local ownership of the securities. It is a wise idea. More power to it.

\* \* \*

### Factors in Rate Making

The efforts to put the retailing of electrical energy on a strictly fair and logical basis are evidenced by the close study of all the factors that enter into the fixing of rates. Of all classes of load the residence class is one of the most vitally concerned in the just solution of this much discussed question.

On another page we give the result of a systematic effort to determine from actual observation, the demand and diversity factors in the case of both residence and general commercial loads. The effort to establish a rate for electrical power completely adjusted to diversity will never be successful. The problem is very similar to the familiar one of freight rates and will tend to come finally to the same solution.

# All Around The World

*Electrical Flashes From Beyond Our Horizon*

## 10,000-volt Direct Current Generator

The Imperial Technical Laboratory of Germany has constructed a 10,000-volt direct-current generator for experimental work. It consists of two double-commutator machines so that there are four commutators, each of 2,500 volts. The voltage between bars is no higher than usual, there being 212 bars to the commutator. The greatest difficulty was found in insulating the armature windings from the iron. By the use of the best materials, using mica for a base, a sufficiently good insulation was finally obtained. The single coils were tested to 22,000 volts and the finished armature to 20,000 volts alternating. The commutation proved to be sparkless up to 50 per cent. overload.

\* \* \*

## International Electrical Power Transmission

A cable has lately been laid under the Skagerack to transmit electric power from Helsingborg in Sweden to Elsinore in Denmark, a distance of about ten miles. This power comes from water falls in southern Sweden and it is expected shortly to transmit 5,000 horsepower.

\* \* \*

## Norwegian Water Power Development

Plans for the erection of a 27,000-horsepower hydraulic electric plant at the Saude Falls in Norway are about completed. Later it is expected to install three other plants lower down on the same river, which comprise two of 12,000 horsepower and one of 45,000 horsepower, making a total development of 96,000 horsepower on this one stream. Most of this is to be used in the manufacture of nitrates.

\* \* \*

## Cheap Chinese Power

When steam power is used in China, along the seaboard, coal can be purchased from Japanese or Chinese mines at prices from \$2.50 to \$3.50 a ton at the factory. In the city of Shanghai, electric power generated by the municipal plant is sold for manufacturing purposes at a charge of  $\frac{1}{3}$  to  $\frac{1}{2}$  cent per kilowatt-hour. When hand power is used in manufacturing, wages per day of twelve hours run from 10 to 12 cents; with children at 5 and 6 cents a day; and there are no restrictive laws in reference to hours of employment or employment of children.

\* \* \*

## Largest European Storage Battery

What is said to be the largest storage battery in Europe has lately been installed in the Dickenson St. station of the Manchester (England) corporation's power system. This battery, which comprises 210 cells, weighs 630 tons, has voltage of from 400 to 450, and is rated at 11,000 amperes, when discharged in three hours. The five-minute discharge rating is 15,000 amperes.

\* \* \*

## Electric Service Under Difficulties

Due to an unprecedentedly dry autumn in Norway the lack of the usual amount of water-generated electric power has caused much difficulty in maintaining anything like a normal service. Following are some of the drastic restrictions in the use of electricity approved by the city council of a town lying far up on the 59th parallel which has only about seven hours of day light in mid-winter:

- (1) The use of electric light from 8:30 a. m. to 4 p. m. is forbidden.
- (2) The use of electric light for advertising or window display is forbidden.
- (3) From midnight Saturday to 4 p. m. Sunday no elec-

tric light shall be used, except at church, hospital, railway station and dock.

- (4) Only bad lighting can be expected from 6 to 12 p. m.

\* \* \*

## The Progress of Electrical Manufacturing in Japan

Our watchful government through one of its commerce reports gives some enlightening information as to the present state of the manufacture of electrical machinery and supplies in the Island Empire:

"The electrical supplies industry in Japan has grown to a remarkable extent in the 25 years of its existence, and the country is no longer dependent upon foreign countries to supply its needs.

"Efficient moderate size motors and generators up to 100 horsepower are manufactured at moderate prices. The small sizes of motors up to 10 horsepower are made in large quantities, and comparatively cheap, and the export prices would compare favorably with those of European factories. Transformers are turned out at low prices and of good efficiency, but the iron sheets are in nearly all instances imported.

"In electrical conductors, Japan is in a position to compete with the United States and Europe in quality and price as it is a large producer of copper and silk, and its spinning and textile industries are well developed. Japan also has the advantage of cheap water power and labor.

### CABLES, SWITCHES AND METALLIC FILAMENT LAMPS

"With the exception of submarine telegraph cable the former large import of insulated conductors has entirely ceased. All classes of electric lighting and power cables, rubber and paper insulated for high or low tension, are made to any specification; flexible silk cords, all types of telephone cable, military and naval cables, are well made in large quantities in well laid-out factories and under expert and scientific supervision. Porcelain insulators and porcelain ware and glassware for all purposes are largely exported. Brass work, switches, lamp holders, and cutouts, although perhaps not quite as good as the best European fashion, are at low prices and good.

Metallic filament lamps are made in large quantities, but practically all the producing factories are controlled by a monopoly which controls the export trade. This may be overcome in the near future, as lamps made under other patents are reported to be shortly coming into the market.

### OTHER ELECTRICAL ACCESSORIES

"Switchboards, instruments, and meters are still imported where high-class work is required, but for ordinary use the Japanese-made article meets the requirements at half the price of the imported goods. The same may be said about laboratory testing instruments and telegraph instruments, the native-made articles improving all the time and the imported goods being gradually superseded.

"In telephones Japan is not only self-supporting, but is doing a considerable export trade to its near neighbors.

"All the various electrical accessories are now being manufactured by small Japanese factories. Electric fans, torches, bells, batteries, devices of every kind as used in Europe and America are obtainable at prices often lower than they can be produced in Western countries.

"The prospects for the electrical manufacturing industries in Japan are good, but the foreign buyers must bear in mind that the reputation of the Japanese manufacturer is not yet established, and that, therefore, it would be best for them to carry on their business through reliable agents only. Japanese in the electrical industrial trade are not as yet acquainted with the export trade and have no catalogues of their manufactures."

We suggest that the American manufacturer should not place any too great reliance on the state of affairs outlined in the last sentence continuing for any great length of time.

### Profit Sharing by Insurance

One of the largest motor manufacturers in the country has devised the following useful method of sharing prosperity with its employees. At the close of the year each one received the following announcement:

"The officials of your company desire to show in a substantial way, their appreciation of the services rendered by all who have been connected with the company during the year.

It was felt that the one thing the company could do which would insure the most lasting benefit, would be to make some provision for the future of the families of its employees. Accordingly, a life insurance policy has been taken out by the company for every employee.

This policy is paid for by the company and all annual premiums will also be paid by the company as long as the employee is connected with The Robbins & Myers Company.

The amount of the policy increases with the length of time of your service as follows:

One year or less .....	\$500.00
One year and under two .....	600.00
Two years and under three....	700.00
Three years and under four....	800.00
Four years and under five.....	900.00
Five years and over.....	1,000.00

As soon as each employee's service brings him from one class into another, as per the schedule above, his insurance is increased automatically.

It is understood of course, that in case an employee leaves the company at any time, the policy is canceled.

The policy takes effect Christmas day, and your certificate will be delivered to you on January 1st.

This protection is extended you by The Robbins & Meyers Company with Company Officials' best wishes for a Very Merry Christmas."

A similar method of profit sharing has been adopted by the Nevada-California Powder Co. which took out a policy of \$1,000 for each employee, and also established a fund for sick and accident benefits in cases not arising out of the nature of their employment.

This means that the benefits to be had from the use of this fund are entirely separate from the benefits conferred by the Nevada Industrial Insurance act and by the Workingmen's Safety and Insurance act of California. The amount of this benefit is limited in each case to \$250.

These plans for increasing the comfort, safety and wellbeing of their employees are well worthy of careful consideration by many other companies.

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### Sharing Prosperity

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., recently mailed checks to its office employees whose salaries were cut a year ago owing to adverse business conditions. About 1,000 men received checks which were for sums equivalent to the wages lost as a result of the cut. In a letter accompanying each check President Otto Falk said: "In the early part of this year business conditions with our company were so unsatisfactory that a reduction was made in your salary. The improvement has been such that it has been decided to reimburse this reduction to our present employees."

\* \* \*

### A 15,000 Horsepower Motor

The new addition to the steel plant of the Inland Steel Company at Indiana Harbor, Ind., which is now in course of erection will have electric drive throughout, including the main rolls, and the electric equipment will include many new features. The new part will comprise open-hearth furnaces, blooming and finishing mills.

The motor for the 40-inch reversing blooming mill will be a direct-current machine rated at 15,000 horsepower and receiving

its power from the generator of a fly-wheel motor-generator set. The control of the motor will be through the voltage of the generator supplying it.

The structural mill consists of one 32-inch reversing roughing mill, and one 28-inch finishing mill of three three-high rolls. Each mill is driven by an 8,000-horsepower direct-connected, direct-current motor and the scheme of control is the same as mentioned for the blooming mill. One flywheel motor-generator set with a generator unit for each motor supplies the power for the mills and by a special system of control and design of apparatus, the power taken from the line is equalized to practically a constant load with variations of not more than 10 per cent. plus or minus, although the load on the mill motors will vary from several thousand horsepower in the opposite direction several times a minute.

Energy for the auxiliaries, most of which are direct-current drive, is to be supplied from the two 1,000-kilowatt synchronous motor-generator sets.

The electrical equipment for this mill is one of the largest ever laid out and will cost close to \$1,000,000. It is being supplied by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

\* \* \*

### Horsepower-Year per Ton of Coal

In certain parts of the world, favored with high-head water-power and cheap skilled labor, water generated electric power is so cheap that it is being contracted for in large quantities at as low as \$5 per horse-power-year. It is interesting to note that the amount of energy in a single short ton of coal of 11,470 British thermal units per pound is just one horse-power-year. If, therefore, we could use the energy in one ton of coal under conditions of 100 per cent. efficiency we could run a one horse-power engine a full year with it. What a field for improvement!

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### Legal Notes

The enactment of Industrial Employees Compensation Laws in eight more States is reported for the past year.

The Bureau of Labor Statistics in a bulletin covering labor laws for the past two years shows that Colorado, Indiana, Maine, Montana, Oklahoma, Pennsylvania, Vermont and Wyoming, besides the Territories of Alaska and Hawaii. The legislation of 1914 included a presidential order providing a compensation system for employees of the Panama Canal and the Panama Railroad, while that of the current year includes a similar order extending the federal compensation act of 1908 to workmen engaged on or about the government railway in Alaska. With the legislation of these two years, thirty-one States and the Territories of Alaska and Hawaii now have compensation laws. A federal statute covers also about one-fourth of the civilian employees of the United States. All of this legislation has been enacted since 1908, and practically all of the existing legislation in the States since 1910.

Of the new laws of 1914 and 1915, one, that of Wyoming, must be classed as a compulsory insurance law, while those of Maryland and Oklahoma are compulsory compensation laws. In other States, eight in number, the law permits the employer to elect or reject the compensation act. In case he rejects it, however, he is deprived of the customary defenses under the liability laws.

\* \* \*

The Pennsylvania Public Service Commission has refused to reopen an order denying a charter to the South Lebanon Electric Company, thus establishing a precedent for public service corporations in the State. The commission, according to the order, cannot limit corporate powers as suggested by the attorneys for the company; neither will it grant charter rights where the community is already being adequately served by an existing company. This decision is in line with the well-established principle that useless competition should not be permitted to set up where the public service is under State regulation.



# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## Home-Made Testing Outfit for Small Central Stations

By G. B. McNair

Nearly all the larger central stations of this country maintain testing departments of their own in which all the apparatus and some of the material purchased by the company is tested before being accepted. Also comparison tests are made to determine which of the several articles of the same kind shows the best performance characteristics.

Due to this, the central stations naturally divide into three classes, as seen by the manufacturer; viz., (A) those that have completely equipped testing departments, and test all apparatus; (B) those that make occasional tests, and (C) those that make no tests. Under such circumstances, it is obvious that those in class A will always be given apparatus up to guarantee, or better; those in class B, apparatus which is not quite good enough for A; and class C—what is left.

Take the case of pole type transformers. There is no piece of electrical apparatus over which there has been so much fighting for a reduction of losses, and very justly so, although some people are disposed to magnify the importance of low losses, even to the extent of sacrificing equally desirable characteristics. In the case of the 15 kva. size, the core loss is usually about 43 watts. The manufacturers guarantee usually is that the average core loss of a lot of transformers of this, or any other, size will not depart more than a certain percent from that specified. Due to manufacturing conditions, there will be numerous transformers come through which will have 44, 46, or even 48 watts core loss. Also there will be some which will have 41 or 42 watts. These latter will naturally be fewer because 43 watts represents about the best that can be done, on the average, with the silicon steel now in use, without at the same time increasing the copper loss. Special low loss transformers can be built but usually not without unduly increasing the cost, so that they could not be sold at our present prices.

In the natural course of events, then, the 42, 43, and 44 watt transformers would be shipped to class A, the 46 watt to class B, and the rest to class C. The copper loss of all these transformers would be nearly the same so the grading would be done mostly on a core loss basis.

The small station, however, cannot maintain an extensive testing department. It is possible, however, to rig up apparatus for a few simple tests which will not involve great expense, and will always enable the central station manager to make a test when he wants to, thereby putting him in class B.

As has been said, the core loss is what he wants to know most. For this, he needs (a) a 0-150 voltmeter, (b) a 0-300 wattmeter, having a 3 amp. current coil, and a 130 volt pressure coil, (c) a slip ring induction motor, preferably two phase. This may be any size over 3 HP, and wound for any voltage, though 220 is preferable. The motor is used as an induction regulator, and its usefulness as a motor is in no way impaired, though, of course, it cannot be used for both purposes at once. Fit a paper pulley to the motor shaft, and nail a board on this for a handle to

permit rotating the armature through 180 degrees. Connect the apparatus as shown in Fig. 1, and you have a source of variable voltage permitting very exact adjustment. If a two-phase motor is used the other phase should be shortcircuited, as this neutralizes the cross magnetizing armature ampere turns and makes the voltage regulation better. However, a three-phase motor will do nearly as well.

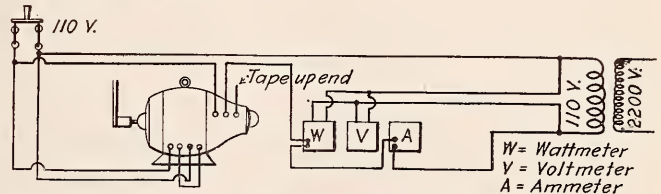


Fig. 1—Arrangement of apparatus for core loss test

The combined loss in the pressure coils of the voltmeter and wattmeter must be determined for the voltage at which measurements are to be made. This can most easily be done by removing the transformer from the leads leaving the pressure wires attached to the current leads. The voltage is then adjusted by turning the motor till the desired pressure is obtained, and the combined loss read off on the wattmeter. Also it can be calculated where the resistance of the two pressure coils are known by the following:

$$W_t = \frac{E^2}{R_v} + \frac{E^2}{R_w}$$

where  $W_t$  is the total pressure coil loss, and  $E$  the voltage impressed,  $R_v$  and  $R_w$  are the two resistances.

This value of  $W_t$  must always be subtracted from the reading on a transformer. Also note that  $W_t$  is different for every value of voltage. However, once measured for, say, 110 volts, no further measurement is necessary at that voltage.

If it is desired to check the copper loss with these same instruments, short circuit the secondary, and attach leads to primary.

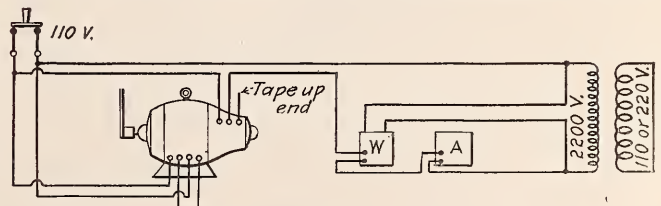


Fig. 2—Arrangement for copper loss test

Adjust voltage till current equals  $\frac{K.V.A.}{E_1}$  where  $E_1$  is the line voltage used, usually 2200 volts. This necessitates the use of an

ammeter of appropriate range which is not needed for the core loss test. (See Fig. 2.)

The copper loss, by this method, will be higher than that given by the manufacturer because he figures it from  $I^2R$ , where R is the ohmic resistance measured with direct current.

It is often convenient to have some source of fairly high voltage for testing transformers. Such a test might be desired on a transformer suspected of being broken down. This may easily be accomplished as shown below:

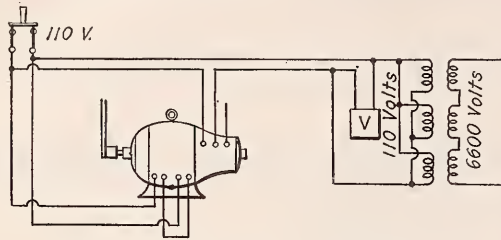


Fig. 3—Arrangement for insulation test

The diagram represents three potential transformers with their secondaries connected in parallel, and their primaries in series. The test voltage would then be approximately 60 times that read on the voltmeter.

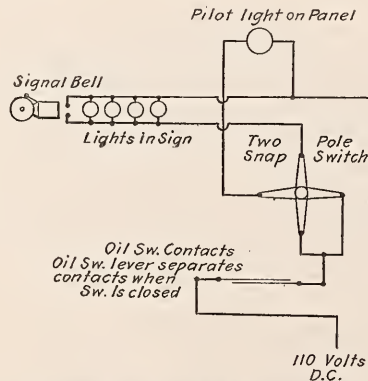
This arrangement may also be used to test the insulation of station wiring of small extent. It is not satisfactory for accurate work in cable or long feeder testing, on account of the condenser effect which tends to produce a leading current, and an attendant rise in voltage.

All these pieces of apparatus, except the meters, are such as might already be owned by the central station, but temporarily not in use.



### Trouble Indicator for Substations

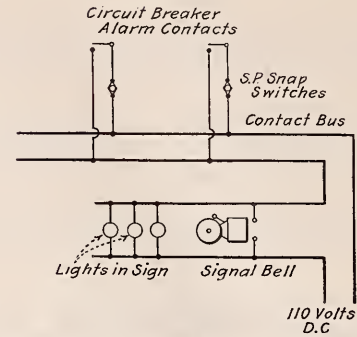
Not so very long ago the substation operator had to rely on his power of hearing allied with careful watching to detect any interruption to the service as in the case of an oil switch or breaker tripping out. The first real aid to the operator came with the introduction of alarm bells and this scheme is now quite prevalent in substations. As equipment was added, additional bells were used until the time was reached when the bells served more to confuse than to help. These bells were inaudible in some portions of the station due to noisy apparatus and the trouble could not always be easily located. To give further help to the operator especially with the idea of eliminating confusion, a signal system has found use in several companies.



Scheme for use with oil switch

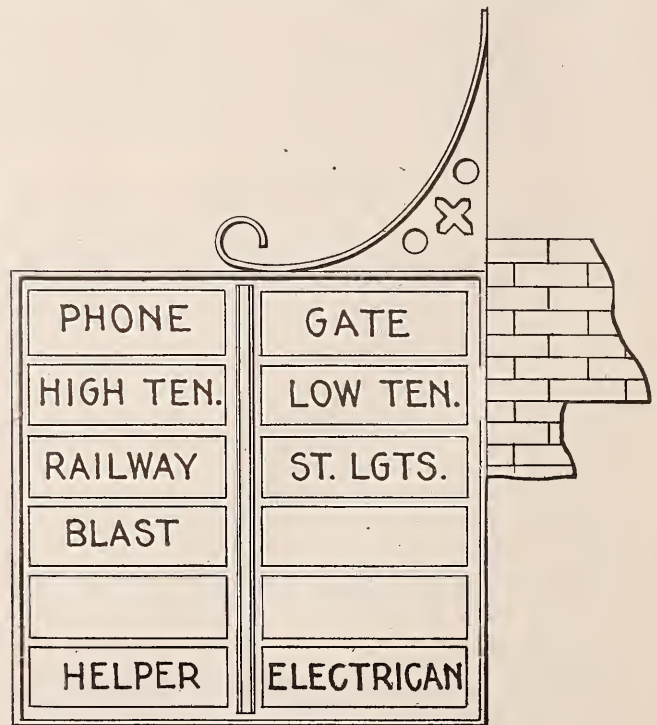
This system consists of a signal or indicator board which may be placed midway and above the switchboard so as to be visible from all parts of the station. The board is divided into sections each bearing a legend and lighted by the closing of contacts on the apparatus which causes the trouble. For instance, if a line from a power station trips out, the compartment labelled "high tension" lights up. If a breaker trips out "railway" or "commercial power" will light up. Now if trouble

occurs, the operator does not have to rely on being able to distinguish the sound of a particular bell, but merely glances



Scheme for use with circuit-breaker

up at the indicator and instantly is aware of the location of the trouble. A number of bells may be placed about the station so as to insure attracting attention. The board has other uses as for instance the calling of the operator and electrician in large substations. In substations where air blast transformers are used, in place of depending on the waving of flags and like signals as indicators of the air blast being on, an air pressure relay may be used so arranged as to light the indicator and ring the bell if the blowers should inadvertently stop. This would also happen if the operator neglected to start the blowers. Other uses may be devised as the service demands.



Arrangement of indicator

The current is supplied from the storage battery which also supplies the control system. The general scheme is shown in the illustrations. Where several pieces of control apparatus are used relays may be introduced to ring the bells and light up the indicator. Snap switches are provided on the panels so that the device can be cut out of service as the need arises. These switches are also a great boon to the short operator who has to run for his little stool every time a circuit breaker alarm button has to be reset.

The system may be elaborated by the introduction of a pilot light over each switch which lights when that particular switch opens and which greatly help to determine the faulty feeder.

Henry A. Cozzens, Jr.

## Motor-Generator or Rectifier?

The electric vehicle is fast entering into all walks of life, commercial, professional and social. The electric vehicle is very advantageous from the view point of the central station company because the charging of them constitutes a steady load, which may be supplied during the off-peak period where desired, thus enabling the greatest advantage to be obtained from the investment in copper, electrical machinery, etc. From the users' point of view the electric vehicle is for many purposes superior to the gasoline propelled vehicle, not to mention the horse drawn vehicle, because it costs less and requires less skilled attention for operation and maintenance, and the insurance rates and the depreciation are lower.

There are various ways in which electric vehicles are cared for, sometimes completely by the owner himself, sometimes the owner charging his batteries and merely sending the car out for periodic inspection and overhauling. There are many advantages in charging the batteries oneself, sending the car out for overhauling at definite intervals. Electric vehicles are now in use from the small electric brougham or the delivery wagon of a few hundred pounds to the wagons of several tons and the teams of a hundred wagons and more of some of the large departmental stores. The large user will in all cases have a garage and a staff of cleaners and repair men; but on the other hand the owner of a single car will not have all the space and facilities at his disposal that the owner of many cars has, and here the greatest economy in charging and maintenance must be practiced if the full benefits of the electric vehicle are to materialize. Concerning this matter of charging, one of the questions most frequently asked of the sales engineer or the contract manager is, "What sort of charging outfit shall I install, a mercury arc rectifier or a motor generator set?" This question does not permit of a definite answer covering the whole question in general, but on the other hand the question may be divided into two or three classes and each answered independently.

In the large garage cars come and go all the time, although the chief charging period is during the night hours. There are usually one or two cars on charge during the day. In this case a motor-generator, (a rotary converter may be preferable where the class of labor permits because it is more efficient, costs less and occupies less floor space) is indicated for the majority of the charging. Mercury arc rectifiers are not as yet built in sizes large enough to care for such loads, and the large number

of rectifiers that would be necessary would complicate matters as well as being expensive in first cost. The labor cost would also in all probability be high for their attendance. It is, however, most desirable to have one or two rectifiers available in addition to the motor-generator set or rotary converter because they can be used at all times when the load is too light to warrant the use of the motor-generator, or during the peak load period.

In the small garage of one or two cars the use of the mercury arc rectifier is indicated. It operates at high efficiency at partial loads, it is cheaper in first cost than the motor-generator, requires less floor space and less attention, there are no moving parts and no noise. If fitted with an automatic starting device, practically all rectifiers are now so fitted, the rectifier can be left charging during the night with the assurance that should anything happen to the supply, on its coming on again the rectifier will continue to charge.

In the not distant past the rectifier was not regarded with great favor either by the average owner of the small electric vehicle or by the men who had to do with charging batteries in the large private or public garages. There was something unfamiliar and unsubstantial about it and its mode of operating which they regarded as unpractical. The preference was unquestionably for the motor-generator. It was much better known and when anything went wrong with it was more or less easy to repair. When the rectifier refused to work it was regarded as hopeless. All this is now changed by the improvements made.

The mercury arc rectifier requires practically no attention, whereas on the other hand the motor-generator or converter should have attention available lest it should be needed; and in any case the motor-generator will have to have its field regulated from time to time during the charge as the internal resistance of the battery changes with increasing charge. Where the charging load is a rapidly increasing one it may be advisable to install mercury arc rectifiers at first until the load assumes such proportion as to warrant the installation of a motor generator set. The dividing line between rectifiers and motor generator sets is not exactly a definite one because more than one factor enters into the case, but roughly speaking it may be said to be somewhere between 100 and 200 amperes according to circumstance, the cost of energy, the total energy consumption, and load factor.

\* \* \*

## How to Remedy Low-Voltage Generator Troubles

THERE ARE several causes for the sparking of a low-voltage generator, which apparently show the same symptoms.

First the brushes may not be composed of proper material. The low-voltage machine usually requires a soft carbon, graphite, or metal brush, or a combination of carbon and metal gauze with good pigtailed if the brush-holder is of the box type, one allowing the brush to slip in the holder not clamped.

The machine may be over-loaded and certainly is if the ammeter reading is in excess of the name plate capacity. The generator may have high mica, that is, mica extending above the commutator bars, allowing the brushes to chatter and make inadequate contact with the commutator for the current supply. The armature may have an open coil, however this is usually shown locally upon the commutator causing the pitting and blackening to be of a greater extent at the commutator where the coil leads enter than elsewhere. In a lap-wound armature one pronounced burnt spot, and in a wave-wound armature two burnt spots evenly spaced around the armature indicate an open coil.

Should the generator be driven by belt with heavy lace in belt and generator bearings be considerably worn, the hammering of belt lace will cause sparking. This can be timed by the hammer of the belt lacing. To correct these faults when high resistance brushes without pigtailed are used, replace them with low resistance brushes and be sure to have the correct brush size. If the machine is over loaded, reduce the load; if an open coil develops in the armature, repair it; if high mica or flat bar, turn commutator true in a lathe, but if a lathe is not convenient, take a piece of old grindstone and hold it firmly upon the commutator until it is thoroughly cleaned and all burnt places ground out of the commutator. Then smoothen up with medium fine sand paper. If the brushes are not self-lubricating, use a good grade of commutator compound to lubricate the commutator but do not use oil or grease. Paraffine would do for this purpose on machines of 250 volts or above, but do not trust it upon low voltage machines. Examine the belt, if one is used, to decide if repairs are required.—A. L. Gear.

## Constructing a Home-Made, Low Voltage Transformer

A secondary voltage transformer, by which we mean a transformer for further reducing the ordinary secondary voltages, is a very convenient device to have around a shop as there are a number of practical uses to which it can be put.

Following is the design of such a transformer which was originally intended to furnish current for operating a small single-phase rotary converter for charging six-volt storage batteries. After it was built, however, so many other uses were found for it that the one for which it was designed represented but a small portion of its useful service.

One of the most important conditions in design is to see that the transformer should be of such a high reactance as to enable it to stand a good deal of short circuiting in the secondary without harm to itself or without blowing the fuses in the primary circuit. To do this, besides a liberal amount of reactance, there should be plenty of iron and copper allowed on the primary coils.

To meet these conditions a core made of the laminated ring-shaped stampings from the armature of an old direct-current motor, after the teeth had been trimmed off, was found satisfactory. The dimensions were approximately, outside diameter 9 inches; inside diameter  $5\frac{3}{4}$  inches; built up to a thickness of 1 inch. This makes a cross section of  $1\frac{5}{8}$  square inches.

The laminations were clamped in a vice and covered first with a layer of  $\frac{3}{4}$ -inch white linen tape, then painted with an air drying insulating varnish, then a layer of 10 mil varnished cambric tape, lapped half, and finally a layer of webbing and another coat of paint.

A liberal design being desired, a saturation of 70,000 lines of force per square inch was decided on. This iron will stand a higher saturation with corresponding less turns of wire. However the higher rate of saturation would require more magnetizing current which would heat the winding more, also the iron would heat more.

The primary winding was calculated for 140 volts, frequency 40 cycles from the formula

$$V = \frac{4.44 \text{ A.B.n.f.}}{10^8} \text{ in which}$$

V=voltage, A=cross section of closed magnetic circuit in sq. in. of iron, B=induction in lines of force per sq. in., n=no. of turns, f=cycles per second.

Substitution gives the equation

$$140 = \frac{4.44 \times 1\frac{5}{8} \times 70,000 \times n \times 40}{100,000,000}$$

Solving this equation,  $n=700$ .

Seven hundred turns are then required for primary, or five turns per volt. This formula is a general one applicable to any form of alternating current apparatus.

Using a table of magnet wire which may be found in any electrical hand-book, it was found that No. 12 double-cotton

covered magnet wire would require about two and one half layers to make 700 turns and would have ample capacity. The same number of turns of smaller wire could be used but the original intention was toward a liberal design and No. 12 was therefore selected.

On account of the outside circumference being longer than the inside, in order to make a smooth job, it was found necessary to wind on eight turns and then skip a space of about  $\frac{3}{8}$  inch on the outside (see Fig. 1). This space was filled in when the next layer was wound on. Between layers a wrapping of  $\frac{3}{4}$  inch linen tape was put on and over the finished primary winding was wrapped two layers of  $\frac{3}{4}$  inch linen and one layer of webbing, lapped half.

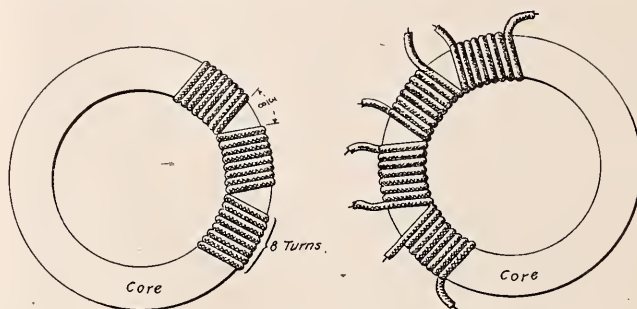


Fig. 1—Primary Winding

Fig. 2—Secondary Winding

To secure high reactance and thus ability to stand short circuits a large amount of magnetic leakage at full load was desirable. This was secured by winding the secondary on only one-half the core as Fig. 2. Forty turns of No. 4 double-cotton covered magnet wire were used for the secondary, wound in four sections of ten turns per section giving a range of voltage of two to eight on open circuit and a current output of 60 amperes per section on short circuit or 240 amperes with the four sections in parallel. Voltage on short circuit is practically nothing, rising as the current decreases until on open circuit the full voltage of 2 volts per section is obtained.

This transformer has been used for a new purpose nearly every day. Its greatest use is to furnish current for testing armatures and for soldering. By connecting the four secondary circuits in parallel it will furnish current to solder a joint in a No. 4 B. & S. wire, doing a much better job than a soldering copper besides being a much more convenient tool. With a pair of leads of No. 2 flexible wire and two terminals of number 4-0 copper, a joint is easily and quickly heated simply by placing one terminal on each end of the joint.

This transformer draws about four amperes at 130 volts with the secondary short circuited. The current and heating on no load are very small, a temperature rise of only about 25 degrees Fahr., being apparent after it has been connected in circuit several hours.

## Why the Motor Sparked

PROPERLY proportioned interpoles will prevent sparking throughout a wide range of load. If a motor, for example, is perfectly regular in the matters of field polarity, air gap equalization, commutator condition, brush-set, brushholder position, tension of brush springs and of shunt field condition, and still the motor sparks, then it is in order to investigate the interpole windings.

Usually there are as many interpoles as there are main poles but among the more modern motors are those with only one half as many interpoles as main poles. This arrangement simplifies construction and reduces costs without sacrificing any desirable features of design.

An inspector was called to locate the cause of the sparking

of a 4-pole shunt wound motor that had but two interpoles. All connections were found to be correct and all commutator and brush conditions seemed to be normal. The sparking seemed to be confined to the brushes of one stud and any brush shift that would improve their operation, would impair that of the brushes of some other stud. A water resistance was connected in place of the armature and the starting box was turned full "on." By gradually adding salt to the water the current was increased to almost half rated load. By means of the 15-volt scale of a 150-volt meter, the "drop" on one interpole coil was found to be twice that on the other.

The substituting of a new interpole coil for the defective one, eliminated all sparking.

# What One Live Electrician Did

By H. W. Fegley



Who is he?

This is a short story of the work of a wide-awake electrician, to whom a certain Pennsylvania city, of considerably more than 100,000 population, is greatly indebted for a number of valuable ideas and improvements such as but rarely come to the credit of one man. We present his picture herewith. Do you know him?

This electrician started in on his work at the city's sewage disposal plant. After two months of experimenting, a segregator to separate the solids from the liquids was introduced.

The solids were dried so they could be burned without creating stench, deadening the fires or injuring the furnace.

A new sprinkler nozzle was added and the devices introduced were approved by the State Board of Health and sanitary experts, and this work paved the way for the inventor of these improvements to become the head of the city's electrical department.

Under his administration, the electrical department paid minute attention to the fire houses and all indicators and boxes were timed alike, so that all fire-alarm boxes recorded correctly when pulled. The city furnished new wire and the department removed all the old bare wire, sold the same, and with the proceeds renewed the system with insulated wire.

Whenever citizens wished to sound an alarm, especially at night, they had trouble to locate the keys. In one instance great damage was done by fire before a policeman could locate the key. The chief turned his attention to this delay and also to false alarms. To-day this city uses what are known as "key-holders' boxes," placed alongside the regular alarm box, with the key to the latter hanging on a hook behind glass. To sound the alarm, the glass must be broken, key taken from the hook to open the alarm box and strike the alarm. Thus, anybody can sound an alarm.

When the key is removed it starts a six-inch rotary gong, which rings a minute, and so loud that the sound is heard several hundred yards distant. It also causes the sending of seven rounds of the box number to be struck over the police lines to the city hall. This is registered on the tape of the police telegraph instrument. Immediately a patrolman on a motorcycle makes a run to the box in question. If the fire-alarm circuit is out of order, the alarm can come over the police lines. Since this system has been introduced, the city has had no false alarms.

The next thing was the abolition of the city auxiliary fire-alarm system. This system was attended to by private parties, or more often not attended to. Wires were frequently cut outside of buildings and consequently would be out of order when needed. Straight boxes were introduced and the trouble ended. Non-interfering boxes were also substituted for the old interfering boxes and no further mix-ups were caused when two or more boxes were pulled.

After a horse belonging to the fire companies was killed, incurring a loss of \$500, the automatic lighting system was changed and an entirely new system of stable-door releases installed in every fire-house where horses were used.

Every fire-house in the city has to-day automatic electric lighters and there is no need of burning gas all the time as a pilot light to light up the main burner when an engine passes out. Now-a-days, when the engine passes out, an electric spark ignites the gas and the large flame from the jet lights the shavings under the boilers. After the engine has passed, the flame is automatically extinguished and remains out until the engine passes again.

The chief electrician next designed a new lightning arrester

which is now in use on all the fire and police lines in the city. Since this was installed there have been no blow-outs of fuses, nor injuries to boxes and instruments during lightning storms. It has saved the city hundreds of dollars and it requires a phenomenal storm or discharge of high-tension current to injure this device.

There are large railroad car shops in the city, where thousands of hands are employed. At the oil houses and the store house, this electrician installed an auxiliary system, without auxiliary batteries and which, when once installed, needs no attention whatever. The system works automatically by means of the heat of the room, the pulling of a lever at the stations distributed throughout the building or the breaking of the wire anywhere's in the building. This will cause the alarm to be sounded from the nearest firm alarm box located on the street adjacent to the building. Its maintenance and installation for all time to come, does not cost more than the old system costs to maintain in a year. It is positively proof against lightning and high-tension currents.

Many improvements were next made by the chief electrician in the city's police department. The dry batteries located in each police telephone box were abandoned and a central battery system introduced with eleven small storage batteries, which cost two dollars a year to maintain. The system is so improved that policemen talk from the local boxes to any policeman in other nearby cities that can be reached over telephone lines. It has also improved the local system; so much, that when the policeman lifts the receiver from his box, a small light flashes up in front of the operator at police headquarters and the call is quickly answered. It is impossible for both lines to be out of order at one and the same time, and eliminates the tape police telegraph instrument.

The next step forward was the introduction of a new red light on the 150 miles of police call system. It's just a little different from any other system in use and does not require a foot of extra wire, being conducted on the wire over which the police report. Automatic switches, consisting of four parts so strong that nothing but a blow from a sledge hammer can destroy them operate these lights at each patrol box. When they were first introduced a murderer was captured thirty minutes after he committed the deed. When an officer is needed, the operator at headquarters turns a switch and all the lights in the respective district are on. When the policemen see the red lights they quickly ask headquarters what is wanted. A bell can be substituted for the light, but owing to the latter's noise and warning to the criminal, the light is preferred. This chief electrician constructed four police boxes that cost \$75 each, just half what other boxes cost and the city claims they give perfect satisfaction and will withstand 100 per cent. more abuse and that they never have given any trouble. The same kind of reports can be made with them as with the Gamewell style.

The city also has an underground system that has lightning arrestors, heat fuses and choke coils that its chief electrician designed. The fire and police machinery at City Hall, and its switchboard were placed into fireproof headquarters. An iron battery rack holds 504 storage batteries, which were especially constructed to answer the city's wants, at a great saving in cost and which operates both fire and police systems.

A new glass battery lid is used for these batteries, which acts as a separator for the plates and prevents splashing and vaporization while charging. The batteries may be refilled when the liquid is low without removing the lids. It prevents all creeping of liquid down the outside of jars, which causes short currents and grounds, as well as the rusting and rotting of the racks the batteries rest on.

This electrician's latest idea is to utilize the waste heat that now goes out of stacks of the city's garbage plants, and with the electrical energy thus obtained furnish light and power services to all the city's municipal buildings.



# Can You Solve This Problem in Two Minutes?

## The Problem

What size of copper wire should be strung to carry 2,000 kv-a. at 0.68 power factor, 60 cycle, 3 phase, 4,000 volts, 18 inch spacing, a distance of 1.2 miles, with a limiting voltage drop of 10 per cent? What will be the voltage drop and power loss for the size of wire selected?

It is probable that you cannot correctly solve the above in half an hour with the means now at your disposal, and it is certain that you cannot solve it in two minutes unless you have access to the new ENGINEER'S EDITION of the

# TRANSMISSION LINE CALCULATOR

This Device is expressly designed to save time and with it you can in two minutes solve any problem connected with overhead transmission, distribution or motor circuits, within the range of the various scales as noted below. This unprecedented speed is due partly to the absolute elimination of formulas, and partly to the extreme simplicity and logical arrangement of the method. It means that a series of calculations which used to take several hours can now be completed in as many minutes, and with far greater assurance as to the correctness of the results.

To show how readily any line can be figured with perfect accuracy, your attention is respectfully called to the illustration below, which shows the 60 cycle page of the Transmission Line Calculator with the transparent celluloid disc set for the above problem, the successive steps in the solution being pointed out by the arrows. Please note that the whole field of wire sizes and percentages is open to view, which means that it is only a moment's work to pick out the size of wire for any drop, or the drop for any size of wire.

### Prefers It to Book Methods

LIBERTY LIGHT & POWER CO.

RICHMOND, INDIANA

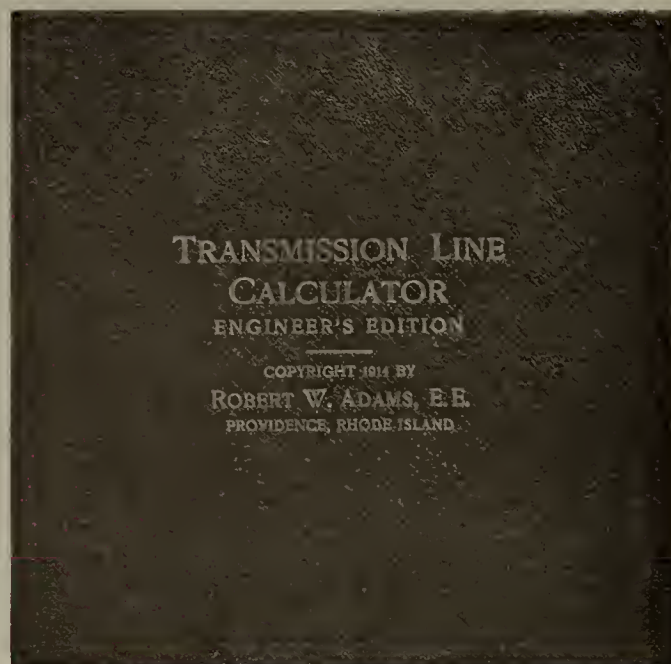
March 16, 1915.

I received the Transmission Line Calculator, and I desire to take this opportunity of conveying to you my appreciation of the general all-around excellence and simplicity of this method of working out transmission line problems. I have worked out your Calculator in comparison with several other methods in book form. The result came out practically the same, but your system is a great deal easier than any other I have ever used, and I feel that your work is deserving of the highest praise.

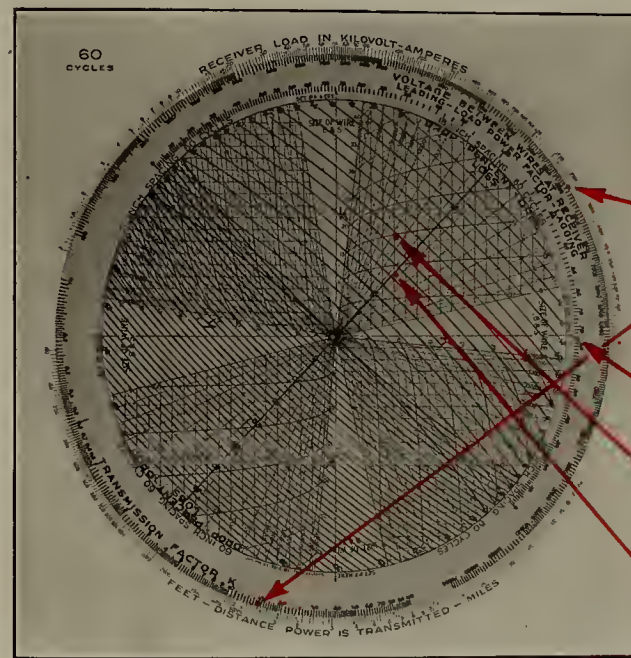
(Signed) ROBERT S. ASHE, President.

## The Means

THE TRANSMISSION LINE CALCULATOR consists of a threefold volume, 8 1/4 inches square, bound in levant grain Persian morocco, and containing separate wire diagrams for 60 and 25 cycle work. Each diagram is laid out for four different standard spacings of conductor, and each is equipped with a transparent celluloid line drop chart. A conversion table is included by means of which the Calculator can be adapted to any frequency or spacing whatever, and a convenient wire table has been added, giving costs and ampere capacities of all sizes of conductor. Explicit directions are provided, together with a typical example, so that a person having no technical training whatever can learn the method in a few minutes. Everything needed for the practical solution of any line problem is given in the simplest terms, and nothing is included in the way of technical discussion to confuse the operator.



Miniature Views of Cover and 60 Cycle Diagram of the Transmission Line Calculator



### Finds It Invaluable



March 23, 1915.

For anyone who has to estimate and figure transmission lines under present-day conditions, it is invaluable as a time-saver. I find since purchasing this Calculator, that I can work out the ordinary transmission line calculation within five minutes, where before it would take from two to three hours, and at the end of two or three hours' work I was not always sure that I was within twenty per cent. of being correct. (Signed) J. J. MURPHY, Superintendent.

## The Method

### FIRST SETTING

Turn the transparent celluloid disc until the Line Voltage (4000) is under the Load Kilovolt-Amperes (2000): then

Look above Distance in Miles (1.2) and find Transmission Factor K (15).

### SECOND SETTING

Turn the disc until the Load Power Factor (0.68) is opposite the arrow for 60 Cycles, 18 inch Spacing; then

Follow the curve for K (15) until it intersects the radial line for No. 000 Wire just under the 10% Line Drop arc on the surface of the disc. Note that the voltage drop for No. 000 wire is 9.6%.

Note the corresponding Power Loss, 7.2% vertically beneath, by reference to the centre line of the disc.

**The Result** IN ONE AND ONE-HALF MINUTES we have answered the given problem as follows: Wire, No. 000; Voltage drop, 9.6%; Power loss, 7.2%. BUT THIS IS NOT THE WHOLE STORY. Suppose it is not convenient to string No. 000 wire, but that No. 0000 and No. 00 are in stock. Referring to the last setting of the disc, we see at a glance that the drop for No. 0000 wire will be 8.8%, loss 5.7%; and for No. 00 wire, the drop will be 10.6%, loss 9.0%. These additional readings take one-half minute, making a total of two minutes, in which time we have secured accurate, practical results, which by any other method in existence would have taken at least half an hour.

### Likes the Wide Range of Voltage

THE MONTANA POWER COMPANY  
H. HERGEN, GENERAL MANAGER  
BUTTE, MONTANA

March 24, 1915.

I have found your new Transmission Line Calculator a very convenient and time-saving device. I used one of your smaller Calculators for some time, but much prefer the larger one, both on account of the larger scale and particularly because of its greater range as to voltage and length of line.

(Signed) A. C. PRATT, Engineering Department.

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# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

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Questions and Answers and Practical Discussions of Trade Affairs

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## Protection or Regulation?

By Kennedy Q. Rockwell

A case recently occurred where one of our customers was experiencing considerable trouble in his 10,000-volt lines on account of the circuit-breakers continually opening due to birds and twigs of trees getting across the lines. These occurrences were so frequent that he desired to know if it would be feasible to remove the automatic trip coils from the circuit-breakers, so that the switches could be opened only by hand, irrespective of the current flowing. The aim was to obtain continuity of service. The station contained a number of 10,000-volt generators, the circuits, also of 10,000 volts, going direct from the station bus bar. This question was submitted to an engineer who was familiar with similar conditions, who answered as follows:

Non-automatic circuit-breakers are very useful in certain cases where short circuits of a light nature, such as birds flying through the wires and branches of trees getting across the line, are of frequent occurrence, because these kinds of obstructions will usually burn clear if current can be kept on the line for a short length of time. Unless the capacity of the individual feeders is very small compared with that of the station some means must be provided for preventing trouble on any feeder from causing damage and a disturbance to the whole system. In the present instance the circuits are taken off the station bus bar direct, and thus the cushioning effect of transformers is absent, making the likelihood of damage to the end turn of the generators quite probable. The question of voltage variation at the time of trouble is also a very important one because in these days both public and public service commissions demand good voltage regulation. The variation in voltage and the speed of variation is also of importance with the increasing use of synchronous apparatus because this type of apparatus is rather sensitive to sudden variations in pressure and frequency. Since synchronous machines, even in small capacities, are coming into quite general usage for phase control, now that good starting characteristics are obtainable, this fact must be kept in mind in all cases.

There are several ways in which the automatic tripping devices might be replaced, but it is only by the use of feeder reactances that both protection and approximately constant voltage can be obtained. Feeder reactances are the only means that enables a short circuited feeder to be carried for any length of time without lowering the pressure of the system excessively; they enable trouble to be localized and give protection where it is needed; they do away with the necessity of sectionalizing the load, thus permitting the operation of one common bus, thereby enabling the operation of generators and prime movers at their best efficiency and at the same time most favorable load factors. The use of a common bus bar has a further advantage in that it simplifies matters considerably, and greatly reduces the chance of mistakes due to the personal element.

As neither the individual nor collective capacities of the machines, nor the number, capacity or characteristics of the feeders are known it is not possible to give more than a very general outline of the scheme of protection. A discussion of some of the more important factors entering into such a problem will be taken up because it is enlightening, and may give a general understanding of the matter which will help in solving similar problems.

Reactance coils should be inserted in the feeders, or at least in those feeders giving the most frequent and serious trouble. If the station operates two buses these may be operated separately or tied together as desired. The desirability of inserting bus tie reactances must also be considered.

A reactance coil for a feeder differs from a generator reactance in that the one must limit the current to a predetermined value with constant impressed voltage behind it for several seconds and possibly even minutes, whereas the other is only required to care for an instantaneous current rush lasting a few cycles only until the generator reaction has had time to become effective. The amount of reactance to be inserted in a feeder depends very largely upon the capacity behind it, that is, upon the ratio of generator capacity to feeder capacity. In general the reactance required for an aerial line will be less than that required for an underground cable, because the former has almost always higher reactance than the latter. In deciding on the amount of reactance to use in a feeder it must be remembered that the coil must have sufficient reactance to permit continuity of service of all feeders except the feeder carrying the short circuit; must prevent damage to the generator end turns or transformers, as the case may be; and must protect the oil switch from destruction when opening the current of short circuit. As the tripping devices are to be removed, so that the switches will be called upon to open only a few times normal current instead of thirty or more the reactance coils enable a less expensive switch to be used. This cannot be taken advantage of where the switches are already installed, but should be borne in mind when planning future installations.

A reactance coil is rated in apparent kilowatts or kilovolt-amperes at a definite current. The kilovolt-amperes or kv-a is the product of current and the voltage drop across the coil at full load amperage. In the case of the feeder reactance the current used in the rating is that corresponding to full load of the feeder. Knowing the rating of a coil in kv-a and the full load current of the feeder the reactance voltage is easily found. This voltage is usually expressed as a percentage of the circuit voltage. For example: suppose in the present installation a 6 per cent. reactance coil is to be installed in the feeders. Each feeder is rated at 1,000 kv-a, 10,000 volts. Since the delta pressure is 10,000 volts the star pressure is 5773 volts, and the drop across the coil is given by  $0.06 \times 5773$ , or about 346 volts. As

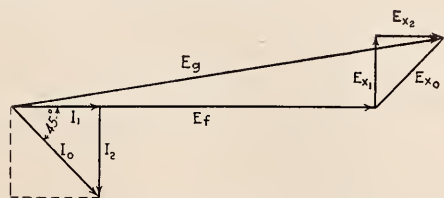


the circuit capacity is 1,000 kv-a the amperage per phase is 100, and the rating of the reactance coil is  $100 \times 346$ , or, 34,6 kv-a. For average conditions a reactance of from 5 to 10 per cent. is satisfactory for feeders; and it is not possible to be more specific without knowing more details of the case.

It must be remembered that while the greater the reactance inserted in the circuit the greater the protection afforded, within limits, the worse the voltage regulation will be. The voltage drop in the reactance coil is at quadrature with the line current, and thus at low power factors the presence of reactance will have a very injurious effect upon regulation. If the power factors to be encountered are very low it may even be necessary to compromise between protection and regulation. This phase of the matter is brought out better by referring to the diagram, which shows the effect of low power factor upon voltage drop. The power factor taken in the example is one of 70 per cent., a good average figure for power circuits. It can be seen that the reactance has relatively little effect upon the regulation at high power factors, but becomes increasingly pronounced as the power factors get lower and lower.

The use of reactance raises the question of exciter capacity, and the ability of the generators to carry greater excitation. At low power factors increased excitation is required by a generator for a given terminal pressure than at higher power factors on account of the field distortion. This taxes the exciters therefore. Now inserting reactance in the feeders necessitates still greater excitation which may over-tax the capacity of the exciters, as well a heating up the generator fields. The probability is that this matter will not be very serious in the ordinary way, but it must be kept in mind as a factor requiring consideration.

Where the different feeders have different load characteristics the feasibility of using different values of reactance naturally suggests itself. For example one feeder serves a lighting load having a power factor of .93 per cent., another feeder supplies power at a power factor of 70 per cent. It can be realized that under these circumstances the voltage regulation will be radically different to what it would be without the reactance coils, that of the lighting circuit being slightly poorer, while the feeder serving the power load will be considerably lower. The question of installing induction regulators now comes up. If the feeders merely serve substations where the energy is distributed to various other circuits these latter will have regulators, each controlling its own pressure. On the other hand, if the circuits leave the station and traverse the country distributing load, then the question of regulators is a very live one. It should be pointed out here that all systems as they grow and extend finally reach the point where regulators have to be installed. The use of feeder reactances do not really create the necessity, but may simply hasten it.



Vector diagram showing effect of reactance on voltage regulation

The graphic method of determining the effect of low power factor on reactance is shown in the diagram. The relations are worked for a power factor of 70 per cent.

In the figure:

- $I_0$  = total current
- $I_1$  = energy component
- $I_2$  = wattless component
- $E_g$  = generator voltage
- $E_f$  = feeder voltage
- $E_{x0}$  = reactive voltage drop, due  $I_0$
- $E_{x1}$  = reactive voltage drop, due  $I_1$
- $E_{x2}$  = reactive voltage drop, due  $I_2$

The resistance drop has been ignored in this diagram, because it is comparatively small.

From what has been said it is obvious that the installation of feeder reactances is not merely a matter of cost and space, but is a matter requiring close analysis of many other factors, generator and exciter capacities, voltage regulation, load characteristics, etc. While all these factors may enter into the problem usually one or two are absent.

The installation of feeder reactances such as have been discussed here would enable operation under the conditions imposed, namely frequent short circuits of a comparatively light nature. It is, however, hardly suggested that such a radical change be made in the station lay-out at one time, rather is it recommended that the necessity for installing reactances be tried out little by little. The most reasonable way to do this, and by far the safer, would be to operate one or two of the feeders—choosing those giving the most frequent trouble—with reactance coils in circuit and the tripping devices cut out. Reactance coils for the necessary tests could be built at the station for a nominal cost. The coils should be designed for 10 per cent. reactance, with taps taken off for reactances of 8 and 6 per cent. respectively. The maximum reactance should be used at the commencement of the tests, the lower values being ready should they be needed. The cost of placing these taps when the coils are made up will be very small, and they may save valuable time later on, as well as permitting varying the reactance should change of line or load characteristics require. After these reactances have been in service and the feeders subjected to a number of short circuits, with the opportunity for them to burn themselves clear, it will be possible to change the reactance if necessary or even eliminate them altogether, although this latter procedure is to strongly discounteracted. Operating without any form of protection whatever is a most hazardous proceeding, and one short circuit may easily cause more damage than could be paid for by a number of reactance coils. The cost of re-winding a generator, and the loss of the machine while it is undergoing repair are factors that must be taken into consideration, as well as the standard of service.

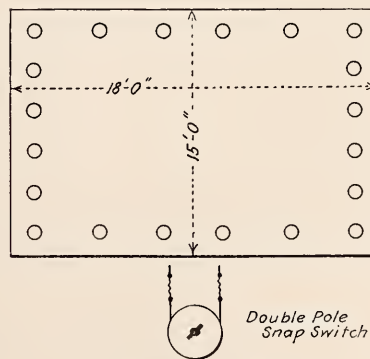


### Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

#### Minimum Wiring

The sketch enclosed herewith shows a room 15 by 18 feet which is to be wired for 20 incandescant lamps placed as shown.



Room wiring diagram

The lamps are on the ceiling near the walls and the switch and fuse are on the wall. How should the wiring be arranged to be a minimum?

**Induction Motor Won't Reverse**

We have a 220-volt, 3-phase induction motor of the squirrel-cage type which has to be reversed now and then. Sometimes instead of reversing when two of the leads are interchanged it runs in the same way as before but at a lower speed. What is the reason for this? W. K.

**Voltage Rise on Series Transformer**

I note that all the instructions regarding the use of series or current transformers warn against having the secondary circuit open while the primary circuit is alive on account of high voltages building up in the open circuited secondary. Why is this?

P. L. H.

**Disposition of Line Conductors**

We are about to construct a long 3-phase, 60-cycle transmission line and there is a discussion as to whether, from an electric standpoint, the circuit should be arranged on equilateral triangle as shown on Fig. 1 or all in the same horizontal plane as shown in Fig. 2.

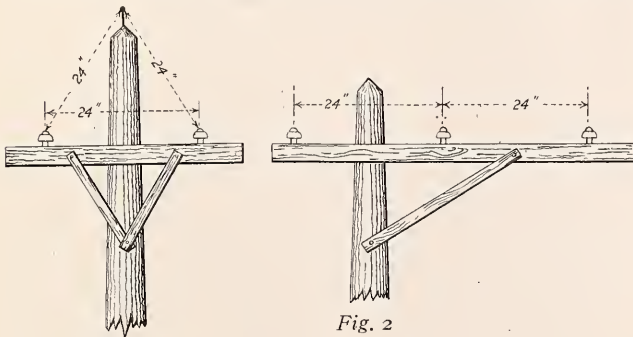
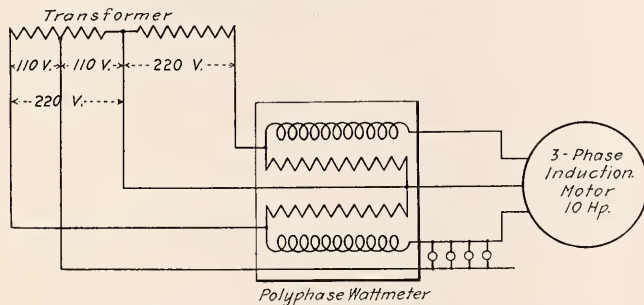


Fig. 1

Fig. 2

as shown in Fig. 2. The line is 10,000 volt and the distance 10 miles. How will this affect the regulation, etc., assuming the transpositions to be the same in the two cases? K. W.

**Metering Lamps on a Motor Load**



A 110-volt lighting load is connected with a motor service which has a 3-phase 220 volt meter as shown in the sketch. What is the error in metering the total, amount of power supplied to motor and lamps? E. L. M.

**Concentric Wiring**

What is the latest information regarding the concentric wiring system? Is it being used to any great extent? Can it be used where neither of the conductors is grounded but the outer one is suitably covered with insulation? Is it being manufactured this way? M. S.

**Protection of Ground Pipes from Corrosion**

Please advise what is the best method of protecting ground pipes against corrosion. We have had ordinary black wrought-iron pipes eaten up within two years in a district where there was no electrolysis and the pipes were used as grounds for lightning arresters of alternating current line. The problem is to get a paint to resist corrosion and at the same time not interfere with the conductivity of the pipe as a ground plate. A. B.

**Discussion of Problems**

**Trip Coils**

In answer to "J. F. M.'s" query concerning the series tripping coil on a 44,000-volt transmission line switch, it is pointed out by several subscribers that the amount of current passing through the coil depends altogether on the load or line conditions.

However, if the amount of current necessary to operate the plunger is required, that, of course, is dependant on the number of turns. Assuming no iron other than the core, a given number of turns, and that the core stands normally about 40 percent in the coil the formula for calculating the maximum pull in pounds

$$P = \frac{A N I}{100 l} \cdot K$$

where A is area in square inches of plunger, N the number of turns in the coil, I the current in amperes, l the length of coil in inches and K a factor varying with the change in position of the coil, varying from 4 to 2. In this case  $P \times 2$  should be greater than the weight of the core and attached glass tube. Calling the weight of these moveable parts W., we have

$$\text{Ampere-turn (N I)} = \frac{100 w l}{A} = 130 w l$$

W. K.

The coil being in series with the line, the amount of current passing through it is the same as the line current. This current multiplied by the number of turns of wire gives the ampere turns.

As the coil is designed to trip only when the current becomes excessive, the normal current will not trip the mechanism.

If only few of these coils are to be made, the best way to go about it is to first make your tripping mechanism, and then wind a coil with wire heavy enough to carry the maximum current, this maximum current being the predetermined tripping current.

By any convenient means pass a current equal to the predetermined current through this coil, and either add or subtract turns from it until the tripping mechanism is operated, when the coil can be finished and placed into service.

The mathematical design of such a coil is rather complicated, but can be worked out by Charles R. Underhill's formula for plunger electro-magnets, as follows:

$$\text{For iron clad solenoids } P = \frac{A P_c (I N - n)}{10000 - n}$$

$$\text{For plunger solenoids } P = A \frac{I N^2}{7075600 l^2} + \frac{P_c (I N - n)}{10000 - n}$$

- Where P = Pull in lbs.
- A = Cross section of plunger in sq. inches.
- I = Current.
- N = Cycles per second.
- Pc = Pull at 10000 amp. turns and one sq. in. area of plunger.
- n = Ampere turn factor.
- l = Length of air gap.

For a coil 3 in. long  $P_c = 23.4$  lbs. and  $n = 2800$ . From the above any factor can be readily solved.

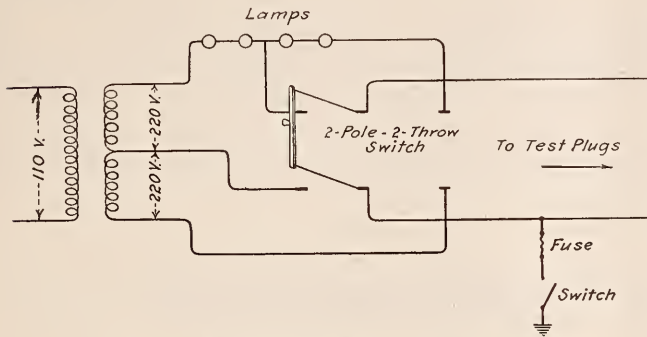
A. J. K.

A correction:—E. R. H. writes what general correspondents have also pointed out, viz: that the signs marked "watts" in his divided current problem in the December issue should be marked "ohms." This would render the problem solvable.

An electrical alarm for open windows has been perfected to give warning in case of rain melting into the room. This device operates by the wetting of a patent compound which when moist acts as a conductor and closes the operating circuit.

**Testing Out Street Light Circuits**

Answering question by E. A. in January issue of ELECTRICAL AGE, would say that a small device for locating trouble on street lighting circuits is shown in the following sketch.



*Test Circuit Connection for Street Lights*

This arrangement can be easily made and is good for testing for grounds or crossed currents. The 440 volts will invariably blow the fuse in case of ground and will blow the fuses if they are clean. Another way is to disconnect the circuit and ground one side through a suitable resistance and connect the other side to the undergrounded leg of a 120 or 240-volt grounded circuit. A few tests along the line with a lamp or two lamps to earth will soon locate the open circuit or the ground.

F. M. A.



**More About Transmission Line Protection**

In answer to the query of J. E. M. in regard to the trouble experienced on the transmission line in question.

Trouble is experienced more or less in high altitudes from static discharges or some abnormal operation of the circuit itself.

The same protection is ample for both conditions.

It might be well to look into the physical conditions that tend to cause these disturbances of which lightning is most common.

If we suppose a heavily charged thunder cloud approaches a transmission line the charge in the cloud will induce an equal and opposite charge in the circuit, this latter charge remains bound so long as the electrical conditions in the cloud remains constant. Now if the cloud slowly discharges or slowly moves away, the charge on the line will slowly dissipate itself without any harm to the line whatever. But on the other hand, if the cloud should suddenly discharge even without striking the line, the bound charge on the line will be set free and will rush back and forth oscillating at a very high frequency seeking an outlet. Usually the frequency of these oscillations are very great, setting up a potential that is sometimes enormous. Therefore when these oscillations meet the coils of a transformer or a dynamo the insulation is usually punctured. These coils act in the same capacity as impedance coils tending to hold these high potentials until some protective apparatus operates, making a path for these oscillations to escape to the earth.

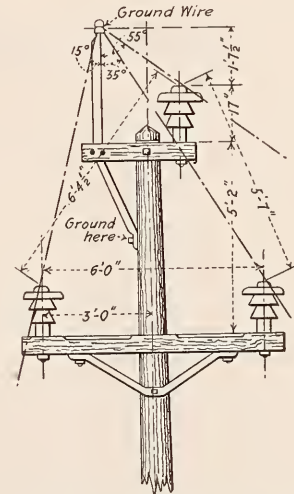
Every long transmission line has considerable capacity—and when in operation stores considerable energy as a condenser. This is met with in common when a switch is suddenly opened a charge is set free as in the case of the static charge induced by the thunder cloud.

This particular transmission here seems to be amply protected by lightning arresters, although some transmission stations find that where considerable trouble is experienced due to static charges that by dividing their line into four equal parts and installing lightning arresters at these points, the trouble is lessened to some extent.

It is very important that sufficient grounds are provided for these arresters as their maximum protection is greatly lessened if not wholly.

These grounds should consist of some of the following ways, viz: burying a coil of copper wire in the bank of a river below the water level; galvanized iron pipe driven into the ground sixteen or eighteen feet, connecting to the rails of an electric railroad, or by burrying a copper plate in the ground a good depth.

The most successful means of providing against such static charges as these due to lightning charges, and one which is coming to great favor is what is known as the guard wire of overhead ground wire, as shown in a typical high-tension top.



*A Typical High-Tension Top*

A single grounded wire over a transmission system offers a very good protection, but, of course, two would be better in case of three or more transmission wires. To get the best results from an overhead grounded wire, it is essential that the lines be within the protective zone of the wire. This is when the lines are within the space of 45° or preferably 60° from the ground wire downward.

Barbed wire is more effective than ordinary wire against some kinds of static charges, such as electrostatic charges picked up by drifting rain or fog, outside of this it has no superiority over the plain wire.

The conductivity of the grounded wire is of considerable importance. For bringing the zero potential up to a point above the transmission line. In this way it greatly lowers the electrostatic potential in the space occupied by the transmission line.

The size of this ground wire is immaterial so long as high conductivity is maintained. This is essential for the protection of the transmission system against atmospheric disturbances such as lightning flashes and also in protecting the stations in case of a direct stroke of lightning reaching the line. This overhead ground wire is usually grounded every few poles, some poles ground every pole, others every four poles, while some every half mile. If steel towers are in use this wire is grounded to the tower.

In pole line transmission the ground wire is usually run up the pole through a shell for personal protection. When setting new poles, wires are sometime spaced around the butts and twisted before the pole is placed in the ground, this affords a very good ground for the overhead wire, otherwise a gas pipe may be driven into the ground about six feet, the ground wire placed in the pipe and about four inches of lead run into the top of the pipe.

E. L. B.

# Questions and Answers

How can the lifting power of an electro-magnet be estimated?  
M. E.

The number of pounds that an ordinary electro-magnet will raise can be approximated by multiplying the square inches of contact surface by .35. This rule is based on a magnetic density of 51,000 lines per square inch at the pole faces. The ampere-turns in the coils must be about 20 per wide of length of magnetic circuit to produce this flux, with commercial wrought iron cores, yoke and armature.

\* \* \*

What regulates the charging voltage and charging current of a storage battery?  
D. S.

The voltage applied to the terminals of a storage cell must be a little more than the back voltage of the cell itself, which, with ordinary batteries, is from 1.8 to 2.3 volts, according to the extent of the cell's discharge. The charging voltage may be from 2.3 to 2.5 volts according to the amount of charging current the battery will stand. This amount is about .06 ampere per square inch of plate surface, counting both sides of all the positive plates.

\* \* \*

What is the difference between direct, continuous and pulsating currents?  
J. B.

All three of these come under the one head of "unidirectional," that is to say they never reverse the direction of current flow. The terms "direct" and "continuous" are used interchangeably to describe this class of current though a really continuous current is that which comes from a battery. Direct-current is the accepted term for that which comes from commutating machinery. "Pulsating" is usually applied to currents which change in strength but not in the direction of flow. An alternating current is pulsating in that it changes its strength, but as it also changes its direction it is not generally referred to as pulsating.

\* \* \*

How can the current per wire for a 3-phase induction motor be determined? For example, what size fuses would be needed for a 10-hp, 550-volt motor?  
A. Y. S.

The current per wire in a 3-phase motor current is found from the formula

$$\frac{577 \times \text{kw.}}{E \times p \times e} = C.$$

In this formula, kw., is the output of the motor in kilowatts, E is the voltage at the terminals, p is the power factor and e the efficiency, and C the current in amperes. A 10-hp, 550-volt motor would likely have a power factor at full load of 85 percent and an efficiency of about 80 percent. From this you can calculate that the current per phase would be somewhat more than two amperes.

\* \* \*

What is the advantage in using a reactance coil instead of an ohm's resistance in series with an alternating current arc lamp?  
B. L.

The advantage is a great reduction in the actual loss of energy in the case of coil. A non-inductive resistance of, say, A reactance coil can be readily constructed which will have an impedance of 2 ohms when resistance will be but .05 ohm. The loss in such a coil would be ( $C^2 \times R$ ) or  $100 \times .05 = 5$  watts, the remainder of the impedance being purely inductive and not entailing any loss of energy.

\* \* \*

What is the best way to tell when a small storage battery is overcharged?  
A. N.

When a storage battery is overcharged the electrolyte boils vigorously. Up until it is overcharged only small bubbles will form, the boiling action not commencing until overcharge begins. The best way is to test the specific gravity of the

liquid with the instrument usually provided with the battery for that purpose.

\* \* \*

Why is end play provided for on motors and rotary connectors?  
S. H. A.

End play facilitates the even lubrication of the bearings and makes them wear smoothly. It also distributes the wear of the brushes on the commutator and rings and keeps them from wearing grooves in their surfaces.

\* \* \*

(1) How does the charging current on a transmission line raise the voltage at its far end?

(2) What trouble is likely to be caused in breaking the circuit of such a line when it is overloaded or short-circuited?  
Ans. E. N.

(1) The charging current does not raise the voltage on a transmission line anywhere. The rise in voltage that occurs at the receiving end of a line is caused by the electrostatic capacity of the line in combination with the inductance. You should consult a good standard text-book on alternating current transmission for the explanation of this. It is too long to give here.

(2) Unless the overload circuit is opened at a moment when the alternating current is near its zero, there is sure to be a surge of voltage occasioned by the breaking of the circuit. This surge may reach an amount high enough to cause puncture of the insulation of the circuit at some point.

\* \* \*

(1) Can you give the rule for re-winding a compound-wound generator for different voltages at the same speed?

(2) Also for re-winding them for different voltages and different speeds?  
Ans. P. L.

(1) Divide the voltage for which the machine was wound, by the voltage for which the winding is to be changed; multiply the result by the cross-sectional area of the wire used in the original winding. This will give you the right sectional area of the wire for re-winding. This applies to both the armature and field windings. The field winding should occupy the same space as before. To calculate the number of turns of the new series winding, or the new total number of turns on the armature, divide the original voltage by the original number of turns and multiply the result by the desired voltage. The correct division of the total number of armature turns into individual coils is dependent on the design of the machine and cannot very well be given here.

(2) There is no rule for such a case. It can only be done successfully by one well versed in dynamo design.

\* \* \*

(1) Why will a compound-wound direct-current motor start up with the field circuit open when the armature switch is closed?

(2) What is the advantage in using six-phase rotaries instead of three?

(3) What is the relation of the voltages between any to adjacent armature taps of a six-phase rotary and the direct current voltage?  
Ans. E. G. S.

(1) The motor starts because of the residual magnetism that is left in the pole-pieces from the last time it was in operation.

(2) With six-phases there is less heating in the rotary armature than with three. Therefore, with a given armature, there can be a greater output with the same amount of heat lost.

(3) The relation of the voltage you inquire about is as 1 to .354 hence for a 600-volt rotary, the voltage between taps and 6-phase armature would be about 212 volts.

# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## Enlightening the Landlord

In a certain old town, which had been substantially built long before the coming of electric lighting, the taking on of old build-

ings seemed to have come to almost a stand-still. Studying over the matter, a new salesman went forth and listed all the unwired houses in the place. In going over the list he was struck by the fact that a large number of them were empty. This led to a new investigation which showed that the proportion of unoccupied, unwired houses to that of unoccupied, wired houses was nearly four to one. Armed with this little fact a "campaign of education" was started among the owners of the unwired properties. A bit of careful comparison was frequently the means of convincing the landlord that he was letting 100 per cent. of investment lie idle for the lack of a 5 or 10 per cent. investment in improvement in the shape of electric wiring—for which extra investment he could easily compensate himself by a slightly increased rent.

After a few cautious experiments the idea got out among the owners of unwired properties. A handsome list of new customers was the result.

In a large city not far from the scene of this investigation, the idea was taken up and resulted in the advertisement shown above.

There is an ample field for this line of operations all through the older and larger settled portions of the country. In several cases the getting in of this sort of "missionary" work among the landlords has proved to be among the best of the methods used in securing the business latent in unwired sections of the older cities.

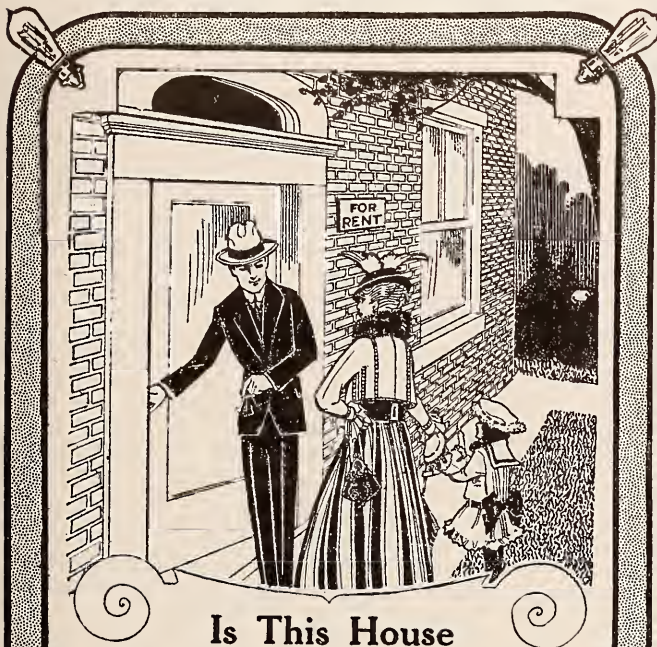
\* \* \*

### Factory Lighting

In spite of all that has been said and written, poor, inadequate, or ill-arranged lighting is still the most conspicuous and general defect in small factory premises in this country. It is not uncommon to find factories of various sorts, where the eye-killing, unshaded tungsten bulbs is in glaring evidence. Often, too, is found an arrangement of improperly shaded lamps that is only less stupid and wasteful.

The benefits resulting from proper lighting, which seldom costs more than the unscientific kind, are known to be such that the retention of poor lighting in factories simply advertises the management as inefficient. Very frequently the rearrangement of illumination in hitherto poorly lighted factories, increases the output from three to ten per cent. without a bit of increase in the lighting expenses. Greater accuracy of work and a big reduction of accidents are only a few of the talking points for the skillful salesman in pushing this line.

The various central station companies and contractors have by no means worked out the case for better lighting to the fullest extent. The number of ill-lighted places still to be found proves this. State laws regarding compensation for accidents undoubtedly help out. Direct legislation on the method of lighting places of this sort have long been on the statute books of the larger manufacturing nations abroad.



### Is This House Electrically Lighted?

The prospective buyer or tenant is pleased when the agent answers, "Yes, it is electrically lighted throughout." After that the agent has a very favorable prospect.

Electric Light is clean, convenient, safe. Mazda Lamps have cut the cost in half.

If you own a house that is tenantless, write or phone us. We will tell you how it should be wired and what the cost will be.

**Potomac Electric Power Co.**

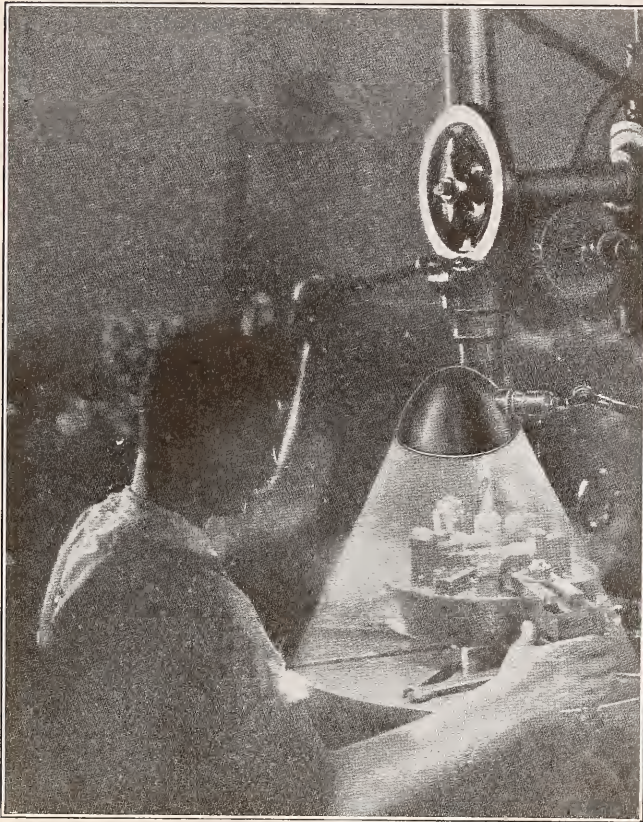
Cor. 14th and C Sts. N. W.

Phone Main 7260

**SAFETY  
FIRST  
LAST  
ALWAYS**

POST ART SERVICE

\* A very striking presentation of the results that can be obtained in a well arranged machine shop is shown in a folder sent out by a well-known Eastern firm, in illustrating an improved line of reflectors for industrial lighting.



*Light in a machine shop*

In the section of this folder is reproduced the flood of light thrown on the machine brings out all the details while the operator's eye is perfectly protected. This sort of illumination on each machine, with general illumination of moderate intensity, provided by one of the well-known indirect methods is the ideal for getting the best results with minimum eye-strain.

The campaign for better factory lighting along this line of double lighting, general and special, should bring in good returns if well pushed. The central station gets the maximum revenue from the factory—and the factory an increased output.

❖ ❖ ❖

### Creating a Demand

**A**N interesting as well as profitable electric range campaign is reported by the Western Electric News as having been conducted by one of their agents, the Iowa Railway and Light Company of Toledo, Iowa. This company, with power lines extending through several of the smaller Iowa cities, decided to put more heating devices on their lines to maintain a day load. The electric range was used as a means to this end.

A campaign was mapped out with three days at Tame, three days at Toledo and two days at Gladbrook—all in Iowa. Previous to the campaign a systematic series of ads, serving to stimulate an interest in electric ranges, were run in the daily papers of the above towns. A few days prior to the actual opening of the campaign, slides pertaining to it were run in the moving picture houses and a special personal letter was sent to each of the company's customers in the various towns.

The actual campaign was the culmination of the preparatory advertising; the people were given an opportunity to see in operation the electric stove they heard so much of in print. Practical demonstrations were held in each town in which the electric stove was made to bake bread and cakes, broil steak and chops and prepare entire meals. These demonstrations were almost continuous and were held where everybody could see them. Not only did the people see that the stoves were practical but they were shown the amount of current for each operation, proving their economy under existing rates. The school boards of the towns received special invitations to visit these demonstrations and as a result, two complete domestic science equipments were sold.

The campaign was a success not only from the standpoint of stoves actually sold but from the educational angle. Those people who did not buy electrical devices during the campaign have an idea as a result of it that electrical devices are worth while, and people with that idea are decidedly good sales prospects. When the company conducts their next campaign, they will find that their actual sales will show an increase because they will cash in on the desire for electrical devices they have created as a result of their first campaign.

❖ ❖ ❖

### Electric Service as "Safety First"

Does the average central station in its sales campaigns realize the value of electric service in preventing fires? Does the contractor know what a valuable factor this feature can become in inducing people to wire their houses?

Here is an impartial testimonial from one who knows concerning electricity as a reducer of fire risks. He is the fire commissioner of the metropolis of the United States and this is what he says in his last report:

"The substitution of electricity for other methods of heating and lighting in this city during the last year was responsible for the low percentage of fires. The estimated loss from fire last year in New York was \$8,217,811. Only 3 per cent. of the total loss is attributed to defects in electrical systems or traceable to violations of Fire Department's warnings.

"These figures are remarkable in view of the fact that the city has 375,037 buildings among which are the tallest structures in the world. Most of the fires were caused by the careless use of matches, kerosene, gasolene and coal stoves. Fires from these sources totaled 13,953 during the year.

"In other cities also there has been a decided decrease in fires, due to the use of electricity. Only 1 percent of the damage done in Boston according to reports, was charged to electricity. Out of 200 fires in Louisville, Ky., two were attributed to improper insulation."

A little consideration of this matter and some careful fitting of it to local conditions should enable a wide-awake solicitor to put up a telling talk that in many instances would supply the necessary bit of extra weight to the argument that is required to tip the decision the right way. Put some of it into your next case and see.

### A Case in Point

A solicitor for a certain electric light and power company labored long and earnestly with a group of wealthy farmers whose homes adjoined the company's lines, to have their houses wired for electric light and power service. After a year's work he had to confess to his manager that he made practically no headway. The farmers were amply well-off and could easily afford the service but were simply old-fashioned and refused to take hold, preferring their time-honored "coal-oil" lamps.

"Try them again," said the manager, "and see what you can do on the safety feature. Play up fire prevention."

Accordingly the solicitor made a call one morning in June and played it all up for all he was worth. Nothing doing. He went on out the line to attend to some other business. An hour and a half afterwards he was on his way back and had just passed the house of the leading farmer in the group when he heard a call and turning back was met by the entire delegation who desired to know how soon he could run in a complete electrical service for all three of the houses.

The solicitor nearly fainted from shock. "What's loose?" he inquired, "I have worked you people for 18 months and never a nibble."

"Just this," chorused the wise ones. "This morning the missus went into her clothes closet to get out some extra light summer wear. The closet being dark, she had to carry a lamp. Some flimsy goods took fire and we were nearly burned out as a result. Only the quickest sort of work prevented us from being burned out. We have had our little lesson and so have the rest of the relatives who came over to see what the fire was about. We don't want to spare any expense to get the electrical service insulated as quickly as possible."

In six weeks the entire group were using electric light and power on all their premises, from the front porch to the back of the barn and wondering why they had been so slow to take advantage of it.

This company took on quite a group of rural consumers principally on the strength of this fire which has proved a drawing feature in soliciting in that vicinity ever since.

\* \* \*

### 1916 Fan Window Display Contest

The feature of the fan season last year was a window display contest conducted by the Western Electric Company. It will be remember that six prizes amounting to 100 dollars, were given to the dealers who, with the material given them, trimmed windows that attracted the most genuine interest to electric fans. The base of the display a cut-out, featuring a wave beaten beach, was given to all the contestants and around that all the displays were made.

The contest created a great amount of interest and comment As a matter of fact, the company considers the results sufficiently encouraging to conduct a similar contest for the 1916 fan season.

The contest for the coming year calls for the use of a cut-out similar to the one used in the 1915 display. There are 10 prizes offered this year—amounting to 250 dollars. The prizes are arranged as follows:

First-\$100.00, Second-\$50.00, Third-\$25.00, Fourth-\$15.00 and six prizes of 10 dollars each. In addition to these prizes, one hollar will be paid for every photograph submitted. The contest will close October first, 1916, at which time a board of judges consisting of representatives of the leading trade papers and the Society for Electrical Development will award the prizes.

The wide awake dealer will start now to plan a window that will be a prize winner. There are any number of attractive combinations he can make with his flashers, motors and fans, all of which will give action, and action makes for interest, which is the basis on which all prizes will be awarded. In view of the success of the 1915 contest, great things may be expected this year.

\* \* \*

### Outbuilding Lighting

"Do you know that in many rural and suburban communities the amount of domestic electric lighting consumed by the average household is but little over half what it would be if the outbuildings were well wired?"

This statement was made not long ago in a certain southern community. The powers in charge of electric service there doubted. They wanted to be shown.

To put the matter to the test, ten consumers whose places were completely wired, were persuaded to allow ten watt-hour

meters to be inserted in their service connections in such a way as to measure the proportion of the total kilowatt-hour load consumed outside of the house. These were left in circuit during October, November and December. The result of the test showed a division of consumption in the out-buildings ranging from 10 to 60 per cent, of the total. The largest outside consumer was a prosperous farmer who burned 5 lights in his out-buildings in the mornings to one in his house. The smallest was a widow who ran a chicken-an-pig farm on ten acres—and successfully, too.

The average out-building consumption for these ten customers during the three months was a little over 40 per cent. The test is still going on.

# YOUR BARN WANTED

## For Electric Light

The most convenient use of electric lights is in those places where you now use a lantern.

A light in the

Cellar

Barn

Back Porch

Chicken House

Garage

will flood the space with light at the touch of a button and you will not be hampered with a lantern hanging on your arm, there will be no shadows to hide your work, no danger of fire from an overturned lantern.

Wiring of these places is all open work and cost is small. The cost of light is trifling. Let us give you an estimate.

## MORAVIA ELECTRIC LIGHT HEAT & POWER CO.

### ELECTRIC LIGHT CHANGES DARKNESS TO DAYLIGHT

The result of the test convinced the management of the value of the out-building load.

The above advertisement shows how one company which was alive to the matter went after the barns, chicken-houses and garages in its district. To the unprejudiced eye it would seem as if wagon sheds and pig-pens might also be inserted in the list.

## Increasing Sales Impetus in the Store

By G. D. Crain, Jr.

There is no doubt that selling electrical merchandise offers one of the finest opportunities, for members of the trade who have the facilities for dealing with the ultimate consumer, to be found everywhere.

Electrical goods are attractive; they are well-advertised, and they fill in most cases a real want, and not one artificially created. In other words, they combine the salability of the novelty with the permanence of the staple; which means that the dealer who is building up a trade of this sort is going to make steady customers and to get repeat orders.

These facts explain why the electrical contractor is breaking into the merchandising field in many communities, and why exclusive stores devoted to this class of goods are being successfully conducted. In most places where the dealers have shown a disposition to develop the business, the policy of the central stations has been to turn it over to them, and not to do anything more aggressive than to make displays and to turn business to the retail distributors by means of general advertising of current-consuming devices. With encouragement of this kind, there is no reason why an aggressive, hustling salesman should not be able to get business right along, whether he is working in an establishment where the sale of electrical goods at retail is the leading interest, or not.

Another thing to consider in this connection is that the man with a stock of electrical merchandise is not on a commercial island, where he is thrown on his own resources. On the contrary the manufacturers have done and are doing right along a lot of creative, educational, constructive advertising; and if the dealer will hook his business onto this publicity, and take advantage of its effectiveness in his own locality, he will make his sales problems a good deal simpler than they otherwise will be. For example, suppose that he is handling the lamps of a certain company. These are staple, of course, and yet the field is by no means exhausted. The name of the manufacturer has become known through advertising, just as the general merits of electric lighting have become known. Is the dealer to sit quietly, with his stock of lamps on his shelves, without telling about the goods, or is he going to make a window display, using the material of the manufacturer to increase its attractiveness, and insuring getting the attention of passersby?

The latter plan is the one which is of course calculated to get the business. A dealer who puts on a display of lamps, helped out by cartons and cut-outs and window cards furnished by the maker of the goods, is sure to get customers, because a big percentage of the people who see such a display will remember an empty socket or two at home, and will come in and supply themselves with lamps. Besides such a display has a familiar look, because its elements have been made familiar through the general advertising of the manufacturer; and putting it in immediately hooks the dealer to the tail of the big advertising kite which is flying across the business sky, attracting the attention of millions of buyers.

There is a lot of other publicity matter furnished by the makers of electrical goods, such as folders, pamphlets, etc. The dealer who allows this sort of advertising to become dusty and soiled in his store, instead of using it to make business, is not playing the game. He is throwing away dollars that have been spent for his benefit, as well as for the advantage of the manufacturer. In this connection, it is usually possible to get the direct advertising material imprinted with dealer's own name and address, so that all of the work which he does in distributing it will advertise him as the local representative of the manufacturer.

An easy and effective way to get results from the use of advertising matter of this particular kind is to make a point of enclosing a piece in every letter going out to a customer. Statements mailed the first of the month should by all means be

accompanied by a slip-in advertising some item of goods carried in stock by the electrical dealer. The two-cent stamp carried by the letter will transport the advertising as well, so that the business developed—and some business will steadily be turned up by this method—will be literally velvet. The postage money spent in other directions can be made more productive if the letters carry something in the way of an advertising appeal, as well as the regular correspondence of statements.

The electrical dealer who is not called on by salesmen representing the different manufacturers is the exception and not the rule. He may think, as a matter of fact, that too large a percentage of his time is being taken up by these salesmen. Perhaps, so, if he is not using them in the way it is easily possible to do. These salesmen, on the road for the makers of electrical goods, are usually bright, intelligent chaps, who have always got their eyes open for new ways of selling their goods, not only to the dealers, but over the counters of the merchants. Consequently their brains are packed with good ideas regarding the proper methods of handling electrical merchandise, and they will be more than glad to impart this information to the dealer and to his salesmen.

It would enable them to sell more goods, consequently, if they could hear from the traveling salesmen, who put the lines in the dealer's stock, the points about them which are worth calling to the attention of the customer. In view of the fact that most electrical merchandise contains the element of novelty, it is necessary to do a certain amount of explaining—educational work, if you please—in order to convince the customer that the article is worth purchasing. Backing up the salesman with help of the kind suggested will thus increase sales impetus inside the store, and make for more sales and more profits.

In fact, some of the most successful members of the trade have formed their salesmen into clubs, which carry on regular work in the development of knowledge about the goods and about the best way to present them. These organizations, which need to be handled intelligently in order to be of the greatest benefit, of course, have splendid possibilities along this line; and at their meetings the salesmen of the manufacturers could very appropriately appear for the purpose of explaining the fine points connected with their goods.

The trouble with the average electrical store, especially if contracting or some other line is carried on in connection with it, is that the man at the head of the business has so many things to think of that no one item, at least if it has to do with the merchandising department, gets a fair amount of attention. That means that the business is likely to drag, unless the dealer is shrewd enough to put some aggressive salesman in complete charge, with full authority in the selling end.

This is one of the best ways, in fact, to handle the business. While it is not always an easy matter to get an ideal assistant, who can direct the sales work with the necessary snap and originality, it is far better to attempt this plan than to let the business fail because of lack of pushing. And electrical goods have so many points of appeal that there is no reason why any store which displays them, which backs them up with reasonably good salesmanship inside, and which takes advantage of the immense publicity campaigns of the manufacturers, should not be able to do a sufficient volume of business to make a satisfactory showing in the matter of net profits.

But it should be remembered, as pointed out above, that electrical goods are too new to sell without effort. No one should expect to be able to get business in this line without devoting something in the form of money and time and effort to it. Money is needed to put the right kind of stock on the shelves: an incomplete array does not deliver the goods, because the average customer invariably wants something which isn't in stock. Time is needed to organize the work properly, and effort to get the displays and the selling punch which are required. But if these are forthcoming, big money can be made out of the business.



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# New Products And How to Use Them

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**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

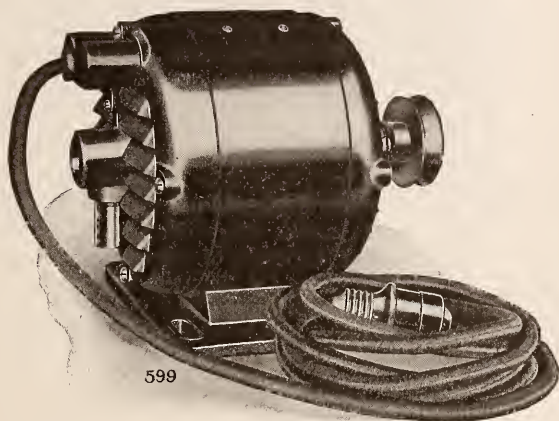
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## New Washing Machine Motor

The new motor shown herewith is a special design lately developed by The Robbins & Myers Co., Springfield, Ohio, for washing machine service.

The end heads are cast in a special form which gives absolute protection from water which may splash on the motor, while at the same time they are open and permit a free circulation of air through the motor. The ventilation is assisted further by a fan on the shaft.

The base is provided with four holes for fastening the motor to machine. It is cast separately from the motor frame and is attached to the frame by four screws. It can be attached to the top of the motor, permitting of overhead mounting when this is desired, without making it necessary to turn the motor over and invert the end heads.



*New Washing Machine Motor*

The motor terminals are protected by an iron box which fits over them and is held in place by two screws. The cord enters this box through a hold which is provided with a rubber bushing. The motor is furnished complete with ten feet of reinforced cord and a separable plug. It is also fitted with a V-groove pulley.

The bearings are made of phosphor bronze and are lubricated by wick oilers. The lubricating system is constructed so as to prevent any leakage of lubricant which might soil the clothing.

The motor can be furnished for direct current of all standard voltages and for alternating current of all standard frequencies and voltages. The speed on direct current and 60 cycle alternating current is 1750 r.p.m.

## "Quick-Hot" Immersion Heater

A new immersion heater, designed for quickly heating small quantities of water in any suitable vessel, consists of a nickel-plated copper tube which eliminates any possibility of rusting or oxidizing. It is in the form of a coil which will readily fit in almost any small vessel.

This coil construction has the decided advantage of a large radiating surface so that the heater is evenly and widely distributed instead of being confined to a small limited area. As a result the "Quick-Hot" heater does not become overheated and is insured a long life and freedom from deterioration.

A useful feature is a sort of shield which keeps the hot coil from coming in contact and doing damage to a table or any other surface upon which it might be placed.

A small but convenient handle, always cool—is another exclusive and practical feature appreciated by users who are thereby enabled to easily handle this immersion heater while it is still hot.



*Immersion Heater*

It is easily cleaned, economical to use, guaranteed not to burn out, and is a device that will stand long and hard usage.

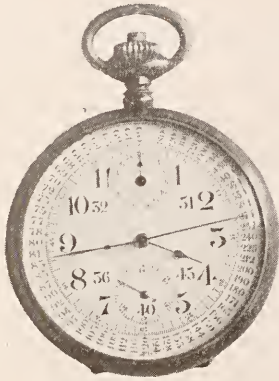
The patented quick detachable connection is furnished with this device. It is the only connector on the market which can be attached or removed quickly and easily with one hand, eliminating the need of holding the heater with the other hand.

A six-foot cord and plug with which it is equipped enables it to be attached to any lamp socket. It is made by the Simplex Electric Heating Company, Cambridge, Mass.

## Master Cronograph

A new and improved instrument has recently been placed upon the market which is very useful in making time and motion studies, and in obtaining direct results of production per hour or per day, both for mechanical and manual operations.

The cronograph contains a 17 jewel timepiece which is extremely accurate and in addition contains divisions in seconds and fifths for the time study feature. The figures on the extreme outside of the dial designate operations per hour for any operation within one minute, and the figures on the extreme inside of the dial such as, 51, 45, 40, etc., denote operations per hour for any operation running into the second minute. For instance; if the large black hand were stopped on 13 seconds, which would denote the completion of an operation, the reading directly under this hand, would show 275, which are the number of operations which could be completed in one hour on a basis of one operation taking 13 seconds.

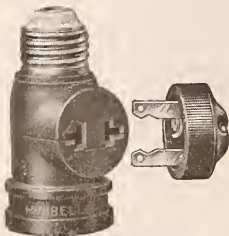


*Master Cronograph*

The master cronograph operates entirely from the crown, being the start, stop and fly-back system. The timepiece feature is the same as any modern watch. The works are impervious to magnetism, to heat and cold, expansion and contraction. The case is of gun-metal. The product is of high grade Swiss manufacture, and the exclusive sales are controlled by M. J. Silberberg & Associates, Peoples Gas Building, Chicago, Illinois.

## \* \* \* Side Outlet Socket

The big increase in the use of electrical appliances for heating as well as lighting uses has led to a demand for a device by which both services may be taken from the same outlet. To meet this a heat-proof side-outlet tap has been placed on the market.

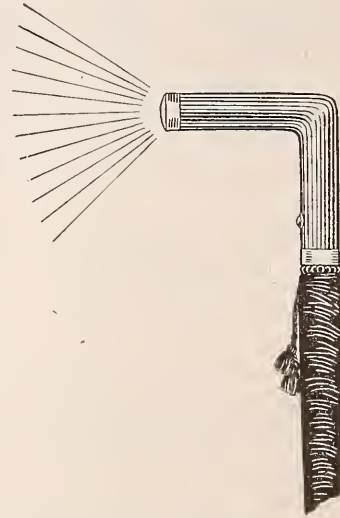


*Side Outlet Socket*

This is designed especially for use in railroad shops, ship building yards, warehouses, factories and similar places where it may have to stand rough usage. It is provided with a shade-holder groove at the bottom. The connecting socket will take the manufacturer's standard insertion plug.

## Flashlight in Cane or Umbrella

A novel use of the familiar flashlight has been put forth by a manufacturer, who inserts them in handles suitable for cane or umbrella, as shown in the illustration. This gives the owner of one or both of these handy articles a double use and will stimulate the sale of these lamps.



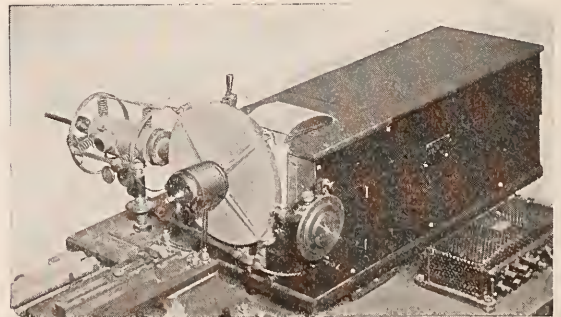
*Umbrella Flashlight*

The battery is easily replaced and the circuit controlled by the button shown on the lower part of the handle.

## \* \* \* Curve Recording and Analyzing Devices

Among the recent developments in instruments for the solution of engineering problems are a curve recording device and a curve analyzing device known as a "Polar Oscillograph Attachment" and a "Harmonic Analyzer" respectively. These devices are extremely useful to obtain a quick and accurate analysis of any periodic wave, such as the current or voltage wave of a motor, generator or power system.

It has been customary for a long time to regard current and voltage values as vector quantities, and use these trigonometric relations to express the various phase relations. This, however, is only correct when the waves of current or voltage are sine values. When these waves are distorted, large errors may result by making these assumptions. So the only positive method of solving such problems is to obtain an actual analysis of the wave by means of an adequate analyzing device as the harmonic analyzer previously referred to.



*Fig. 1—Polar Oscillograph Attachment*

Fig. 1 shows the polar oscillograph attachment used to obtain a polar oscillogram of the wave which is to be analyzed. This attachment can be used interchangeably with the regular rec-

tangular film holder on the standard oscillograph. The oscillogram is made on a photographic film about ten inches in diameter, and is then printed on a sensitized piece of bristol board, from which a template is cut for use on the analyzer.

Fig. 2 shows the analyzer, which has been designed to give any one harmonic at a time, odd or even, as high as the fiftieth. The procedure for analyzing is extremely simple and entirely mechanical. Although the operation of the machine is based on the Fourier theorem, the actual procedure for analyzing can be performed by a person without any knowledge of the mathematics involved. Selecting the proper gears, turning the crank, and reading the planimeter are the only operations required.



Fig. 2—Curve Analyzer

This device can be applied to electrical problems of wave shapes of generators, and problems arising from the paralleling of generators, or cross currents in machines or transformer connections.

The use of the analyzer, however, is not limited to electrical problems. Any periodical wave, such as sound waves, waves of magnetic flux, torque curves of gas engines, can be analyzed and the related waves derived by simple mathematical transformation.

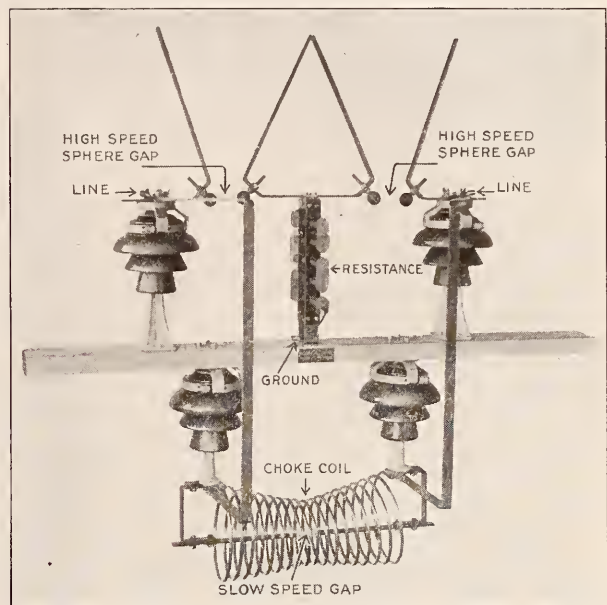
These new devices still prove to be valuable additions to any standard oscillograph equipment. The case and the metal parts of the analyzer are nicely finished, so that the instrument has a most attractive appearance and fits in very well with other instruments in a well equipped laboratory. They are manufactured by the Westinghouse Electric & Manufacturing Company and received a bronze medal at the Panama-Pacific Exposition.

The value of this device as a saver of time and brain-wearing calculation in any place where much of this sort of work has to be done can hardly be over-estimated. As a matter of economy it will speedily save its money cost many times over—not to mention the lessening in mental wear and tear.

### Arrester for Line Voltage Surges

To protect electrical equipment from damage by surges it has usually been the practice to install choke coils or reactors between the outside lines and the equipment and drain off the surge through horn-gaps to ground. This has minimized the possibility of damage to inside apparatus, but it does not insure full protection to line insulators, which are a vital part of a system. The Delta-Star Electric Company, Chicago, however, has developed apparatus which can be inserted in series with conductors at any desired intervals to prevent a disturbance causing extensive damage.

As shown by the accompanying illustration, the equipment consists of two horn-gaps in series with the conductor, but shunted by a choke coil which will allow normal current to pass. The triangle-shaped horn is grounded through a multiple-series resistance arrester. At the heel of each horn is attached a small metal sphere, and extending from both choke-coil terminals inward are bars, the ends of which are slightly nearer each other than the balls on the horn-gaps.



Voltage Surge Arrester

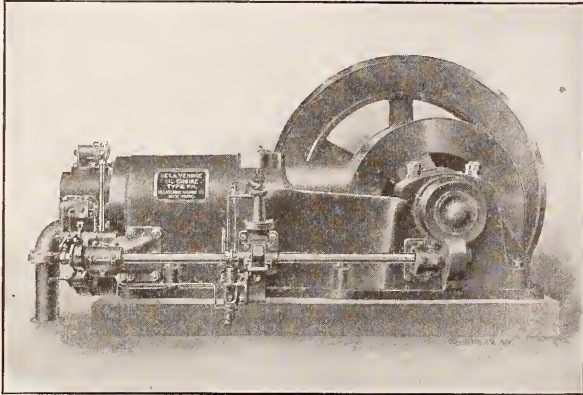
The action of the equipment is as follows: If a voltage wave with steep front approaches the apparatus the choke coil will check its progress along the line, causing some of the energy to "spill" to ground by allowing it to jump across the sphere-gaps. If the surge is abnormally large, it will break down the gap inside the coil and continue along the line until another opportunity is afforded for its escaping to ground. In other words, this apparatus acts as a shock absorber, dissipating all or part of a surge and allowing the remainder to pass on to other absorbers until it is entirely overcome. The net result is to confine a disturbance to a portion of the line, the length of the section which will be disturbed depending on the distance between shock absorbers.

\* \* \*

### Single-Cylinder Horizontal Oil Engine

An oil engine of four-stroke-cycle design, operating on the Beau de Rochas cycle, has recently been developed by a well-known manufacturer. The engine is massive but well proportioned in design, the prominent features, according to the manufacturer, being simplicity of construction and small number of parts. The frame or bedplate is integral with the cylinder casing and extends almost the entire length of the en-

gine. Oil is injected just before the end of the compression stroke, and the injection is continued until almost the end of the compression stroke. The compression pressure of the engine is about 180 lb. and the ignition pressure slightly above 300 lb. The piston is of the trunk type and of large size. No cross-head is employed. The cylinder and cylinder head are water-jacketed, and both air and exhaust valves open vertically in the cylinder head. The spray valve is placed at the end of the cylinder head and is directed so that the injected oil will impinge upon the vaporizer at the bottom of the cylinder head. Vapor and air are compressed and mixed in the cylinder head,



*Single Cylinder Horizontal Oil Engine*

where ignition takes place. Only the gases resulting from the explosion enter the cylinder. The governing is done by means of a by-pass valve. After leaving the pump, the oil may either pass to the spray valve or the check valve in the governor.

The engine is designed to operate on commercial grades of crude or fuel oil produced in the United States or Mexico. Developing 14 brake-hp. per hour per gallon of oil, the engine takes 0.55 lb. oil per brake-hp.-hour at full load, 0.55 of oil per brake-hp. hour at three-quarters load, and 0.65 lb. oil per brake-hp.-hour at one-half load. These economies compare favorably with any oil engine on the market.

\* \* \*

### **New Conduit Service Cap**

A handy line of neat caps for the service end of conduit lines is just being placed on the market. It comes in two pieces as shown. Although each wire has a separate insulated outlet, there is no threading necessary. The base is screwed on the conduit—the conduit secured to the building and the wires drawn



*Conduit Service Cap*

in and bent down. The cap is then placed over the wires—each wire being in a separate groove in the cap. There are three grooves in the cap. When used as a two-wire fitting the middle groove is closed by the lip which projects from the base. To make a three-wire fitting it is only necessary to strike the lip a sharp blow with a pair of pliers or a screw driver handle and it will break off, leaving the third hole open. There are no loose pieces to drop out and lose.

### **"Attacho" Electric Lantern**

The electric battery lantern has long since passed the novelty stage and is rapidly supplanting the dangerous and inefficient oil lantern. A very convenient form of lantern has just been put on the market under the name of "Attacho." It is simple,



*"Attacho" Electric Lantern*

safe and durable, and throws a strong beam by means of a 3-in. non-tarnishing glass reflector. It is designed for use with No. 6 dry cell and will average 75 hours continuous light and manufactured by the Attacho Light Company, Syndicate Trust Bldg., St. Louis.

\* \* \*

### **A Reliable Insulating Material**

Although many special insulating materials have come on the market during the last few years, the ideal insulator—the long sought, unbreakable, unburnable, non-absorbent, high-resistance material has not yet been found.

We therefore judge the quality of a given insulating substance by the closeness with which it approaches to the ideal. The patent compound now sold under the name of "bakelite-dilecto," seems as close to the pattern as any yet developed. It has a dielectric strength of from 700 to 1150 volts per mil, sheets of  $\frac{1}{8}$  inch thickness standing upward of 100 kilo-volts. It is also good for 10,000 pound per sq. inch tensile strength and 50,000 pound compression. Chemically it is unaffected by almost everything and its insulating properties do not deteriorate under 300 degrees F.

It can be worked with tools, drilled, threaded, machined and polished and is used in a multitude of different ways to such an extent that it has become almost standard for certain insulating purposes. It is made by the Continental Fibre Company, Newark, Del.

\* \* \*

### **A New "Dry" Storage Battery**

A leading storage battery which in size and shape resembles an ordinary salammoniac dry cell and contains a non-flowing electrolyte is being manufactured by J. P. Mentzer & Company under the Crowds patents and is being sold by S. S. Stolp, 134 South LaSalle Street, Chicago. According to the manufacturers, tests show that the battery can be recharged an indefinite number of times at a lower price per charge than the original cost of an ordinary dry cell. The rating of the battery is 0.5 amp. for forty hours, 1 amp. for eighteen hours, 2 amp. for eight hours, or 3 amp. for five hours. The average discharge potential is 2 volts.

The container for the battery is an unbreakable paper-fiber can, made proof against water, acid and electrolysis. The positive and negative elements are made from rolled strips of corrugated lead. The electrolysis is contained in an amorphous, non-crystallizing white substance which is said to possess exceptionally high absorbing power. A tube divided in the center of the cell, carries water to prevent the cell from drying out.

There has long been a demand for a light storage battery as every one of an economical turn of mind has felt a sense of waste in throwing away the ordinary dry cell which looks perfectly good when it is as dead as Hector. With this type of battery, the user can carry the cell, when run down, back to the local garage and have it re-charged at a nominal cost. It is said to be good for re-charging at least 300 times.

**Cutting Ice by Electric Light**

Efficient lighting of lakes for the harvesting of natural ice has long been a problem. We all know how expensive is the old overhead method, with its poles to be set, wires to string, globes and sockets to attach—it has always been the nightmare of the ice man—with all its work and worry, lighting at best about half the area required with an illumination which has never been quite satisfactory.

A firm of Chicago engineers has come to the front with a new flood lighting invention, which judging from the remarkable results, has overcome all past troubles in this line. This system of flood lighting accomplishes that which has heretofore been impossible, by using a 1000-watt, 115-volt gas-filled incandescent globe burned in a ventilated steel hood, with a mirror reflector behind it and closed with a wire glass front, making the lamp rugged, storm and waterproof.

The illustrations shown herewith were taken at Armour & Company's Round Lake, Ill., plant, Fig. 1 showing the lights in position on the ice house roof shooting their beams out upon the lake and channel, lighting at the same time the conveyor and all work directly in front of the house. The lights are portable, being fastened wherever desired. These lights were installed and burning in less than four hours. Fig. 2 is a bird's-eye view of Round Lake from the ice house roof showing the area lighted, three quarters of a mile long and a half mile wide.

The advantages of this plan for cutting ice after night are particularly appreciated in the middle section of the country where the natural ice harvest is an uncertain quantity. By proper illumination many thousands of tons of ice that would be lost if dependent on day light work can be saved and gathered in the ice houses at a very small extra cost for illumination.

\* \* \*

**New Insulating Material**

A new substitute for porcelain in places where the latter is liable to be attacked by heat or moisture has recently been put under some searching tests.

This new material is somewhat similar in appearance to porcelain although it is greyish in color and has not quite such a glossy appearance and under the most severe strains, both due to extreme of heat and cold, and also electrical strains, it has shown itself vastly superior to any other insulating material we have ever seen. One test to which it was subjected was to heat some of these new insulators white hot and then plunge them into cold running water which was repeated 10 times without sign of fracture; the 27th time a small crack appeared and the 28th time a part of the insulator cracked off.

Of several samples of porcelain which were tested, none would stand plunging into cold water. Some of the porcelain specimens broke when they reached a temperature of about cherry red and others when they were beginning to get white hot. A very few of the porcelain specimens stood the white heat temperature but cracked immediately they were placed in cold water.

From this it can be seen what a remarkable test this new insulating material has stood. Porcelain insulators are, as a rule quite good electrically but this new insulating material in all the electrical tests which it was subjected to, has been found superior to porcelain and in some of the tests, vastly superior.



Fig. 1—Showing ray and illuminated field

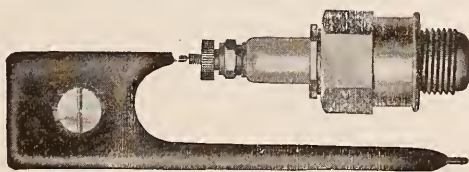


Another View of the field

\* \* \*

**Spark Plug Tester**

A simple and convenient spark plug tester for automobiles, motor boats and motor cycles has been put on the market lately. It consists of a crotch containing a spark gap and two legs containing the terminals, as shown in the illustration. One leg is



Spark plug tester

3 inches longer than the other, so as to permit a convenient contact.

The tester is made of hard rubber with rounded corners, is only 5 in. long and can be conveniently carried in the pocket.

# TRADE LITERATURE

# Catalogs and Books

## A Review of the Latest Publications

A tasteful calendar for 1916 in white and green has been sent out by the Samson Cordage Works, Boston, Mass.

\* \* \*

The nickel-iron Edison storage battery and its merits for commercial electric vehicle service are set forth in a neat well-illustrated bulletin, No. 500, issued by the Edison Storage Battery Company, Orange, N. J.

\* \* \*

Electric welding and riveting as done by the latest improved machines is the subject of a comprehensive bulletin, No. 17, published by the Toledo Electric-Welder Company, Cincinnati, O. Spot, and other kinds of welding, riveting, and similar work once among the dirtiest and noisiest of jobs, are now done cleanly, quickly and silently at lower costs than with the old methods.

\* \* \*

Electric Fans for 1916 including exhaust fans and blowers are treated in Catalog 8-A of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

\* \* \*

Numerous plugs, sockets and receptacles are featured in another of the "green-goggled cow" folders of Harvey Hubbell, Inc. of Bridgeport, Conn., who have also issued folders on their lamp guards and the general reliability of their products.

\* \* \*

"Isolite" batteries in glass jars for farm lighting plants, burglar alarm and fire alarm systems are featured in Bulletin No. 15 of the General Lead Batteries Company, Newark, N. J.

\* \* \*

"How to Figure Illumination" is the title of a handsome, illustrated booklet packed with valuable, practical information on laying out lighting installation for almost any class of requirements, and also cataloging "Sunbeam Mazda" lamps. It is sent out by the Western Electric Company, Chicago, Ill.

\* \* \*

"Some Essentials of Street Lighting" are the subject of a 15-page illustrated booklet, treating of up-to-date lighting in Cleveland, sent out by F. W. Ballard and Co., Engineers, Cleveland, O.

\* \* \*

Preserving wood-poles from rot is a matter of interest to most people engaged in transmission and distribution of electric power. The C-A-Wood-Preserver Company, Inc., of St. Louis, Mo., has gotten out a well illustrated booklet of 36 pages showing what it has accomplished in this respect in many lines of business with "carbolineum" wood preserver.

\* \* \*

A line of electrically driven tools, second to none, is described in the handsome, copiously illustrated catalog No. 25 of the James Clark, Jr. Electric Company, Louisville, Kentucky. It shows upwards of forty different kinds of buffers, grinders and drills of every sort, all made with the unmistakable finish that marks this manufacturer's product.

\* \* \*

1916 Starting, lighting and ignition equipment is abundantly described and illustrated in Circular 1532-B just issued by the automobile equipment department of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

High-tension insulators and insulating parts, as made by the Electrose Manufacturing Company, of Brooklyn, N. Y., are the subject of several illustrated folders recently sent out.

\* \* \*

Centrifugal pumps and pumping units are well described and illustrated in Catalogue No. 1633-A issued by the Allis-Chalmers Company, Milwaukee, Wis.

\* \* \*

Safe, Scientific and Sanitary Illumination are subjects of live import that are skillfully handled in three beautifully gotten up booklets entitled "Eye Comfort," "Logical Light for the Hospital" and "Standard Show Window Reflectors," distributed by the National X-Ray Reflector Company, New York and Chicago.

\* \* \*

The "National" Trolley Guard made by the Ohio Brass Company, Mansfield, O., is described in an illustration folder just out.

\* \* \*

"Una-flow" steam engines are the subject of illustrated Bulletins No. 66-B and No. 67 of the Ames Iron Works, Oswego, N. Y.

\* \* \*

Motor-driven rotary planing machines are told about in Catalog No. 50 of the Newton Machine Tool Works Company, Philadelphia, Pa.

\* \* \*

"Automatic Weighing of Coal and Water in Power Plants" is the title of an attractively illustrated bulletin, No. 101, sent out by the Richardson Scale Company, Passaic, N. J.

\* \* \*

"The Mazda Lamp in Photography" is the title of Bulletin 26 which has just been issued by the engineering department of the National Lamp Works of General Electric Company. This bulletin presents in simple language such data and information in regard to the mazda lamp and its application to the processes of photography as will assist photographers in their work, and acquaint the electrical public with the principles involved. Particular attention is paid to the special photographic-blue-bulb mazda C lamp and its application to the lighting of portrait and motion-picture production studies.

\* \* \*

### Book Review

A handy and practical little work for all those who are interested in electricity and magnetism is Professor F. E. Austin's "Examples in Magnetism." It starts with a couple of chapters devoted to a simple explanation of trigonometric functions, formulas and problems, takes up the metric and C. G. S. systems of measurements and passes thence to definitions and discussions of magnetic quantities.

Practically all problems involving magnetic poles and pole strength, fields of force and the changing of magnetic to mechanical force are presented in a way that is easily understood by anyone with a knowledge of arithmetic and elementary algebra. The whole subject is handled in twelve lessons. At the end are several useful tables and a comprehensive index. It is neatly bound in flexible leather, and worker, engineer, and student will find it well worth the price. Size 4 by 6 inches. 90 pages. \$1.10 net. Technical Journal Company, Inc., 233 Broadway, New York.

# Review of the Month

## A Complete Record of Important News Edited for Busy Readers

The price of Tungsten metal at the Colorado mines for 60 per cent fine has risen from \$5.85 per unit in April to \$48.00. This makes the metal worth \$2,850 per ton.

\* \* \*

Since January 1st the Lynn plant of the General Electric Co. has closed at 5:30 instead of 6 o'clock, the same as is being done at the Pittsfield and Schenectady plants. The wages of the 8,000 employes will not be affected by this change in time.

\* \* \*

The Calumet Electric Company has changed its principal place of business from Crownpoint, Ind., to Cary, Ind.

\* \* \*

A central station, the Eastern Pennsylvania Power Company, of Dover, N. J., has contracted to sell 1,200 kilowatts to the International High-speed Steel Company for running a Pieroult electric steel furnace at Rockaway, N. J. The furnace has a capacity of 50 tons a day and the load should be a fine source of revenue to the power company.

\* \* \*

The Cudahy Packing Company has arranged to buy electric power for its Armourdale packing house from the Kansas City municipal plant. The contract is a sliding scale running from a little under ½ cent to 1-½ cents per kw-hr. It is expected that this will bring from \$40,000 to \$50,000 a year into the city treasury. This is the first packing plant to use municipal current.

\* \* \*

The Denver and Rio Grande engineers engaged on study of the electrification of mountain grades have completed their report. The study is based on the use of water power for furnishing the necessary electrical energy. The actual cost of steam locomotive operation is also given. According to the information received an estimated net saving of 30 per cent in favor of electrification is indicated. Action in this matter is expected in the near future.

\* \* \*

Following the re-incorporation of the Western Electric Company in New York, the Western Electric Company of Illinois reduced its capital stock from \$25,000,000 to \$10,000,000.

\* \* \*

A company for manufacturing and marketing a new electric device for changing alternating current to direct current has been formed at Toledo, Ohio, under the name of Mutual Holding Co. This invention is to be known as the D. & W. Rectifier. A factory has been leased and twenty-five men will be employed at the start.

\* \* \*

It is reported that the Aluminum Company of America has purchased the water rights and property on Yadkin River, N. C., from the Southern Aluminum Company at a price exceeding \$5,000,000. This property was recently sold by French capitalists to American purchasers and a 70,000 kilowatt development is partly under construction.

\* \* \*

The gross weekly business of the General Electric Company since the first of the year is reported a running about \$3,000,000 per week, or at any rate of over \$150,000,000 a year. The largest business the company ever did was in 1913, when the total was over \$111,000,000. Special activity is reported in the steam turbine department.

A special committee reporting on the cost of turning out electricity at the city plant in Groton, Conn., estimates the cost of production with a new plant at 2.1 per kw-hr allowing for depreciation. The Connecticut Power Co. offered to furnish power to the borough on the basis of a load averaging 2700 kw-hr. per day, which is the same as now carried, for 1.4 cents per kw-hr.

The proposition will probably be accepted.

\* \* \*

Strong efforts are being made by the 25,000 electric light consumers in Washington to secure a lower rate from the Potomac Electric Power Co. The present rate is 10 cents per kw-hr. for the first 120 hours, all in excess 5 cents, with a \$1.00 per month minimum charge. It is contended that the Washington rate is higher than that of all other cities in the country of equal population with the exception of Boston, Milwaukee and Newark.

\* \* \*

The Government report on the development of Potomac water power at Great Falls, some distance above Washington estimated the cost, providing for 20,000 horsepower, at somewhat less than \$10,000,000. There is considerable opposition to the plant on account of the very high cost per horsepower, which runs nearly ten times that of a modern steam turbine plant of the same capacity.

\* \* \*

The Iowa Power & Light Company at Cedar Rapids is about ready to turn on the current from their Iowa Falls plant for the electric service at Dows. The current will be sold at 15 cents per kw-hr. for the first ten units used and 10 cents for each unit in excess. The town will also pay \$32.00 a year for 100 c. p. street lights. The town has heretofore been served with direct current, but the change to alternating is expected to affect only a few fan motors.

\* \* \*

The municipal light plant at Tacoma, Washington has put a new domestic service rate of 5 cents per kw-hr. into effect. This is said to be the lowest light rate for domestic service in the country.

\* \* \*

Water power generated-current is being sold for from \$1.00 to \$1.25 a month per kilowatt capacity installed at Rupert and Burley in Idaho, where three out of every four houses, large and small, are electrically heated. This cheap power is sold as a by-product of the irrigation plant which has converted a sage-brush desert into a prosperous farming country during the last few years.

\* \* \*

The California Railroad Commission in granting the application of the Great Western Power Company of California to issue \$27,498,600 par value of common capital stock, \$5,263,200 par value of 7 per cent. preferred stock and \$5,000,000 face value ten-year 6 per cent. of convertible gold debentures for the purpose of acquiring the stock of the Great Western Power Company and to provide funds for extensions and improvements, has imposed the unusual condition that each certificate of common stock so issued shall recite that the Railroad Commission has been unable to ascertain to what extent the capital stock of the Great Western Power Company, at the time of its issue, represented tangible value.

The Hull (Mass.) municipal electric light plant has been permanently shut down, the town now buying its electricity from the Weymouth Electric Company.

In passing from municipally made to purchased electric power the town expects to make an annual saving of \$700.

\* \* \*

The General Service Company, of Indiana and the Indiana Lighting Company, owning utility properties in various cities in Indiana valued at a total of \$10,632,000, propose to affect a merger. These companies have about 53,000 customers to whom they are furnishing gas, electric, water and heating service.

\* \* \*

It is reported from Utah that a 6,000 horsepower hydro-electric plant will be built at Logan River near Temple Fork. Construction is to start as soon as the weather permits A 14,500 horsepower project on the east fork of Lake River in Wasatch County is also under consideration.

\* \* \*

The 1915 report of the Public Service Commission having jurisdiction over the city of New York showed that during the year the Commission awarded contracts aggregating \$26,000,000, of which \$20,000,000 were for subway and elevated railroad construction.

The report also states that the Commission's running expenses for the year were about \$3,600,000, of which \$3,000,000 were devoted to rapid transit. The Commission's employees now number about 2300, and it claims to have done a larger amount of work during the year just closed than at any other time since its organization eight years ago. An interesting feature of this report is that for the first time since the Commission's existence the total earnings of the street railway traffic under its jurisdiction, are less than the preceding year by about \$5,570,000. This decrease, for some reason which is not very clear, is attributed to the European war.

\* \* \*

The Bailey Meter Company has been incorporated in Boston, Mass., by E. G. Bailey. The line of meters which they will manufacture has been developed during the past six years in the Mechanical Engineering Department of the Fuel Testing Company, of Boston. Mr. Bailey will devote his entire time to the new company, but the Fuel Testing Company will continue its regular line of work under the direction of W. B. Calkins, who has been a partner of Mr. Bailey in the latter company.

\* \* \*

The public utilities of the Dist. of Columbia and the Public Utilities Commission are co-operating in an electrolysis survey of Washington.

\* \* \*

The Rockford (Ill.) Electric Company has announced a reduction in rates of from 10 to 15 per cent. in domestic electric service.

\* \* \*

The Minneapolis General Electric Company will reduce their domestic electric rate from 9 cents to 8 cents per kw-hr. after March 1st.

\* \* \*

The General Railway & Power Company, Atlanta, Ga., who developed the Tallulah Falls power plant, is projecting another large extension of its power system.

\* \* \*

The city of Milwaukee, Wis., has voted to issue bonds for \$750,000 to begin construction on a city electric light and power plant.

\* \* \*

By way of insuring continuity of its service in Lansing, Mich., the Michigan Power Company is spending about \$50,000 in constructing a duplicate distribution trunk line system.

\* \* \*

The San Antonio Gas & Electric Company, of San Antonio, Tex., has reduced its rate of domestic electric service from 12 cents to 10 cents per kw-hr.

The Electro-Dynamic Company, makers of a line of inter-pole motors, reports business sufficiently good to justify an increase in the size of their plant at Bayonne, N. J.

\* \* \*

According to the Minneapolis Journal "the costly effect of competition in public utilities that are naturally monopolies is strikingly illustrated by comparison with electric rates in Minneapolis and St. Paul." St. Paul is paying 9.9 net per kw-hr. while Minneapolis is paying 8.5 net with a 5 per cent. discount. Reasons for this are thought to be cost of competition, cost of business-getting and the 5 per cent. gross earnings tax paid to the city, in the case of St. Paul.

\* \* \*

The Dayton (Ohio) Power & Light Company expects to spend about \$1,000,000 on the construction of a 110,000 kilowatt steam turbine plant just south of the city. It is said that this plant will be the largest between Pittsburgh and Chicago.

\* \* \*

A street lighting contract, longer than a year, as has hitherto been the custom, is asked by the Philadelphia Electric Company, which claims that in order to be able to give the best service the contract should be drawn for not less than five years.

The city is now paying \$97.00 a year each for 3,000 arc lights on the underground circuits and \$81.25 for about 11,000 lamps fed from overhead circuits.

\* \* \*

It is probable that a stiff rate war for light and power business will take place in Los Angeles between the Los Angeles Gas & Electric Corporation on one hand and the city's municipal activities on the other.

\* \* \*

The Martinsburg Power Co., of Martinsburg, West Virginia, has again gone into the hands of a receiver. This company is capitalized with \$500,000 and operates two plants on the Potomac River and a steam plant in Martinsburg. The receivership was asked to prevent costly litigation in the Federal courts.

\* \* \*

A campaign for the construction of a municipal light and power plant in Springfield, Mo., was defeated. The local company reduced its rate from 10 cents to 9 cents per kw-hr. and 5 per cent. discount, taking effect February 1st.

\* \* \*

It is reported that the Workingmen's Compensation Board of Pennsylvania has granted the Reading Transit & Light Company, of Reading, Pa., exemption from insurance under the State law of 1915. The same privilege has been extended to the Metropolitan Electric Company, the Oley Valley Railway Company, the Neversink Mountain Railway Company and the Lebanon Railway & Light Company, all operating in the region around Lebanon and Reading.

\* \* \*

The public utilities in the Imperial and Coachella valleys, consisting of an electric plant, transmission line and electric railway have been sold by W. F. Holt to the Southern Sierras Power Company, Riverside, Cal., for a price approximating \$1,500,000.

\* \* \*

The contention of the Colorado Power Company that it had certain vested rights in the Government lands, on which its \$3,000,000 hydro-electric plant is located, was disposed of in the Federal Court at Denver, and unless the company pays a rental of \$100 a month the property will be seized by the Government.

\* \* \*

The General Gas & Electric Company controlling a line of electric, gas and railway properties in Vermont, New York, Pennsylvania and Ohio reports an increase in gross earnings during the past year in all of its constituent companies, the aggregate being \$227,532, or 10.3 per cent. This company's properties are operated by W. S. Barstow & Co., New York. They are planning various improvements during the coming year.



### Among the Associations

At a meeting of the Society for Electrical Development it was decided to open a Spring House-Wiring Campaign to be conducted somewhat on the same lines of the Electrical Prosperity League last fall. Details will be announced following an early meeting of a committee of representative manufacturers and others interested.

\* \* \*

The annual meeting of the Western New England section of the National Association of Electrical Inspectors took place on January 12th at Hartford, Conn., and was attended by representatives of the Connecticut Electrical Contractors' Association, the Massachusetts Electrical Contractors' Association and State members of the National Electric Light Association.

An interesting paper on "Concentric Wiring," the method now used in England, was read by Past President Thomas A. Day, accompanied by pictures and samples of fitting illustrating the subject.

\* \* \*

It is announced that the annual convention of the American Institute of American Engineers will be held at Cleveland, Ohio, next June. About 700 delegates are expected from the United States, Canada and Mexico.

\* \* \*

Two hundred members of the Buffalo branch of the National Electric Light Association recently heard a very interesting talk by Archer A. Landon, vice-president and general manager of the American Radiator Co. on the European way and its effects on manufacture.

\* \* \*

The Illuminating Engineering Society will hold its mid-winter convention in New York City, February 10th and 11th, at the Engineering Societies' Building, 29 West 39th Street, at which time it will also celebrate the tenth anniversary of its existence.

\* \* \*

"National Preparedness" was the subject of a splendid address given by Mr. Stevens Heckscher before The Philadelphia Electric Company Section N. E. L. A. on December 20th at the New Century Drawing Rooms. This was followed by a short address by Lieutenant-Commander Payne, of the U. S. Naval Home, Phila.

\* \* \*

The meeting of the Detroit Engineering Society on January 7th was addressed by Edwin Henderson, attorney, on the subject of "Bonus and Penalty Clauses in Contracts."

\* \* \*

The Wisconsin Electrical Association and the Wisconsin Gas Association will hold their annual convention at the Hotel Pfister, Milwaukee, on March 15, 16 and 17.

\* \* \*

The thirty-ninth annual convention of the National Electric Association will be held during the week of May 22, 1916 in Chicago. Headquarters will be at the Congress and Auditorium Hotels.

\* \* \*

The Electrical Contractors' Association of New York State held their annual convention at the Hotel McAlpin in New York City on January 17 and 18. The convention was addressed by Assemblyman Powers, of Rochester; Comm. Williams, of the Department of Water Supply, Gas & Electricity, New York City; Mr. Forsythe and Mr. Bruen of the Board of Underwriters, and J. P. Ryan, of the New York City commission for the licensing of writers, and J. P. Ryan, of the New York City commission for the licensing of electricians. The semi-annual meeting will take place in New York City in June. Buffalo has been selected for the next annual meeting on January 17, 1917.

\* \* \*

The fifteenth semi-annual session of the Missouri Electrical Contractors' Association took place at Kansas City, Mo., on January 15.

### Personal

H. C. Eddy, former engineer of the Public Utilities Commission, employed in the electrical department of the District, has resigned his position to become electrical engineer in the Navy Department.

\* \* \*

As the directors' meeting of the James Leffel & Co., Springfield, Ohio, Mr. John A. Bookwalter was elected president to fill the vacancy caused by the death of his uncle, John W. Bookwalter. Mr. Bookwalter has been vice-president and treasurer of the company for a number of years. It is reported that the plant is doing more business this year than last and the prospects are very bright for the future.

\* \* \*

A. M. Moore, Atlanta, Ga., has been appointed to the newly created office of superintendent of equipment in the Georgia Railway and Power Company's organization. Mr. Moore has been master mechanic for several years with offices in the Fulton County plant.

\* \* \*

J. D. Bowles, superintendent of the electrical department of the Springfield Gas & Electrical Company, of Springfield, Mo., has been named chairman of a committee of the Association of the Missouri Public Utilities Companies to draft uniform rules and regulations governing the construction of overhead and underground lines maintained by the electric light and traction companies of Missouri.

\* \* \*

The Lux Manufacturing Company, Hoboken, announces that they have appointed their former advertising manager, Mr. R. A. Barenberg, as General Sales Manager. Mr. Barenberg was born in Boston and has been in the incandescent lamp business over twenty years. He learned the trade under the supervision of his father, Mr. Adolph Barenberg, one of the pioneers of the lamp business.

\* \* \*

Changes resulting from the recent decease of Mr. W. A. Connor, late vice-president of the Standard Underground Cable Co., have made Mr. P. H. W. Smith vice-president and assistant general manager. Mr. C. W. Davis becomes vice-president and general manager in place of Mr. Smith and is succeeded as manager of the Central sales department of Pittsburgh district by Mr. Arthur A. Anderson.

Mr. C. C. Baldwin has been made vice-president of the company and general manager of the Perth Amboy plant; Mr. Tracy D. Waring, assistant manager of the lead cable works there; Mr. Albert C. Meyers, superintendent of the rubber wire factory and Mr. E. J. Waring, assistant purchasing agent.

\* \* \*

### Obituary

John A. Hill, president of the Hill Publishing Co., New York, died suddenly Tuesday morning, January 5, in his automobile while on the way to his office, Mr. Hill had just left his home in East Orange when he was stricken with heart weakness.

Born Feb. 22, 1858, near Bennington, Vt., Mr. Hill removed with his parents soon afterward to Wisconsin. At the age of fourteen he entered a printing office and served six years at the trade, leaving it to become a locomotive engineer. In 1856 he founded the Pueblo, Col. Daily Press. In the early nineties Mr. Hill was elected president and treasurer of the publishing firm which bears his name, and since that time had published *American Machinist*, *Power*, *Coal Age*, *Engineering News* and other mechanical trade journals.

\* \* \*

W. C. Anderson, vice-president and general manager of the Canton Electric Company, Canton, O., died December 23rd. He had been manager of the Canton electric light plant for fifteen years.

# BUSINESS OPPORTUNITIES

## Alabama

Alabama Port.—Tidewater Securities Corp. of Mobile proposes establishing an electric light plant.

Demopolis.—The Demopolis El. Lt. & Pwr. Co. is contemplating placing its boilers in steel settings. G. D. Cornish is superintendent.

Fairhope.—An electric light plant will be constructed here, for which the city will issue \$5,000 bonds. Engineer is Xavier A. Kramer, Magnolia, Miss.

Hurtsboro.—City will vote on \$9,000 bonds for light and power plant extensions.

Moulton.—The Moulton Water Works will install an electric plant at this place, the equipment to include a 15 or 20-hp. crude oil engine (double cylinder) for electric lighting and 15-kw. compound generator direct-current belt-driven from above engine.

Russellville.—It is rumored that the Sloss-Sheffield Steel & Iron Co., Birmingham, will construct a \$50,000 central electric plant.

## Arkansas

Booneville.—Booneville Light & Power Co. will construct a 28-mi. transmission line to supply four towns with electricity, and will install equipment for street lighting and distributing systems, meters, etc. Require material for 4-mi. 2300-v. line for one town; contemplate three installations, using single-phase motors from 5 to 25 horsepower.

Gravette.—City contemplates improvements to electric light plant, and will install boilers, generators, and pumps. E. H. Crayton, Supt.

Hartford.—City plans bond issue for the purpose of constructing electric light plant and water works.

Morrillton.—The Morrillton Light & Power Co. has been acquired by the Arkansas Light & Power Co., of Arkadelphia. The latter will rebuild the power station and install equipment, including engines, generators and boilers; also rebuild distribution system and construct 6 mi. transmission lines to connect Plummerville. J. F. Mullins is the local manager.

Newark.—The Newark Canning Co. are contemplating the installation of a 300 to 500-light a.c. lighting system.

Sulphur Rock.—An electric light plant will be constructed here by Smith Bros.

## Florida

Clearwater.—Surveys are being made for an electric railway to be constructed from Tampa to Clearwater on the west coast, a distance of 30 miles. E. W. Parker, Curry Building, Clearwater, is interested.

New Port Richey.—R. L. Gillet anticipates installing village electric light plant.

Palatka.—It is rumored that the Southern Utilities Co., of Jacksonville, will install a generating equipment to furnish 3-phase, 60-cycle alternating current day and night at the plant of the Palatka Ice Co.

Waldo.—The organization of a company to construct an electric-light and ice plant in Waldo is being promoted by the Board of Trade.

## Georgia

Graymont.—The contract for construction of an electric-light plant to supply electricity in Graymont and Summit has been awarded to the Singleton-Smith Co., Macon. The cost is estimated at about \$10,000.

Griffin.—Light, Water & Sewage Comm. plans the extension of ornamental street-lighting system; to install 15 series incandescent street lamps.

Juliette.—Juliette Milling Co. may extend electric-lighting system for general public lighting.

Woodland.—Electric light plant will be constructed by city; develop 20 hp.; install 20 hp. oil or gasoline engine and 9 or 10 kw. generator. J. H. Woodall, Engr.

## Illinois

Chicago.—During 1916 the Department of Gas and Electricity will place in service 619 additional arc lamps, 3084 300-watt incandescent lamps, and 1,372 75-watt lamps. The construction work necessary for these lamps has practically been completed. William G. Keith is commissioner of gas and electricity.

Decatur.—The city engineer has been instructed to prepare plans and estimates for the installation of an ornamental lighting system on both sides of South Main street from Lincoln Square to Washington street, and on the north side of Wood street from Main to Water street.

Dixon.—The Illinois Northern Utilities Co., Dixon, is erecting a transmission line to Poplar Grove and will soon furnish electrical service there.

Joliet.—A steam turbine power plant to cost approximately \$1,500,000 will be built two and a half miles southwest of this place, according to an announcement recently made by J. M. Strasser, Supt. of Pub. Service Co., of No. Illinois.

Murrayville.—The installation of a municipal electric-lighting plant in Murrayville is under consideration by the town officials.

## Indiana

Anderson.—It is reported that the City Council will authorize the expenditure of a considerable amount of money to improve the city light plant with additional equipment, including three new boilers.

Columbia City.—Plans, it is reported, are being prepared by Charles Brossman, engineer, Indianapolis, for the installation of a new generating unit in the municipal electric-light plant.

Newcastle.—The City Council has decided to enlarge the municipal electric-light plant to supply electricity throughout the city for lamps and motors. At present the plant only furnishes street-lighting service. The cost of extension to the plant is estimated at about \$40,000.

South Bend.—A committee has been appointed by Fred W. Keller, Mayor, to make investigations relative to the establishment of a municipal electric-light plant in South Bend.

## Iowa

Ames.—\$50,000 will be expended for municipal light and water-works plant.

Audubon.—The Council has passed an ordinance granting R. G. Weiland a franchise to install and operate an electric-light plant in Audubon.

Dysart.—The Dysart Brick & Tile plant contemplate installing an outfit for operating their plant with electricity.

Latimer.—The Town Council has granted the Cedar Valley Pwr. Co., Charles City, a franchise to supply electricity for lamps and motors in Latimer.

Mapleton.—The installation of an electric light plant in Mapleton is reported to be under consideration. B. Leitzen is reported interested.

Sioux City.—The Sioux City Gas & El. Co. is reported to be contemplating extending its transmission line to Riverside, at a cost of about \$8,000.

Sioux City.—Articles of incorporation were recently filed by the Ponca Light & Power Co.; capitalized at \$50,000. Headquarters will be in Sioux City and an electric light plant will be operated at Ponca, Neb.

Waterloo.—The Citizens' Gas & Electric Company expect to receive an electric franchise for twenty-five years and will erect a modern power station in this city at a cost of from \$700,000 to \$800,000, from which they will supply current to many of the smaller cities in northeastern Iowa.

#### Kansas

Argonia.—The city of Argonia is contemplating the installation of a municipal electrical distribution system. Energy to operate the proposed system will be secured from the municipal electric plant at Wellington.

Elkhart.—The City Council is considering calling an election to submit to the voters the proposal to issue bonds for the installation of water-works system and electric-light plant.

Marion.—An entirely new power station has been built for the municipal electric-light plant. The old power house was destroyed by fire last September. An additional 120-hp. Diesel-engine-driven unit will be installed within the next six months. D. Hazen is superintendent.

Plains.—Bonds to the amount of \$20,000 have been voted for the installation of an electric lighting and power system in Plains. H. W. McGruder, Liberal, is engineer.

Riverton.—The Empire District Electric Co. will add a new steam turbine unit, capable of generating 10,000 horsepower, auxiliary machinery and buildings to the plant at an approximate cost of \$200,000.

Zenith.—Plans are being considered for the erection of a transmission line and distribution system for Zenith. Energy to operate the system will be obtained from the plant at Stafford.

#### Kentucky

Clay.—The Clay Ice & Light Co. is negotiating with Providence and Dixon, Ky., to supply electricity, and contemplates building a 14-mi. transmission line and install a 200-kw. generator and engine, discontinuing the single-phase machine now used. They will also install a 300-hp. water-tube boiler.

Kuttawa.—An electric light and power plant will probably be installed here in September by the Kuttawa Milling Co. Use storage batteries, not to be operated at night, but to have 48 hours' storage capacity.

Louisa.—Sandy Valley Light & Power Co., Pikeville, Ky., will build power plant.

Louisville.—The Louisville Gas & Electric Co. intend to nearly double the capacity of their plant at 3rd and Washington Sts.; will construct addition to present building, erect 250-ft. smoke-stack, construct parallel cooling tunnel connecting with river, additional unit of 15,000 kw. capacity, etc.; for which purpose they contemplate issuing \$1,000,000.

Middleboro.—City Commissioners have the erection of an electric light plant under advisement.

Mt. Sterling.—City contemplates constructing a municipal electric-light plant. R. A. Chiles, City Atty., will engage consulting engineer to make preliminary survey in regard to the proposed establishment.

Murray.—City is planning to construct an electric light plant.

Providence.—Bonds to the amount of \$20,000, it is reported, have been sold by the city of Providence, the proceeds to be used for the installation of a municipal electric-lighting plant.

#### Louisiana

New Orleans.—New Orleans Ry. & Light Co. is planning to install street-lighting system at a cost of approximately \$160,000.

#### Maryland

Cumberland.—The electric light plant here will be remodeled, for which purpose the city expects to issue \$25,000 bonds.

Sharptown.—A transmission line is being constructed from Sharptown to Cambridge by the Eastern Shore Gas & Electric Co. Day & Zimmermann, Gen. Mgrs., 611 Chestnut St., Phila., Penn.

#### Massachusetts

Chicopee.—The Quigley Furnace & Foundry Co. has entered into a contract (providing for 850 hp.) with the city of Chicopee for electrical service from the municipal electric plant. I. T. Benedict is manager of the municipal plant.

New Bedford.—The New Bedford Gas & Edison Lt. Co. is contemplating the erection of a 11,000-volt transmission line to Lakeville. The company is building a 22,000-volt transmission line (on steel towers) to Wareham. W. H. Snow is general manager.

North Attleboro.—Plans are being considered by the Electric Light Department for rebuilding the transmission lines on Chestnut and Washington streets, covering a distance of about 1½ miles. Estimates are also being received for placing the wires underground on South Washington and other streets, a distance of about 1 mile. William Plattner is superintendent of the municipal electric-light plant.

#### Minnesota

Floodwood.—The Cloquet Electric Co. has been granted a thirty-year franchise. They will also install the poles, string the wires, furnish the lamps and keep the system in repair.

Blue Earth.—Preparations are being made to change the municipal electric-light plant from direct current (110 volts) to alternating current (2300 volts). It is proposed to install a 250-kw. generator. The type of engine has not yet been decided upon; will use either oil or steam. Don Fitch is superintendent.

#### Mississippi

Grenada.—It is reported that ornamental lighting system will be installed on the principal streets by the Municipal Light & Power Dept.

Oxford.—City is contemplating the installation of 150-kw. generator and engine, direct-connected, and have issued \$6,000 bonds. J. H. Lawshire, City Clerk.

Pass Christian.—City will erect ornamental electric-light posts. Xavier A. Kramer, Engr., Magnolia, Miss.

Pontotoc.—The Pontotoc Electric Light & Power Co. will change system for single-phase to 3-phase and install 60-kw., 3-phase generator, 50-hp. oil engine, 40 kva. 3-phase generator and switchboards.

#### Missouri

Camden.—An electric light plant will be installed by the Missouri Gas & Electric Service Co.

Higginsville.—City contemplates issuing bonds, \$15,000, for the improvement of electric light plant.

Joplin.—A \$100,000 bond issue is contemplated for the improvement and extension of the electric-light plant. C. A. Paterson, Commr. of Public Utilities.

Kansas City.—Kansas City Light & Power Co. has incorporated with a capital of \$2,000. The incorporators are: Frank Hagerman, Clyde Taylor and E. E. Ball. Will do a general electric business and operate power and heating plants.

Kansas City.—\$50,000 bonds have been sold by the city for the extension of electric-light system.

Kirkville.—City will construct an electric-light plant and remodel water-works.

Memphis.—The city is planning to construct an electric-light plant. E. McDaniel, clerk.

Monett.—A substation will be built by the Ozark Power & Water Co. at a cost of \$40,000.

Mount Vernon.—City plans improving electric light plant at a cost of \$10,000.

Slater.—The city of Slater has purchased a 300-hp. Skinner uniflow engine directly connected to a 250-kva., three-phase, 2300-volt alternator for the municipal electric-light plant. A 33,000-volt transmission line (8 miles long) will soon be put into operation. Two or three water-tube boilers will probably be installed. L. E. Shepard is superintendent.

Springfield.—The Young Men's Christian Association is planning to install an independent electric-light plant.

Springfield.—It is reported that a municipal lighting plant is to be erected at a cost of \$60,000.

Spickard.—City contemplates electric-light system.

Warrenton.—Warrenton Electric Light, Ice & Power Co. anticipate constructing 6600-volt, 3-phase transmission line to Wright City; 8 mi.

**Nebraska**

Ainsworth.—The Ainsworth Lt. & Pwr. Co. is reported to be considering the installation of a turbo-generator in the spring.

Bloomfield.—The Bloomfield El. Co. is planning to establish a 24-hour service by June 1, 1916. Lew B. Knudsen is proprietor.

Dawson.—The State Railway Commission has granted the Dawson El. Lt. & Pwr. Co. permission to erect a transmission line between Dawson and Humboldt. It is proposed to secure energy from the electric plant in Humboldt to operate the system in Dawson.

Edgar.—The municipal electric plant is now being rebuilt, a three-phase, three-wire, 2300-volt alternating-current system being installed. It will be completed in about two months. R. C. Strawser is general superintendent.

**New York**

Esopus.—Sargo Co. has incorporated with a capital of \$150,000. Will manufacture machinery, steam traps, temperature regulators, engineering, electrical and railway supplies, etc. M. D. Isrel, 201 West 107th St., New York City; G. Huber, 1390 E. 15th St.; G. E. Kammerle, 1034 Forest Ave., Brooklyn, are the incorporators.

New York.—Nesco Corp. is the name of a company recently incorporated, capitalized at \$25,000; electrical and engineering supplies, steam packing, rubber goods, etc. J. P. Nolan, L. & R. A. Manes, 7 Manhattan Ave., are the incorporators.

New York.—Independent Electric Lighting Corp., capitalized at \$5,000; transportation, electricity for light, heat and power.

New York.—Articles of incorporation have been filed by The Ringwald-Vogel-Goldberg Co.; capital \$25,000; electricity, specialties, supplies.

New York.—The Universal Electrical Supply Co., manufacturers of wireless telegraph and telephone apparatus, general contracting and electrical business has incorporated with a capital of \$10,000. Nicolas Macoluso, Mildred Goldsmith, Albert Rubin, Manhattan, are the incorporators.

New York.—European Carbon Corp., capitalized at \$5,000, carbon, carbon products, electrical appliances, machinery equipment; H. Gugler, C. Monash, L. Hopkins, No. 1,564 Broadway.

Rockwood.—Plans are being prepared by Morrell Vroom, consulting engineer, Gloversville, for a 1,000-hp. hydro-electric power development and storage dam of 100,000,000 cu. ft. capacity for the Rockwood Mfg. Co. Work will begin as soon as the weather permits in the spring.

Seneca Falls.—A company to be known as the Seneca Power Corporation, has been organized by the water-power owners for the purpose of constructing a hydro-electric power plant just below the new dam in Seneca Falls. The officers of the company are: Henry R. Micks, president; Paul B. Kendig, vice-president; Henry B. Cutter, secretary; C. W. Maier, treasurer.

**North Carolina**

Washington.—Articles of incorporation have been filed by the Washington Lighting Co., capitalized at \$150,000, the incorporators being J. T. Bland and Stephen C. Bragan, of Washington, and Clawson Bachman, of Philadelphia, Pa.

**North Dakota**

Van Hook.—The installation of an electric-light plant by the town is under advisement.

Sheldon.—The Town Council has passed an ordinance granting Frank E. Corson & Co. a franchise to construct and operate an electric-lighting system in Sheldon.

**Ohio**

Cannelville.—The power-house of the Rise Hill Mining Co. was recently destroyed by fire at a loss of \$15,000.

Cleveland.—The Joseph Philips Company, dealing in electric and gas appliances, has been incorporated with a capital of \$10,000. Joseph Philips, Milton Philips, Eugene E. Wolf, Julius Bloomberg and M. G. Sloss are the incorporators.

Cleveland.—The Fitch Electric Company has filed articles of incorporation, capitalized at \$30,000; general electric business; J. A. Fitch, A. T. Fitch, S. A. Armstrong, F. H. McCollough and Philip R. White are the incorporators.

Cleveland.—The Elliott-Thompson Electric Company has incorporated with a capital of \$20,000. The incorporators are J. N. Elliott, M. B. Elliott, T. Thompson, J. P. Elliott, Ted Howard.

Cleveland.—Articles of incorporation were recently filed by a firm operating as the Service Electrical Company, capitalized at \$10,000, Maurice Harbinsky, Max Simon and Benjamin Stern being the incorporators.

Dayton.—The Dayton Power & Light Company contemplate constructing a mammoth power plant at Miller's Ford, south of this city, at an approximate cost of \$1,000,000.

Dresden.—The Dresden Electric Light is the name of a corporation just formed by Maxwell Frazier, Wm. C. Lemert, C. M. Haas and Wm. A. Walcutt, with a capital of \$10,000.

Kent.—Plans are being considered for the installation of a municipal electric-light plant to cost about \$35,000.

**Oklahoma**

Durant.—The Durant Ice & Light Co. will construct a high-tension line to Caddo.

Enid.—The Enid Electric & Gas Co. is reported to construct a transmission system to furnish light and power to Lahoma.

Gotebo.—The Gotebo Lt. & Pwr. Co. is now installing a 25-kva. generating unit and changing its system from direct current to alternating current. J. A. Litel is president and manager.

Mountain View.—City voted \$8,000 bonds for electric-light plant.

Stratford.—The proposal to issue \$10,000 in bonds for the installation of a municipal electric-lighting plant will soon be submitted to the voters.

Tuttle.—The installation of an electric-light plant in Tuttle is under consideration by the City Council.

**Pennsylvania**

Alburtis.—The Lehigh Valley Lt. & Pwr. Co., Allentown, has been granted a franchise to supply electricity for lamps and motors in Alburtis. The transmission lines will be extended from Macungie, a distance of about 3 miles.

Bethlehem.—The Roller-Smith Electrical Company is building a \$30,000 addition to its plant, and will increase the number of its employees.

Harrisburg.—Charters have been granted by the State to the following companies: The Farmers' El. Cos. of East Lampeter Township, of Manheim Township and of Upper Leacock Township, all in Lancaster County. Each company is capitalized at \$5,000 and John H. Ware is treasurer.

Philadelphia.—Plans are being prepared by William Steele & Sons, architects, 1600 Arch street, Philadelphia, for the erection of four five-story brick and reinforced concrete buildings to occupy an entire city block between Twenty-fifth, Twenty-sixth, Reed and Dickinson streets for S. B. & B. W. Fleischer, Inc. The main power plant will be in the center of the block. The total cost of the project is estimated at \$1,000,000.

Pottsville.—The Eastern Pennsylvania Light, Heat & Power Company is the title under which eight electric service companies recently received charters to operate in Schuylkill County, and in addition will bear the name of the locality in which they will operate. Each company is capitalized at \$5,000; have combined offices at Pottsville. The incorporators are: W. B. Rockwell, Vandusen Rickert and Ira G. Walborn.

Philadelphia.—An ordinance has been introduced in the City Council asking for an appropriation for lighting in the city hall from 6 p. m. to 12 p. m. every night in the year. The plans provide for installation of additions to the present plant and additional lamps to flood the William Penn statue, to cost about \$9,000. The Mayor has extended the original plans to include the installation of 200 lamps on Broad street, from Oregon to Albany avenue, which will increase the cost to about \$20,000.

**Tennessee**

**Humboldt.**—The city is planning the extension of the electric-light system to small towns within a radius of 12 miles.

**Kingsport.**—The Federal Dyestuff & Chemical Co., of 30 Pine St., New York, will construct a steam-driven electric power plant here at an approximate cost of \$100,000; equipment to include steam turbine-drive a.c. generators and either rotary converters or motor generator sets. The engineering and erecting contract has been awarded to the Southwestern Engineering Co., Bristol, Va.-Tenn.

**Kingsport.**—The Clinchfield Portland Cement Corp. contemplates building a 7,000 to 10,000-kw. electric power-distributing station, and will extend and enlarge their present power plant for this purpose. The plans contemplate most modern design with latest power-generating machinery. Full details can be obtained from L. L. Griffiths, Gen. Supt. Kingsport.

**Nashville.**—Nashville Railway & Light Co. will install sub-power station between West Nashville and West End car lines.

**Sevierville.**—Sevierville Milling Co. will construct a lighting plant.

**Friendship.**—Local electric-light plant is reported to have been purchased by W. H. Sudbury. The new owner, it is understood, will make improvements to the property.

**Texas**

**Beeville.**—Plans have been completed for the improvement of the Texas Southern Electric Co.'s plant.

**Bryan.**—It is rumored that the city is contemplating the construction of an ornamental lighting system, consisting of 54 standards on Main St.

**Center.**—The Texas Southern Electric Co. has purchased the Pittman Ice & Light Co. plant which they will improve, reconstruct wiring, install new machinery and remodel old equipment.

**LaPorte.**—LaPorte Water, Light & Ice Co. contemplates building 3 mi. transmission lines; poles have been purchased.

**McAllen.**—McAllen's Public Service Corporation will expend \$25,000 for machinery for new electric light plant.

**Marble Falls.**—M. M. Barry, lessee of the local electric light and water plant, contemplates installing new machinery and making other improvements.

**Nixon.**—The City Council has been petitioned for franchise to build electric light plant.

**San Angelo.**—Crowther-Shield Electric Co. has been incorporated with a capital of \$3,000. Incorporators: Lawrence Westbrook, J. E. Crowther and J. A. Shield.

**Sherman.**—Texas Traction Co. will rebuild burned substation.

**Sour Lake.**—Sour Lake Ice & Light Co. contemplate incorporation and will operate combined electric light and ice plant; will construct brick or cement building; total estimated cost \$40,000.

**Troup.**—Troup Light & Power Co. will install 50-hp. oil engine and 40-kw. generator.

**Virginia**

**Boyce.**—The Northern Virginia Power Co., of Winchester, contemplates constructing an electrical transmission line from Boyce to Riverton via White Post.

**West Virginia**

**Buckhannon.**—The city of Buckhannon is considering the purchase of the property of D. T. Farnsworth and is planning to convert it into a power house to furnish electricity for the city and to establish a high-pressure water system.

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# ELECTRICAL AGE

*The National Monthly of Electric Practice*

*Technical Journal Company, Inc., New York*

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Vol. 48

MARCH, 1916

No. 3

## High-tension Outdoor Substations

*Some of their Advantages and Costs*

The problem of furnishing electricity supplied to isolated communities and consumers has received much attention during the past few years, and is now recognized as an undertaking deserving the most careful consideration of central station managers. The desirability and necessity of giving service to outlying territories is unquestioned—providing the investment and maintenance charges insure a fair return.

Prior to the building of transmission networks and high tension distribution feeders radiating from a central point to smaller communities, the cost of individual lines to reach small consumers, combined with the high cost per kilowatt of switching and protective equipment, practically closed a field now being rapidly developed.

The outdoor substation, as has been frequently pointed out, owes its origin to the desire of the power company to reach the small, out of the way, consumer. This prospective customer, possibly a farmer desiring to install electric light and power, or a small manufacturer or even a village with a few street lights, could not, for a number of years at least, purchase power in sufficient quantity to make the construction of an indoor station an economical proposition.

Therefore, before the advent of the outdoor substation, it was generally necessary for the farmer to get along without electric power, and for the manufacturer either to install a small power plant of his own, or to joint with some of his neighbors in building a co-operative plant, with a short distribution line between them. The former was uneconomical for the manufacturer, and not a source of revenue to the power company, while the latter might also in course of time become a serious competitor.

The consolidation and unification of central station systems has resulted in a large mileage of transmission lines passing through districts ready and waiting for electrical development. The problem of supplying electrical energy to the rural districts has forced itself to the front as a real commercial and utility proposition, and the large number of isolated plants installed at high expense and operated under great disadvantage is an indication that the rural population is demanding and will secure electric service.

A few central station managers still believe that high

tension distribution will not pay. If the plant were to supply a single consumer or a small group at a considerable distance from the generating station, it must be admitted that such an opinion would be valid, but the supplying of current from high tension transmission systems is not being developed along such narrow lines.

The problem has resolved itself into the building of lines from a large-capacity centralized plant to a definite point where a load of suitable characteristics to justify the expense can be secured. From these high tension feeders branches are run to farmers, mills, stone quarries, grain elevators, irrigation projects, railway pumping installations, dairy farms, canning factories, brick or tile plants, excavating shovels, etc.

### SUPERSEDING OF SMALL GENERATING STATIONS

The small generating station supplying a town or village is at a distinct disadvantage in the generation and distribution of electricity as compared to the larger stations. This condition is due to the small amount of power generated, the poor load factor, and the fact that the enterprise does not justify the employment of high class engineers or operators characteristic of larger systems. Small generating stations will, therefore, be quite generally superseded by outdoor sub-stations tapping high tension transmission lines.

With one or more small towns as a nucleus, the transmission line is built—the first step towards supplying an entire district or even county from a centralized plant. Supplying of power along the main transmission lines then becomes a comparatively simple matter, and many possible installations heretofore considered undesirable come to the front as good commercial investments. In addition to supplying current to those who heretofore have without its conveniences, the various isolated plants in a given territory will gradually be connected and tend to help raise the load factor of the entire system.

### SOME TYPICAL SUBSTATIONS

A single transformer attached to a pole represents the outdoor substation in its primitive form. Then for heavier loads, two or three transformers are mounted on a platform between two poles, with the switches above, or on adjoining poles.

Fig. 1 shows the cheapest type of station, 11,000 volts. The platform is mounted on two poles and the lightning protection apparatus is mounted on a separate pole.

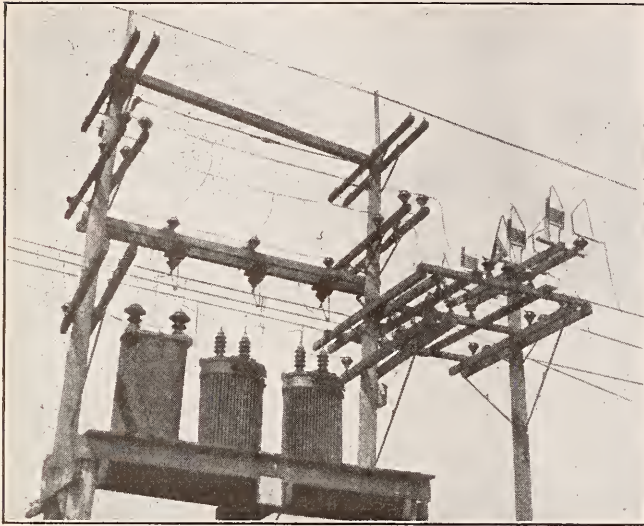


Fig. 1—A Simple, 3-phase Wooden Substation

Fig. 2 shows a station of this type for a 22,000-volt line. It consists of four wooden poles with the switches and protective apparatus at the top mounted on galvanized steel channels, and the transformers resting on a wooden platform supported by channels.

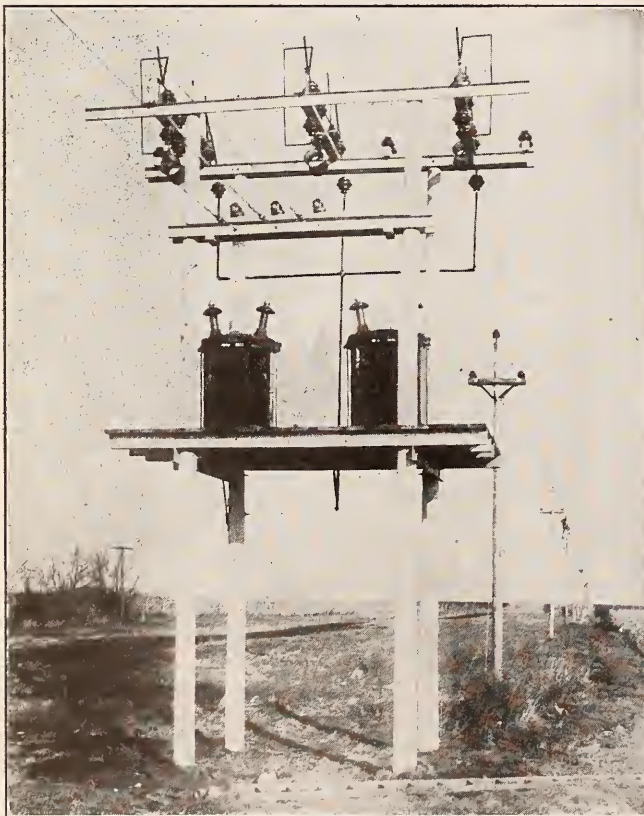


Fig. 2—A Better Type of Wooden Substation

Fig. 3 shows a 33,000-volt, 900-kv-a. substation at Bennington, Vt. The switches are supported on a pipe

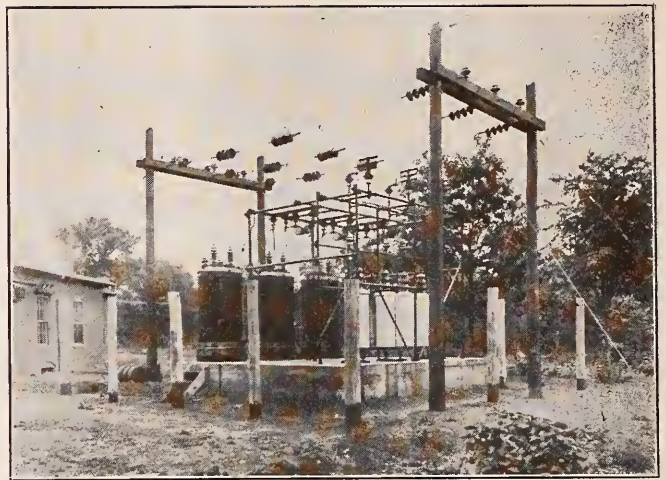


Fig. 3—Combined Wood and Steel Substation

frame and the transformers rest on a concrete platform. To the writer, this seems a preferable arrangement, as it keeps the heavy transformers near the ground where they can be more easily inspected and repaired. The butts of the poles shown in the photograph surrounding the platform are to carry a wire fence to keep too inquisitive strangers at a safe distance.

Many of the smaller substations built of steel have their transformers up in the air, and are provided with one or more jib cranes for handling them. It would seem, in general, more desirable to carry the transformers on a concrete or steel platform near the ground and if necessary to provide a fence for the protection of the public. This is almost invariably the custom with the larger stations.

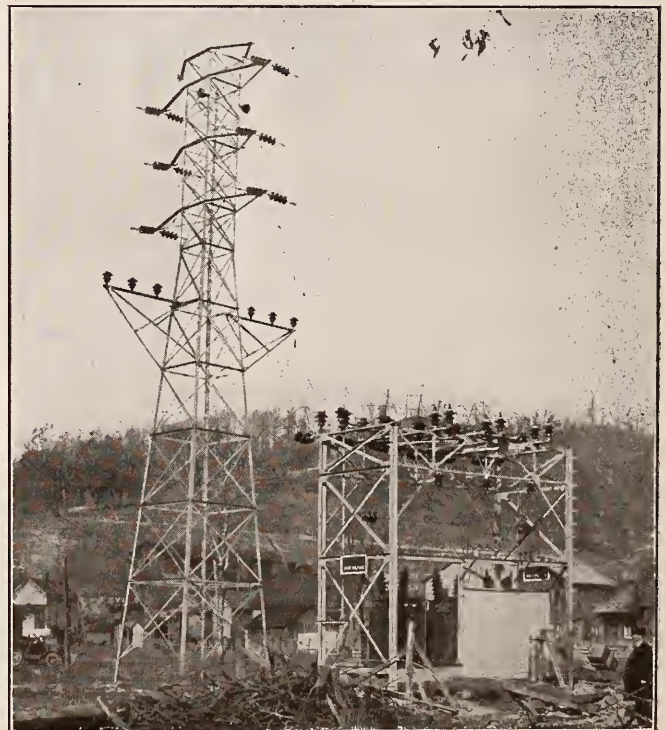


Fig. 4—Galvanized Steel Substation and Line Tower Adjacent



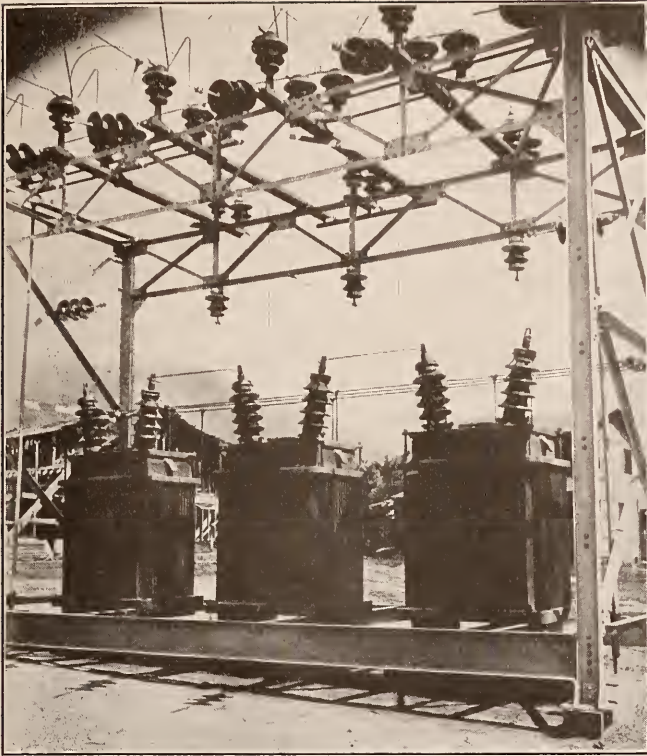


Fig. 5—Galvanized Steel Substation Details

Fig. 5 shows a galvanized steel outdoor substation of the Virginia Power Co., at Mt. Hope, W. Va. Fig. 4 shows the location of the station with respect to the transmission line, and Fig. 6 shows details of the wiring

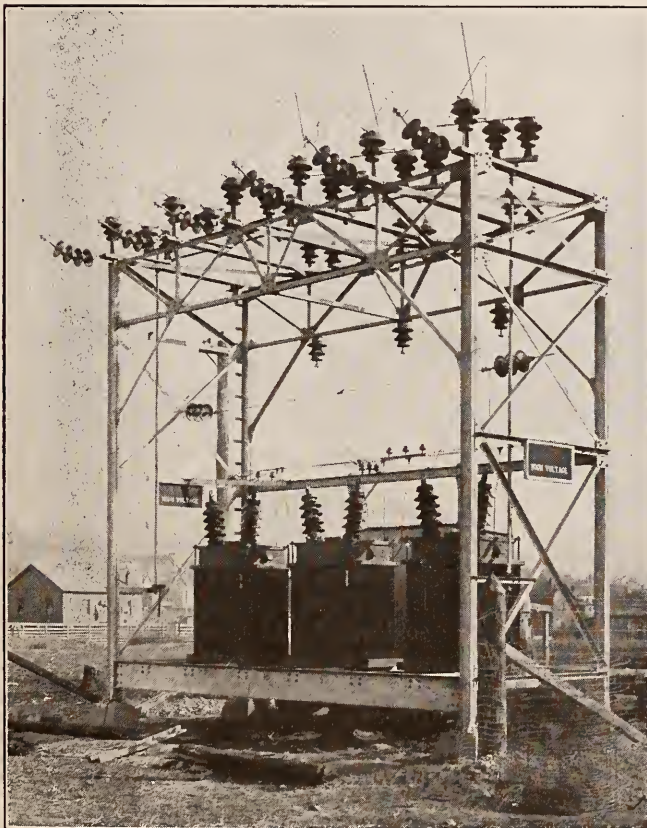


Fig. 6—Details of Another Modern Substation

on the switches and transformers for a similar station of the same company.

With the perfection of the equipment for outdoor service made necessary by the requirements of the small outdoor substation, there has come into existence the large outdoor station, in direct competition with the indoor station. The largest of these yet in operation is the Atlanta substation of the Georgia Railway and Power Co. This has a present capacity of 30,000 and an ultimate of 60,000 kw. with a voltage of 110,000.

Many of these larger stations are of a combination type, in which the high voltage and bulkier apparatus, which would make an in-indoor station large and costly, are placed outside, while some of the lower voltage secondary equipment is placed inside.

#### OUTDOOR SUB-STATION COSTS

When considering the use of outdoor sub-station equipment, one of the first questions is—how much will it cost? As a ready reference in making up cost estimates, the values—given a little further on from actual practice under normal market conditions—can be used. The present tendency toward increase in cost of raw material should be taken into consideration when making estimates. Furthermore, the prices of equipment include standard horn gap lighting arresters—and when more expensive forms are used the cost will be correspondingly increased.

The principal advantage of the outdoor substation over the indoor type, and, as has already been pointed out, the main cause of its popularity to-day, is its lower first cost. This is especially true for the smaller and middle sized stations where the saving is probably from a third to a half. For those of the larger class, where the combined indoor-outdoor type is necessary, the economy over an all-indoor station is sometimes not so evident. The equipment which is placed out of doors reduces the size of building necessary, but at the same time is more expensive, and occupies more ground than if it were placed inside. Therefore it is possible to conceive of a condition where, with land values high, the first cost of the indoor station would be the lower. Possibly a saving of from 10 to 15 per cent. would be the average for this larger size of station.

It is difficult to give figures that would be of much value as to the cost of outdoor substations. Conditions in different localities may vary so much that the problem which can be solved satisfactorily in one place, in one manner, will require radically different treatment in another.

The wooden station is generally the cheapest—in first cost at least. The cost of the equipment decided upon can be accurately determined from the manufacturers, and the cost of furnishing and installing the wooden poles and transformer platform, whether of wood or concrete, and putting the equipment in place can be pretty closely estimated, with a knowledge of the location and the conditions to be met. The cost of the structure itself, is only a small part of the total cost of the station, so that a fairly accurate estimate can be prepared.

In general, the first cost of a steel structure will be from two to four times as much as one of wood. The steel frame, however, will be stronger, can be expected to have a much longer life, and will present a neater

appearance. Frequently these properties can be made use of in securing new business, as the customer will feel more secure against interruption to service due to mechanical failure.

With the price of steel advancing as it has recently, from two to six dollars a ton per month, and with galvanizing costing three times what it did at the outbreak of the war, an accurate estimate of the cost of a steel structure to-day may be worthless a few months hence. Copper, of course, has also advanced to high prices, but fortunately the cost of equipment, of foundations and of labor have not risen so rapidly, so that the total cost of the completed substation will not show so great a proportionate increase.

The approximate cost of a steel frame similar to that shown in Fig. 6, based on present market conditions, and erected on concrete foundations ready for equipment should be about as follows. The station is 21 ft. long, 8 ft. wide and 17 ft. from the ground to the top of steel, and is designed to carry 3 250-kv-a. transformers.

Steel (painted and delivered at site)	=	\$300.00
Erection	=	75.00
Foundations	=	100.00

Total = \$475.00

For galvanized instead of painted material, the cost should be

Steel (galvanized and delivered at site)	=	\$425.00
Erection	=	75.00
Foundations	=	100.00

Total = \$600.00

These figures are for average conditions only. A considerable part of the items for erection and founda-

tions will be for getting men, plant and materials to the site, so will vary greatly with the location.

It is evident that so long as galvanizing remains at its present abnormal figures, there will be a considerable economy in using a painted structure, and painting it in two, three or four year periods.

Another advantage for the outdoor station is the ease with which it may be extended when conditions demand.

#### HIGH CAPACITY SUB-STATIONS

A typical high capacity form of steel tower station is shown in Fig. 8, and is well adapted for use where large initial or future loads are contemplated. The standardization of steel tower sub-stations has revolutionized old practice—and will prove a vital feature in selling power from high tension transmission lines.



Fig. 7—Substation With Switch House

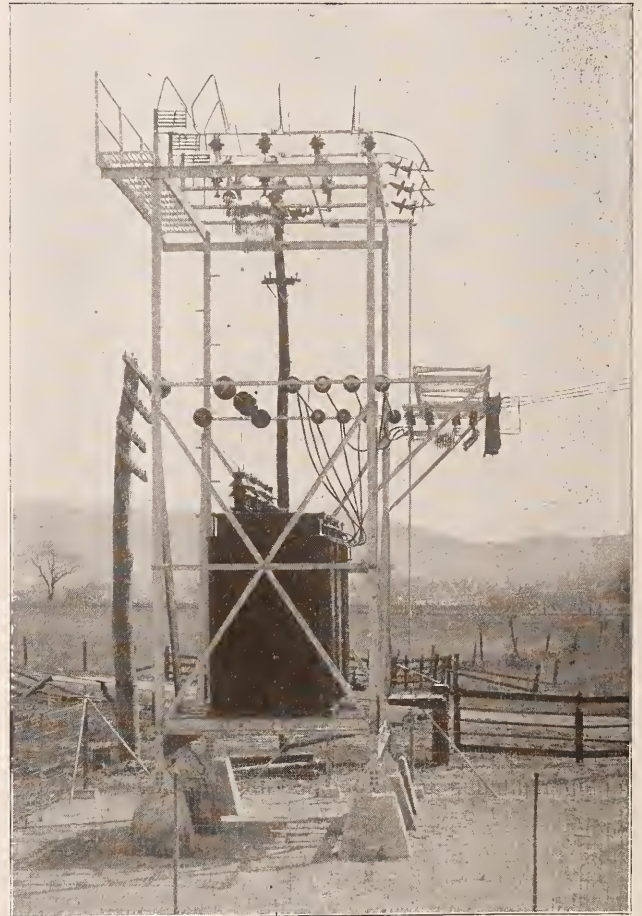


Fig. 8—A High Capacity Substation

#### STEEL TOWER SUB-STATIONS

The outdoor sub-station shown, comprises a supporting structure, a high-tension, air-break switch, a set of primary fuses, choke coils and lightning arresters. The primary fuses are so located and rated that protection is secured against current rushes, which would endanger the transformers.

In case of transformer failure the fuses instantly clear the line and prevent a local disturbance from spreading to the main transmission system. Protection against ordinary overloads or secondary short circuits is secured by the use of fuses or automatic oil circuit breakers.

The high tension switches are so constructed that all phases are simultaneously opened or closed by means of a single control handle. Arcing horns prevent burning of the main contacts during opening.

The lightning arresters are so constructed that they do not require daily attendance, and limit current flow to ground when discharging.

METERING EQUIPMENT

The usual method of metering power is to install suitable meters in a steel housing at the base of the tower, as shown. This method does not register the transformer losses—which, however, are quite constant and easily computed, and can be allowed for when making the rate.

The advantage of secondary metering is that the use of high cost potential and serious transformers necessary when metering the high tension side is avoided. As a rule, the metering equipment is mounted on a small panel which also carries an automatic oil circuit breaker with inverse time element relay. This panel also carries the necessary feeder switches, indicating or graphic recording instruments.

OTHER COST DATA

NET COST PER KW. OF OUTDOOR, 3-PHASE SUBSTATION  
33,000-VOLT EQUIPMENT

Station Capacity.	No. of Trans.	Transformer cost per k. w.		Cost per k. w. of High Tension Switching and Protective units.
		25 Cycles.	60 Cycles.	
45	3-15 k. w.	\$25.00	\$20.00	\$6.25
60	3-20 k. w.	20.50	16.50	4.75
75	3-25 k. w.	18.00	15.00	3.80
90	3-30 k. w.	16.00	15.00	3.10
120	3-40 k. w.	12.50	10.50	2.50
150	3-50 k. w.	11.00	9.00	2.00

TOTAL NET COST OF STEEL TOWER 3-PHASE OUTDOOR  
SUB-STATION

(With 3 single-phase 33000/2300 volt transformers)

Station Capacity.	No. of Trans.	25 Cycle Station per k. w.	Total Cost.	60 Cycle Station per k. w.	Total Cost.
45	3-15 k. w.	\$35.50	\$1597.00	\$30.25	\$1361.00
60	3-20 k. w.	28.50	1710.00	24.50	1470.00
75	3-25 k. w.	24.50	1897.00	21.50	1612.00
90	3-30 k. w.	21.50	1935.00	18.25	1642.00
120	3-40 k. w.	16.75	2010.00	14.50	1740.00
150	3-50 k. w.	14.25	2137.00	12.00	1800.00

The decrease in cost per kilowatt with increased capacity of station is worthy of note. This indicates that the original installation should be such that as the load increases the station capacity can be increased at the

least possible expense. With the standard control and protective equipment now available it is only necessary to replace the original fuses with others of heavier rating, when increasing the station capacity.

SOME ADVANTAGES OF OUTDOOR TYPE

There should always be less danger from fire provided that proper precautions are taken against grass or brush fires in dry weather.

The advocates of the indoor substation are inclined to point out the greater risk to the public from the outdoor station, the greater difficulty in making repairs and a less reliability of service.

It would seem that if the structure were surrounded by a stout fence, the danger to the public would be eliminated.

It is true that making repairs in an outdoor station during a heavy storm, when breakdowns may most reasonably be expected, is not an easy task. The only remedy is to provide the best possible construction consistent with the importance of the station. It is not economical to add considerably to the cost of an installation to provide absolute immunity from interruption, in cases where minor difficulties at infrequent intervals will cause little trouble.

In general wires and equipment should be arranged so the men may do necessary work around them with the least possible danger of accident. Transformers should be placed on substantial foundations, with convenient facilities for repairs. In some of the larger stations a truck is provided running on rails between the banks of transformers so that any transformer can be carried directly to a covered repair shed at one side of the yard.

With reference to the greater reliability of the indoor station, it should be remembered that outdoor substations are as yet only in the infancy of their development. Their successful operation in all parts of the country from Florida to Canada proves that the difficulties which first retarded their success have been successfully overcome. Switches that will work even when covered with ice, and transformers whose circulating systems do not freeze are now fully developed. There appears to be no reason why the defects which appear from time to time should not be completely remedied, so that the outdoor substation will become more and more valuable in the official and economical distribution of power.

\* \* \*

Mangesite Scarcity Hinders Electric Furnace Making

On account of the difficulty in obtaining mangesite, a mineral which is used in making brick for lining electrical furnaces, it is feared that there will be delays in the delivery of new furnaces unless a satisfactory substitute can be obtained. Mangesite is a magnesium-bearing clay which is usually obtained from Hungary. There are some deposits in the West, particularly in California, which are now being developed. The price of the mineral has advanced 300 per cent. since the war began. Mangesite has a basic reaction and is essential in the process to get rid of sulphur and phosphorus.

Making Coke and Electric Power Combined

A project has been under consideration in Pennsylvania by which a company was to be formed to establish a coking plant in a new location, selling its by-product of gas to another company that would generate electric power from it; this concern to distribute the current through a certain part of Pennsylvania and to enter into particular contractual arrangements with an important railway that would thus obtain power for a contemplated mountain electrification much more cheaply than it could itself generate it, at the same time saving the cost of capital necessary for its own power houses and the cost of operating them.

# Testing Insulating Materials for Dielectric Strength

By Kennedy G. Rockworth

Assimilation of knowledge and friendly co-operation of the various national societies and manufacturing associations has enabled standardization to enter in all walks of life. This is particularly true in the engineering industry where almost all structural work and material of importance is ordered and installed on specification, which is possible only through standardization. The purchase of material on specification—which is now being done by not only the large company but also by the small—gives one a feeling of security, but this must be backed up by tests to determine whether or not the specifications are being adhered to if the security is to be fully realized. To test all material as received from the manufacturer requires a staff of chemists and engineers with a complete and extensive laboratory at their disposal because there are so many materials to be tested, each with an almost endless variety of uses. In the electrical branch of the engineering industry adherence to specification, in so far as uniform quality of material is concerned, is so closely related to reliability of service, safety to persons and apparatus, and economy of operation, that the necessity of closely watching the quality of material supplied, and strictly enforcing adherence to specification in certain classes of material is of paramount importance.

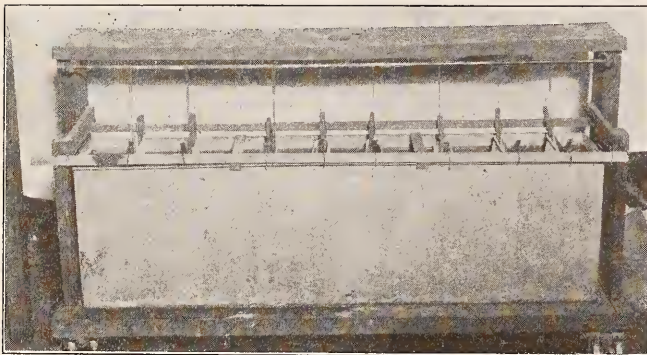


Fig. 1—Method of Testing Rubber Gloves

Perhaps no material plays so important a part in the electrical industry as do insulating materials. Be it in the generation, transmission, distribution and consumption of electrical energy, insulation enters as the chief factor. It is thus of vital importance that the insulating materials used for any application be suitable for the purpose, and capable of remaining so. The chief requirement of an insulating material is that it should be capable of insulating, and this, in turn, depends upon its dielectric strength. Since the dielectric strength is the criterion of an insulating material, ignoring the other physical and mechanical properties, it is apparent that the testing for dielectric strength is a very important test. Testing materials completely adds, of course, to the purchase price of the material: in the large company this additional expense is usually significant on account of the large quantities of material purchased, but with the smaller company it may be serious item, and one which may prohibit the testing. Tests for dielectric strength may, however, be carried out at a very small cost, low initial investment, and with little loss of time, whereas complete determinations for the various characteristics would be costly and tedious. The purpose of this article is to discuss the commercial testing of insulating materials in a general and elementary way.

Testing of insulating materials may be divided into two classes, namely research tests and routine tests. Research tests are undertaken to find out the complete characteristics of a

material, its behavior under a large number of conditions, practical and academic, in order that conclusions may be drawn as to its fitness for any specific application. Routine tests, on the other hand, are carried out as an assurance against the use of faulty material and to insure the acceptance only of suitable material, and uniform quality in the same and different shipments from the manufacturer. It is with these latter, routine tests, that we are concerned.

In making routine tests for dielectric materials it is necessary to remember that such tests may be divided into two classes. One of these embraces all tests made to determine whether or not a material or piece of apparatus is capable of withstanding a certain pressure, usually considerably higher than that which it will be subjected in service. The other class embraces all tests where potential is applied until the dielectric fails, that is, breaks down. Throughout the following the tests of the first class will be known as high potential tests, those of the latter as breakdown tests. It is important to discriminate between these two, for the former is merely a test applied to a piece of apparatus before placing it in service and is practically harmless in its influence on the material, whereas in the latter the test piece is always tested to rupture, and is thus always ruined, for the time being at least. Many com-

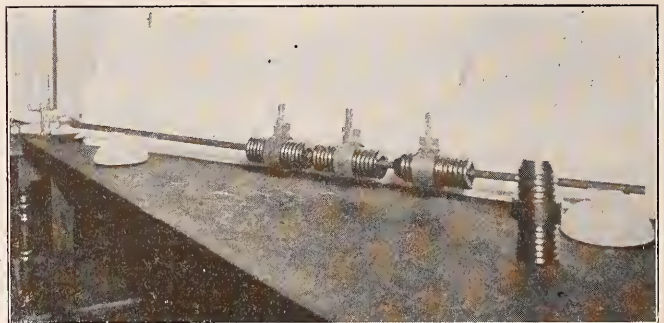


Fig. 2—Method of Testing Bushings

panies test all insulators, insulating bushings, rubber gloves, rubber mats, etc., at over-voltage before using them; and in addition test a certain percentage to destruction.

It must be obvious that the company which purchases all material on specification, and refuses to accept anything that fails to conform to standard, obtains better material and greater consideration than the company that pays for anything the manufacturer cares to furnish. Better material means better service—fewer failures and shut-downs, higher degree of continuity of service, lower maintenance expenses for normal operation and emergency work, lower life risks to employees and public—and it can be seen that the saving in these items, not to mention the other factors which can hardly be capitalized, will go a long way toward making the testing of insulating materials a paying proposition. The number of companies carrying on this class of work is continually increasing as the benefits from doing so are coming to be more fully realized. That more central station companies are not testing their materials is because they fail to appreciate the advantages of doing so or on account of lack of knowledge of how to do it. The object of this article is to discuss in an elementary way the testing of solid and liquid and dielectrics, the errors to be guarded against, and the apparatus required, in the hope that it will awaken the smaller company to the realization of the value of testing their apparatus and materials before placing them in use.

## HIGH POTENTIAL TESTS

Routine high potential tests are made to assure that only material which is electrically strong is installed. While making the test inspection should discover any mechanical defects. The test is applied to apparatus and materials before it is placed in service, sometimes after installation. The potential is applied for one minute, the time of application being considered from the instant full potential is reached. The potential applied depends upon the normal rating of the apparatus, and should conform to the test voltages specified in the AIEE Standardization Rules.

The arrangement of material for test is largely a matter for each individual case; but since the material or apparatus is to be used it is best where possible to submit it to similar conditions such as it will meet in practice. Current and potential transformers present no difficulty, but with many forms of bushings and insulators it is necessary to make special provision for subjecting the whole material to potential stress. The manner of doing this is shown in Fig. 1 and 2. Fig. 1 shows a number of rubber gloves being given a routine test, while Fig. 2 shows a number of insulating bushings being tested at once; note the tin foil used to cover the surface of the insulator and assure all parts of the insulators being subjected to stress.

## BREAKDOWN TESTS

This test is usually applied to samples of materials or to a certain percentage of all consignments to orders. The test-piece is always tested to destruction, that is until puncture occurs. For this purpose some form of electrode is used, the material being placed between two of them and potential then applied until the test piece ruptures.

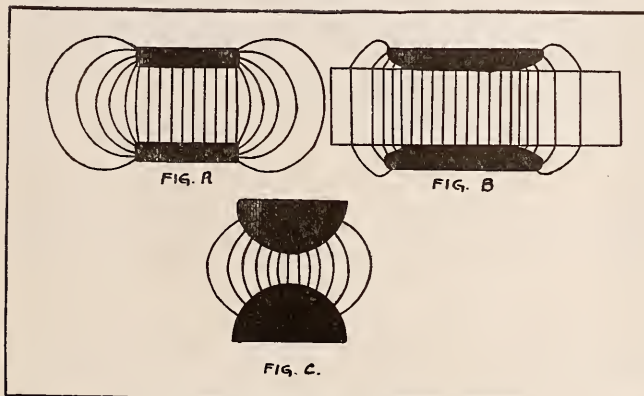


Fig. 3—Distribution of Electric Flux

When high potential is applied to an insulating material molecular strain results, the extent of this strain depending upon the flux density per unit of area. When the flux density, or potential gradient exceeds a certain critical value breakdown occurs. It is this value that is known as the dielectric strength. This value will always be found to be much lower than the maximum gradient at the point of rupture. The flux density varies with the shape of the electrodes and their spacing, as does also, therefore, the puncture voltage; and from this it follows that if different but similar materials are to be tested for dielectric strength, the electrodes should have the same shape and spacing and size if the results are to be readily comparable. For voltages such as may be expected in ordinary commercial testing the electrodes might well consist of brass disks 2-in. (5.08 cm.) in diameter, and one set 1-in. (2.54 cm.) in diameter. The corners may or may not be rounded, according to choice, but it is preferable to have a radius of about one-tenth the diameter of the disk. When disks have square corners the flux tends to be highly concentrated at the edges, whereas with corners rounded the flux distribution will be more uniform.

In the former case there will be little corona while in the latter the corona will be more pronounced, and therewith the resulting heating. As the test voltage is usually raised rapidly the flux density is of greater importance than is the heating due to corona. The flux distribution with electrodes of different shape is shown in Fig. 3.

In placing the electrodes and test-pieces care should always be taken that they are not near enough to extraneous objects for the voltage gradient to be affected, and the results therefore. The surfaces of the electrodes and specimens must be thoroughly cleaned of all dirt and grit, and the electrodes should cover the dielectric squarely and firmly because dirt and air-pockets may introduce large errors on account of the re-distribution of flux around the substances having different individual specific inductive capacities.

Many materials, from their nature, have such irregular surface that it is necessary to close up the air spaces or fill all interstices between electrodes and test-piece. The manner in which this is done depends upon whether the test is merely a high potential or a breakdown test. If the former tin foil or water are usually used, the object being to offer a maximum surface to the test voltage. If the test is for breakdown more care should be exercised in both the choice and arrangement of filling the interstices because of the re-distribution of flux that occurs when materials having different specific inductive capacities are connected in series.

The pressure exerted by the electrodes upon the test-pieces should always be the same for the same material, and it is most desirable to keep this pressure constant wherever possible with various substances. In deciding upon what pressure to apply it is well to remember that it is not so much what the actual pressure is as that it be constant throughout the test. The most advantageous pressure to apply will, of course, differ with the different materials, but for most cases about 100 grams per sq. cm. or about 1.42 lbs. per sq. in. is a good value.

The breakdown voltage will be found to depend very largely upon the length of time the potential stress is applied, on account of the heating due to energy losses—dielectric hysteresis, ionization, and possibly conduction. For this reason the rate of increase of potential should always be the same. For simple breakdown tests a rate of 1,000 volts per second until puncture occurs is a good rate of increase, as by this means the influence of heating is reduced to a minimum. In raising the voltage, care should be taken that it is possible to read the voltmeter correctly to within two per cent. of the true breakdown value. This will be the case if the voltmeter used to be practically dead beat. It is well to standardize the rate of increase of voltage, and for this about 1,000 volts per second is recommended.

There is another way of finding the breakdown strength of a material, and it is often used in the laboratory since it gives one a valuable insight into the practical behavior of a substance. It consists of raising the potential in increments of 5 per cent. in one minute intervals, starting at an initial voltage of, perhaps, 50 per cent. of the final breakdown value. If the test is performed in this manner the voltage obtained will, with solid dielectrics, be considerably lower than when the voltage was raised as rapidly as possible, since in this case the heating effect will have considerable influence. The former method, namely the rapid raising of voltage, is satisfactory for the usual commercial tests, and is the one usually used, because the tests are performed to determine only the approximate insulating properties of the sample.

## VOLTAGE CONTROL

Close control of the voltage is most essential if satisfactory results are to be expected. If a special generator is to be used for this work good voltage control can easily be obtained by operating the field. It is advisable to operate the generator at near normal pressure as possible, lest the wave-form and

regulation be affected; this can be easily accomplished by the use of parallel-series connections of the low-tension coils of the testing transformer. A method that will practically eliminate the armature reaction due to out-of-phase current, and hence prevent wave distortion is what is known as the "potentiometer method" of control. This method consists of placing non-inductive resistance across the generator circuit while the generator operates at normal pressure; the low-tension coils of the testing transformer are then connected across this resistance, or any portion of it, so as to receive the required pressure. This method permits of obtaining very easily any voltage desired within the range of the generator. Experience indicates that it is only when the energy required for the test is considerable, or when the voltage is very high and the electrodes large, that such a refinement as this is really necessary.

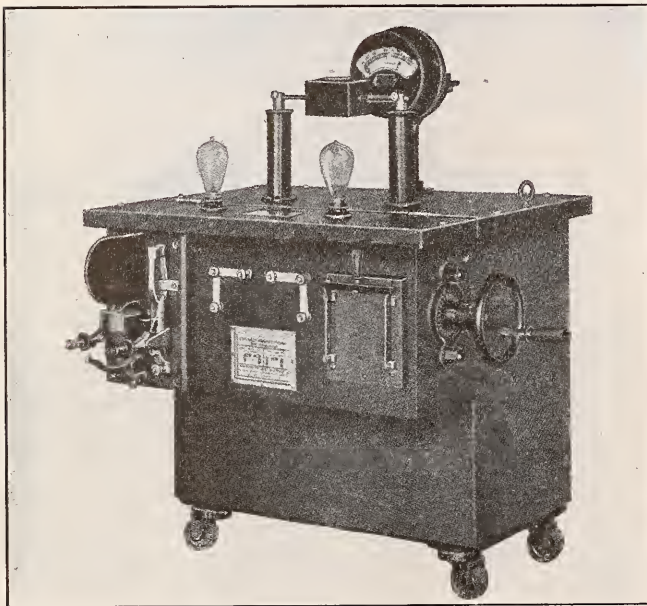


Fig. 4—Small Portable Testing Transformer

#### MEASURING THE VOLTAGE

There are a number of different ways of measuring the voltage, all of which have their advantages and disadvantages, and in choosing any one method it is really a matter of using the one which has the fewest disadvantages and which will be of use for the greatest variety of work. One method, and the most commonly used, is to place a voltmeter in the primary of the testing transformer, which in this case is, of course, the low tension side, and assume that the voltage on the high tension side is equal to the ratio of transformation or number of turns. This method is safe, simple and inexpensive to employ, but on the other hand, may be in comparatively large error due to charging current and wave distortion. For voltage up to 60,000 volts, and for the electrodes of the sizes before mentioned this will be the satisfactory one to use. Sometimes a voltmeter is placed in the secondary of another transformer which is connected in the high-voltage test circuit, but this method necessitates having on hand another transformer with a voltage rating the same as that of the highest test voltage, it complicates matters, takes up space, and is about as accurate as the other method. Still yet another method consists of building a voltmeter coil in the high tension winding of testing transformer; from this winding taps are brought out so as to give various ratios for the different test voltages—a very valuable feature where many different voltages are used—at the voltmeter. This method is claimed to be quite accurate, the effect of load, power factor, etc., having little effect; it is convenient and safe while at the same time simple.

Spark gaps, which may be composed of needle points or spheres are also used extensively, exclusively for very high voltages. Both are liable to error due to wave-form, ionization, transients and growth of charge, while humidity and temperature have to be corrected for. The chief advantages for high voltages, of these methods, the spheres are preferable, is that maximum potentials are measured instead of effective values; since the puncture potential depends upon peak values rather than on the effective, this is a valuable feature. For the class of work here supposed neither gaps are needed, because the voltages are hardly high enough for them.

Static voltmeters are quite often used. This method consists of connecting a static voltmeter to one or more condensers which may be cut in or out of circuit by means of switches. For example: one voltmeter could be used for 25,000, 50,000, 75,000 and 1,000,000 volts by means of condensers which are all in series for the highest voltage, but being shunted by a switch as the lower voltages are used, until for 25,000 volts there would be only one condenser in circuit.

Of the methods mentioned the one best applicable to the present work—all-round usefulness with reasonable accuracy—is the ratio method, either with the voltmeter across the primary of the testing transformer direct or connected to a voltmeter coil. Both methods are inexpensive, are economical of floor space, and are accurate enough for all commercial requirements. The voltmeter coil is the more preferable of the two, but is only available when a special coil has been built into the transformer, of course. In ordering a testing transformer it would be advisable, in any case, to have this coil built in, lest it should be needed at some future time.

#### ALTERNATING CURRENT SUPPLY

Regarding the alternating current supply. For the present purpose commercial circuits are usually satisfactory, provided the voltage regulation is sufficiently close, because the wave-form in practically a sine-form. Where possible, if scope and magnitude of the tests warrants, it is, of course, preferable to have a generator specially for testing purposes. There are a number of high-speed machines now on the market well suited for this class of work. In choosing a machine it is advisable to choose one having distributed field and armature windings, and low armature reactance, as these types will have a minimum distortion of wave-form at partial loads and low armature factors.

#### FREQUENCY

Commercial frequency of 60 cycles is the frequency that is generally employed for testing materials. It is available, the transformer is more readily designed for this periodicity, instruments on hand, etc., for it. On the other hand testing with high frequency has many advantages for some classes of work, for example testing line insulators. It is a matter of experience that insulators tested at commercial frequencies, 25 and 60 cycles, fail when tested at very high frequency, several hundred thousand cycles. Lightning, arcing grounds and similar causes set up high-frequency surges, and this testing with high frequency is much more severe than if normal frequencies were used. The high-frequency seems to find out the flaws in the porcelain, the corona spreading out along and adhering to the surface of the insulator more closely with high than with low frequencies. High-frequency transformers are now in use to a considerable extent by manufacturers of high voltage insulators and similar work, but are hardly required by the small company.

#### TESTING TRANSFORMER

In choosing a transformer for testing purposes, of which there are several very good ones on the market, there are several matters well worth keeping in mind. A testing transformer should have an extremely liberal amount of iron and comparatively few turns, and these turns should be heavily insulated at their ends. Such a transformer can be made very strong mechanically and to have good regulation, while the

fewer turns permit of heavy insulation with low space factor. Secondary (high tension) taps should not be used on a testing transformer as they increase the possibility of breakdown resulting from high-frequency oscillations at both the end-turns and at the insulating bushings where they come out of the case, as well as adding to the cost of the transformer. If change of ratio is desired—and it is a very desirable feature where one

several groups of coils which may be connected in series or parallel. Four groups of coils will generally be found sufficient for general work up to voltages of 60,000 volts.

The capacity of the transformer is of importance, although not as important as one would be inclined to believe from the amount of emphasis so often placed upon this one detail. For the testing of small samples of materials, tapes, insulating cloths, etc., 2 to 5 kv-a capacity will be found suitable. If on the other hand a large number of rubber gloves, lengths or cable, and other material which results in comparatively high charging current, are to be tested a unit from 10 to 50 kv-a may be necessary. For all ordinary work 5 kv-a will be satisfactory.

The above remarks have been apropos of testing materials in the laboratory, where the testing transformer remains stationary. For carrying out the high potential tests on apparatus which has been, or is being, installed it is extremely convenient to have a transformer which can be moved from place to place as requirements dictate. There are several transformers available of this type the usual capacity being about 2 to 5 kv-a giving a voltage up to 40,000 volts.

It can be seen that the apparatus required for testing materials and new apparatus for dielectric strength, as here considered, is not really extensive nor expensive, especially when the fewer shut-downs, lower operating and maintenance costs are taken into consideration. A transformer, voltmeter, ammeter (not really necessary), an instrument board, switch and water rheostat; a vat for testing rubber gloves, an assortment of tin foil and brass sheeting and a few wooden clamps. The work is interesting, the more so the deeper one delves into it. The testing of materials is, of course, a business proposition pure and simple, and as such will start to pay for itself from the day it is commenced. The cost of performing the routine tests will depend to a considerable extent upon the location of the testing laboratory with respect to that of the store room, and it may be found cheaper to test materials closer to the store room and install a generator for testing purposes rather than to use commercial mains farther removed from the store room. In the one case it is a matter of initial cost whereas on the other hand the cost is one which goes on indefinitely, and as long as the material must be moved from one place to the other and back again.

The aim of this article has been to cover a very wide and complex subject in a general way, going into only the more important matters sufficiently to enable anyone taking up this class of work to know how and where to start, and what precautions to observe. Testing materials on a business basis will show large returns on the initial investment and labor costs, and this must be apparent when the fewer interruptions to service, the reduced life hazards, the better quality of material obtained for the same price, and the higher quality of service rendered, are taken into consideration.



Fig. 5—Large Portable Testing Machine

transformer is to be used for a wide range of work, which is the condition obtaining here—it should preferably be accomplished by dividing the primary or low-tension winding into

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## Water Power Control in the United States

Somewhat over a year ago, the long-standing controversy as to whether the present laws providing for and regulating the use of water-power that are under the Federal control are helping or hindering the development of this national resource, led the senate to call for the facts in the case.

The investigation was conducted by the Department of Agriculture and has resulted in three large volumes, which, on account of their size, will not be printed as a public document. They have been laid before the Senate and constitute the most thorough and extensive analysis of the situation, as it stands to-day, that has ever been made.

The extent to which it has been carried is justified by the importance of securing an accurate knowledge of what has really occurred.

The most striking feature of the abstracts of the report that have so far been sent out is the concentration of ownership and tendency to close relations between the principal holding companies through hands of direction and management.

The latest figures as to the potential water-power of the country places the total sum at a minimum of 27,943,000 hp. and a maximum of 53,905,000 hp., the minimum representing the amount of power that could be developed from the use of the average annual minimum stream flow for the lowest two consecutive 7-day periods of each year, while the maximum represents the amount that could be developed from the use of the average maximum continuous stream flow available for six months during the year. The National

Forests are stated to contain 30.4 per cent. of this minimum and 31.3 per cent. of the maximum, while over 72 per cent. of the country's total is found in the Mountain and Pacific States and 42 per cent. in the three Pacific Coast States.

While 80 per cent. of the total installed power from all sources in 1912 was steam power, and while nearly three-fourths of the total primary power installed in commercial and municipal central stations (or establishments for the sale of power) and in street and electric-railway plants was steam power, the preponderance of steam power was found, according to the figures given, in the Eastern States; and the percentage increase in water-power development for public-service use, in the three years since 1912, has been three times as great as in steam power. Primary power installation from all sources and for all uses increased in the eleven Western States 240 per cent. from 1902 to 1912, or more than 2½ times as rapidly as in the remainder of the United States. This includes primary power used in manufactures, 94 per cent. of which is found in the Central and Eastern States.

According to the report in the ten years from 1902 to 1912 the proportion of all primary electrical power installed in central stations increased from 11.2 per cent. to 23.8 per cent. for the whole country. In the Southern States the increase was over three-fold. In 1912, 50 per cent. of all primary electric power in the Mountain group of States was owned by public service corporations; in the Pacific States 25 per

cent. To-day in these states the proportion is 90 per cent.

Primary electric power increased 440 per cent. in the Western States between 1902 and 1912, as against 226 per cent. in the remainder of the United States, or nearly twice as rapidly, while the development, per capita, in the Western States in 1912 was two and a half times as great as in the remainder of the United States. In installed water-power, per capita, the Western States had more than four times as much in 1912 as the remainder of the United States. There is at the present time, according to this report, an over-development in nearly all the power centers of the Western States, California, Oregon and Washington in particular showing installations far in excess of maximum demands.

The power developments which utilize National Forest lands have 42 per cent. of the total development power of the Western States—30 per cent. through occupancy with some part of the immediate generating plant and 12 per cent. through storage reservoirs. An additional 14 per cent. either occupies public lands outside the forests or depends directly upon storage reservoirs upon such lands, making 56 per cent. of the total developed water power of the Western States dependent upon the use of public lands, taking place under existing laws. Plants either now under construction or for which final permits have been taken out will provide a further increase equivalent to 20 per cent. of the total present Western water-power development.

## Present Status of Electric Power Generation, Transmission and Distribution

*By Percy H. Thomas, Consulting Electrical Engineer\**

An electric power supply system with its transmission and distribution lines has become an essential feature in every important industrial community and a review of some of the more significant features of our best installations will be of interest to Pan-Americans. While it is not possible in the present paper to give a critical discussion of specific power systems, it will be possible to consider how some of the problems of more present interest in such systems have been solved.

The electric power system supplying an industrial community is of value to the community not only for the general supply of power and light it offers for domestic service, but because it offers a cheap source of power to large users, a readily obtained, reliable and cheap power to small users, and because it enables power users in general to avoid the capital expenditure and the operating responsibility of a private power plant. This latter consideration is of the greatest practical importance.

The technical problems of the generation of power, the distribution of the power, and its application to industrial processes, while involving skill and special knowledge, are worked out thoroughly and satisfactorily.

The overshadowing feature of the ordinary power plant is that of cost—cost of installation and cost of operation. Since the cost of installation is determined by the maximum capacity of the plant and is fixed once for all and since the income depends primarily on the actual sale of power, it is of the greatest importance to utilize the plant to as near its full capacity and as nearly continuously as possible. Here arises a very great advantage in the supplying of a whole community from a single plant, for the average power requirement of many diverse users calls for a very much more uniform supply of power than that of any other user, so that the general power system may be loaded much more nearly

to full capacity than could a series of individual power plants.

As a notable example of an enlightened power company supplying a whole community, the Commonwealth Edison Company of Chicago, may be mentioned. This company supplies nearly all the electric power used in the Chicago district (except for certain steel mills and some isolated plants) including the electric street railway load and a considerable percentage of the refrigerating machinery load, which is a very large item in Chicago. Its yearly load factor is approximately 45 per cent. and its monthly power factor averages 50 to 60 per cent.

Many other companies have not been so successful in securing a diversified load and a high load factor. The usual values run below a 50 per cent. monthly load factor. In exceptional cases, in such plants as the Niagara Falls Power Company, for example, having a large percentage of continuous process electrolytic load, may reach an annual load factor very much higher. This company has had a yearly power factor for the last five years ranging from slightly under 80 per cent. to over 87 per cent. and a monthly load factor ranging from 80 to 90 per cent.

The very large Montana Power Company, with a considerable proportion of mining load is said to have a yearly load factor of about 75 per cent. and a monthly load factor of about 80 per cent. This is very high. On the other hand, the Power Company at Portland, Oregon, though a large company, has a daily load only slightly over 50 per cent. Small local light and power companies may have monthly load factors far below 50 per cent. The difference between a 40 per cent. and an 80 per cent. load factor would be a dominating factor in determining the cost of power.

Much study has been given by the power companies to methods for securing power users whose requirements come at off-peak times or whose load is practically continuous. Special rates are often given such consumers.

In plants depending largely on hydraulic power—often times there occur months or years during which the supply

\*Paper read before the recent Pan-American Scientific Congress at Washington, D. C.



of water is low and power cannot be sold up to the full capacity of the generating apparatus. This is a very unfavorable condition but a condition by no means infrequent, so that it is of the greatest importance in studying new water power projects to determine the lowest rate of water flow to be expected within a period of years.

One method of meeting this condition, especially when the shortage of water occurs regularly during certain months of the year, is to sell some power at a lesser rate, but with the provision that the power supply may be discontinued during a limited period of low water on proper notice. Such power is called "secondary power." Such power is offered, for example— by the Southern Power Company of Charlotte, North Carolina, and by the Alabama State Power Company of Alabama.

The extent to which the advantage of diversified load may reduce the cost of power and the tremendous advantage to a consumer in being relieved of the capital expenditure and operating responsibility of a private plant are now being realized as is shown by the fact that many of the steam railroads of the United States are buying or planning to buy power from the already established power companies rather than install their own power plants. It is found that the general supply system can furnish power more cheaply and more reliability than even the large plants that might be installed by railroads. Among such railroads might be mentioned the New York, New Haven & Hartford, which has a four-track main line electrification of over seventy miles, and the Chicago, Milwaukee & Puget Sound R. R., which is now electrifying a mountain section several hundred miles long; other important roads are considering the same plan.

Briefly then it is of very great importance both to the power company and the community that the company secure as general and diverse a load as possible, since this will go far to reduce the total cost of power and permit a reduction of rates.

As a corollary to this condition may be added the statement that there is everywhere a strong tendency to consolidate and inter-connect adjacent power systems, and that this is, from a technical point of view, very greatly to the advantage of the companies and the community in general, for not only is the reliability of the service greatly improved and a higher standard of technical staff warranted but an improvement of the load factor, that is, the tendency to average out the peaks of the various loads results. The enormous sizes to which these consolidated power systems have grown in the United States will be seen from some illustrative examples given later. There so far has appeared no limit to the growth of such systems.

#### Cost of Power

While general figures as to the cost of generating power in miscellaneous power systems, such as are here under discussion, are of little value as applied to any particular case, it may be worth while to point out that under the most favorable circumstances (e. g. certain Norway projects, and such a plant as the Niagara Falls Power Companies, and certain irrigation projects) a horse power year may be generated for less than \$10, but that usually the best plants will require double this and \$30 to \$40 may be frequently expected. When it is necessary to buy power in limited quantity a rate of \$50 to \$80 per horse power year is not unusual and in unfavorable conditions the price may run considerably over \$100 a year.

#### Reserves

The matter of reserves or relays to insure the maintenance of service in case of interruption of transmission lines or failure of machinery is always a difficult one in large power plants for apparatus held in reserve cannot earn a revenue. Various expedients are used. In the case of transmission lines reliability is frequently secured by having alternate

routes for supplying power. This plan may take the form of duplicate circuits (a very imperfect embodiment) or a loop line or closed network of lines connecting the power house or power houses and the principal load points.

Where main portions of the system's load are concentrated at one point, a very satisfactory relay of low cost can be obtained by a specially designed steam turbo-generator installation. Such a machine can be given a very heavy over-load capacity with forced draught boilers and an extremely simple switchboards, so that the relay can be installed at a minimum cost and can be gotten into operation very quickly. The Southern Power Co., of Charlotte, North Carolina, has three such stations each with a single turbine of 10,000 kw. capacity. These turbines are located at three important centers and serve for the protection of the service, particularly at these points. These 30,000 kv-a. represents about 25 per cent. reserve. One or more of these stations operates at all times with banked fires under the boilers and the turbo-generator "floating" on the line, to permit the rapid taking up of the load, and occasionally at times of storms or especial danger, all three stations may be so operated. Another example of a plant with such steam relays is the Pennsylvania Water & Power Company, which has 40,000 kw. in steam plant to protect the load in case of accident or low water; this represents something like one-third of the total rated capacity of the system.

The Pacific Gas & Electric Co.'s system has steam plants aggregating 80,000 kw. rated capacity, representing over half the maximum load.

On the other hand the Montana Power Company has but about 5,000 kw. steam apparatus, which is less than 10 per cent of its maximum load. This plant has a large number of water powers lying in widely spaced locations and is therefore not in as great need of steam relays as most systems.

Most large systems which depend upon hydraulic power and long transmission are supplied with from 20 to 40 per cent. of steam generating apparatus.

#### Reservoirs

Closely related to steam stations having the function of making up for temporary low water in hydroelectric plants is the storage reservoir. The development of hydraulic opportunities are often largely dependent upon the possibilities of water storage. Storage possibilities as found in various places vary from a few hours supply to the storage of a whole season's rain fall over the water shed. There are a number of instances where practically the whole run off of a water shed in an ordinary year is impounded and except for evaporation and leakage is used for power and then often afterward for irrigation. One such example is the Spaulding Lake development in Drum reservoir, in the Sierra Nevada Mountains of California. In this system most of the precipitation is in the form of snow and on melting in the spring it is stored in this lake assisted by certain other lakes and enables the powerhouse to maintain an output of 20,000 hp. It will in the future supply twice the quantity.

Large water storages now developed for power purposes include as much as 325,000 acre feet, as in the Hebgen reservoir of the Montana Power Company, which reservoir is fed by a drainage area of 900 sq. miles. In some cases the amount of storage is increased by utilizing a very great range of operating water level in the reservoir. The level in the reservoir may vary considerably over 100 ft. between high and low water. This wide range of water level of course greatly adds to the available storage, but causes a very uneconomical utilization of the water, except where very high heads are concerned. It goes without saying that the most effective storage of water is that in systems where the water power is developed through a high head, which head many of course be utilized in one or more stations.

(To Be Continued)

## General News

### Storage Battery Demand

Storage-battery manufacturers report a strong demand and a fine business outlook. The constantly increasing use of these batteries in mines, in motor boats, commercial and pleasure vehicles and railroad equipment is the cause of the growth of this business. Electric trucks and train-lighting equipment are particularly active. As yet there has been no marked advance in price.

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### Expanded Steel Poles

The use of expanded steel poles is increasing throughout the country. The one-piece poles turned out in the economical shapes by the leading manufacturers are to be bought for a price that puts them into strong competition with the wood pole. Their up-keep is hardly more than that of the wood pole and the durability, of course, is considerably greater.

\* \* \*

### Substituting Steel for Aluminum

Owing to the increasing price of aluminum, which invariably follows the copper market, makers of small articles such as vacuum cleaners, fans, etc., in which this light metal has heretofore been used, are now tending to replace it with steel. Unless the aluminum part has been very carefully designed, it is sometimes found that the weight increase caused by the substitution of steel is negligible.

\* \* \*

### Electric Machinery in Demand

The manufacturers of electrical machinery continue to report large orders for all sorts of generators, motors, transformers and accessories. Steel mills, public-utility companies, mines and metallurgical works are expanding their capacity in an effort to meet the present demand. With the advancing cost of steel and copper, the prices of most electrical machinery and apparatus have advanced from ten to twenty per cent. This will, of course, tend to check the rush, but so far, its effect has not been noticeable.

\* \* \*

### High Tide in Electrical Exports

Electrical exports broke all records in November, generators and motors alone showed a decrease and this was overbalanced by an enormous increase in other articles, all as compared with preceding year. The total was \$2,744,847 against \$1,644,773 for November, 1914. Among the material listed were: Metal-filament lamps 658,000, carbon-filament lamps, 121,672, electric fans 3,943.

\* \* \*

### Soaring Copper Prices

The copper market has continued to climb until it has reached a peak higher than any time known since modern conditions of production have been used. For forty years there have been no such prices recorded, and the prices of forty years ago were on an inflated currency basis and hence not really comparable.

According to a note on this subject in the Engineering and Mining Journal: During the last week the price for copper rose to a higher figure than anything on record in recent history, and by recent history we mean to go back to the time of our civil war and the years immediately following. In July, 1864, the average price for Lake copper at New York was 59¾ cents per pound, and the average for the year 1864 was 46¾ cents. By May, 1870, the price had fallen to 19 cents, but in April, 1872, it was up again to 41¼ cents. In 1873 the average price for copper was 29 cents per pound. After that it was never higher than 25 cents until March, 1907. In March, 1907, Lake copper touched 26 cents, and electrolytic 25½ cents. To-day it has passed both of these figures with a demand stronger than ever.

### Reaching out for Russian Trade

Twenty-five non-competing American manufacturers have organized a concern known as the International Manufacturers' Sales Company of America to promote trade in their lines in Russia. The membership lists in the new company is later to be increased to fifty. At present the main office of the concern is at 1133 Rookery Building, Chicago, and the Russian headquarters is in Moscow. In forming this company the organizers received assistance from the United States government through Consul-General John Snodgrass in Moscow, various other consuls, and the Bureau of Foreign and Domestic Commerce offices at Washington, at Chicago and elsewhere in this country. Several electrical manufacturing companies are reported to be interested.

\* \* \*

### Electric Taxicabs

The success which has attended the experiment of establishing electric taxicabs in Detroit, where there are now more than fifty cars in service, has led to efforts to introduce the electrics in New York.

One of these cars has been on test in the metropolis for more than a month and has been tried out by all of the principal hotels, restaurants, clubs and other large users of taxicab service. The results show the electric taxicab to be acceptable to the New York public and further that it will operate successfully under the conditions of New York traffic. According to the present plans, the operation of the New York service will begin some time in July with a fleet of more than 150 cars.

The new company to be formed in New York is the first step toward the formation of similar companies in other large cities in the United States. It is also expected that a holding company will be formed to control the separate operating companies.

It is thought that, owing to the high price of gasoline, which is now well above 20 cents a gallon and is expected to go much higher, and the decreasing price of electric energy, electric taxicabs will be able to compete more than successfully with gasoline machines.

The difference in the atmosphere of some of the busy streets in New York during the hours of maximum traffic if the smoke and foul exhaust from the gasoline cars that now renders them so offensive is replaced by the cleanly electric, would alone be a strong motive for patronizing the electric service.

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### Science Notes

An alloy of zirconium and iron has been proposed for lamp filaments, as it is tough, malleable and ductile. Its radiation is highly selective, providing high luminosity at low temperature.

### Regulated Electric Iron

An electric flat iron with a regulating rheostat for controlling the amount of heat required by different kinds of laundry work, has been placed in the market. Hitherto, this has been done by cutting the current off and on as found necessary.

\* \* \*

### Sorting Ore by Tungsten Light

A new use for nitrogen-filled tungsten lamps has been found in the zinc refineries. Under most artificial lights dark zinc or lead ore appear to have about the same color. With the white light from the gas-filled lamps they are readily distinguishable, and these lamps are being used wherever these ores are to be sorted.

\* \* \*

### Asbestos Quartz Insulator

A new non-carbonizing insulator has been developed by a Pittsburgh inventor from purified asbestos. It is a sort of an asbestos quartz and has heat resisting qualities of a high order. At approximately 7,500 deg. it melts and runs like molten metal. It can be made in any form and has a promising future for insulating work.

# All Around The World

*Electrical Flashes From Beyond Our Horizon*

## Mexican Electrical Business Picking Up

Considerable electrical machinery and equipment, it is reported, is being shipped into Mexico from the United States. Practically all of the public-service electric light and power plants are badly in need of new machinery, it is declared, and orders for equipment are being placed exclusively in the United States. Much of this business used to go to Germany. Furthermore, the electrical equipment of many of the mines and industrial plants must be renewed, and this class of business will be large for some time to come. Transportation facilities in Mexico are improving rapidly, and before long regular traffic will have been established upon all of the divisions of the National Railways of Mexico and other roads.

## War Ravages Among Electric Workers

As so many of the workers in the electrical field have enlisted and left the country, the English contractors are talking of training women for wiring work. The next new noun in English will be "wire-women." They should soon become experts on switches.

From neutral sources it is reported that the mortality caused directly and indirectly by the war among the electrical workers of Germany has reached such figures that no more lists of losses in these fields are being given out. Boys and old men are doing most of the electrical work of the Empire.

## Electrical Improvements in Germany

The Berlin electrical works, which supply the greater part of Berlin with electric current, having passed into the control of the city, are planning a reduction in the tariff for large consumers.

It is figured that the latter, using a very large amount of current, will have to pay as little as 1.4 cents per kilowatt-hour.

The output of this plant has increased from 37,000 kilowatt-hours in 1885, to 267,600,000 kilowatt-hours in 1915.

In spite of the dislocation of business caused by the war certain improvements in Germany continue to be carried out. The steam railway through the Silesian mountains from Salzbrunn to Waldenburg has been changed to electric operation and was opened to traffic very recently.

## Some Foreign Fun

Although the cloud of war hangs heavily over Great Britain, and any evening may bring one a sociable call from the Zepelins, British hearts are stout enough to still enjoy the British varieties of joke.

Behold an extract from the unofficial bill of fare at a concert given lately by the London Electro-harmonic Society!

PEAK LOAD, CHORUS—"Every Valley Shall be Exalted"—*Handel*  
I<sup>r</sup> DUET—"Ohm, Sweet Ohm"—*Adopted*

ZEPPELIN INTERLUDE—"We Won't Go Home Till Morning"—*Holi*  
\* \* \* \*

IRON-CLAD EXIDETTE—"Have an Acid Drop"—*William*  
TRANSFORMER, SOLO—"The Humming Bird"—*Eulenberg*  
BATTERY VEHICLE, DIRGE—"The Place Where the Old Horse  
Died"—*Melville*

or this from the British muse:

Said the Turbo to the Switch,  
You're a little chap, 'tis true,  
And on my most extensive back  
I could take a lot of you.

Said the Switch unto the Turbo,  
Although I am quite small,  
Still, if I open up myself  
You are no good at all.

## Gas Producer Plant in China

The General Electric Co. of China, Ltd., has just secured the contract for a complete electrical plant for the lighting of Chowchao-fu in Kwangtung Province. The machinery consists high speed, vertical type, suction gas engine direct coupled to a Witton three-phase alternator, complete with suction gas producer plant, high tension switch board, main cables, transformers, etc. All machinery to be installed is of British manufacture. This contract represents the sixth that this company has in hand for the lighting of Chinese cities in different provinces.

## Swedish State Railway Electrification

The Swedish State Railways have adopted a plan for the electrification of practically their entire system. The work is expected to be completed in about eight years and to save the importation of 500,000 tons of coal a year.

Sweden is credited with having six million horsepower in water falls. Nearly one-fifth as much as that of the United States on less than one-seventeenth of the area.

## War Stimulates the Use of Electric Trucks in England

Because of war enlistments there is a scarcity of labor in many English industries, and women are therefore often found in places formerly filled by men. This is particularly true in truck driving, and as a result, instead of the heavier, the lighter units, which are easier to operate, are often employed. Also, on account of the simpler mechanism and ease of control, electric trucks are becoming popular. Women are proving themselves efficient and careful drivers and the constant changing of gears and the necessity for cranking by physical force make the operation of heavy trucks a severe tax on their strength. The electric trucks are therefore in great demand.

## Water-Power in Russia

In European Russia alone, which includes the mountain districts of Finland, Ural and the Caucasus, there is estimated to be about 13,000,000 water-horsepower which can be easily developed, yet there is only about 250,000 actually at work, according to the figures given by the Imperial Russian Technical Society. Of those plants, 80 per cent. were of 10 horsepower or less, being used for running flour mills, saw-mills, small factories, farm equipment, and mostly fitted out with wooden water wheels.

Out of 250,000 kilowatt capacity of electric plants now operating in Russia, divided among 230 different concerns, only one, having about 435 kilowatt capacity, is water driven. From an article on this subject by P. Gurewitsch in a recent issue of the *London Electrician*, it appears that hydro-electric plants and transmission systems are virtually unknown in the Muscovite empire.

Russian coal comes mostly from the southern provinces and Poland, and the development of the latent water-power, particularly in the north, is greatly needed for industrial growth. A project involving the recovery of 85,000 hp. in Finland for use in factories and the Finnish state railways was about to be put through when the war stopped all improvements of this kind. A company of English capitalists had plans under way for the development of 40,000 hp. at Lake Gotchka in the Caucasus when the same sinister event indefinitely postponed their execution.

According to the latest advices, there should be a splendid opportunity for the profitable exploitation of these powers, and for the selling of the water-power and electrical machinery that goes with it, open to American enterprise as soon as the war is over. Will the capitalist and the manufacture of the United States be prepared to take hold of it?

# Electrical Fathers

Georg Simon Ohm

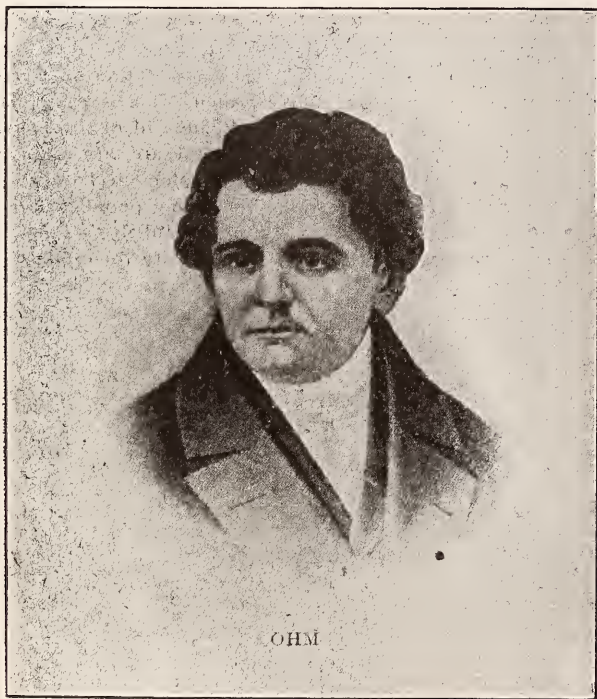
By the end of the first quarter of the nineteenth century men had a fairly clear idea of an electric circuit as consisting of a route or path in which traveled an electric current that was "set up" or propelled by an electric pressure or force.

The patient experiments of dozens of men had already shown a large number of effects of the current—chemical, thermal, physiological and magnetic.

This knowledge, however, was almost entirely empirical and based on experiments that had indicated quality only in a general way.

The man who cleared up the situation and first showed the strict and simple relation between electrical pressure, or "voltage," as we now call it, electric currents, and the circuit in which they worked, was Georg Simon Ohm, a German scientist and mathematician.

Ohm was the son of an humble, but very intelligent locksmith and was born at Erlangen in Bavaria, March, 16, 1787. His father was a lover of mathematical studies and early determined to do everything in his power to give his two sons, Georg and his young brother Martin, a liberal education.



Ohm graduated at the university in his native town in the fall of 1811 and after a year and a half as instructor, he was appointed professor of mathematics and physics in the gymnasium at Cologne.

There he taught and studied with success for ten years and here it was he did the work that laid the foundation of his fame. He began a series of investigations which had for its basis, the idea that physics and physical phenomena could not be thoroughly understood without the help of mathematics.

Fortunately for him, he fastened on the subject of electric currents and circuits for a proof of his theory and by means of a line of skillful experiments he was enabled to discover that there really was a simple relation between the strength of his battery currents in a given circuit and the voltage, or electromotive force, producing them.

It is said to have taken him nearly seven years to have completed the evidence of his law to his own satisfaction. At any rate, in 1826 he requested a year off from his routine duties on half-pay to round up his work on the subject. This was

readily granted and in May, 1827, when only six months of his year had expired, "Ohm's Law" was announced and fully demonstrated in a booklet entitled, "The Galvanic Circuit Mathematically Treated."

The core of this work was the statement that in "any given electrical circuit, the strength of an electric current equals the electro-motive force impressed divided by the circuit's resistance."

Before Ohm's time this truth as a general law had been declared to apply to heat effects. Since his day it has been extended to nearly every branch of investigation and is one of the most widely known formulas in use.

In electrical work it is the corner-stone of exact calculation of most electrical effects and the A B C of the science.

However, like many another great discovery, its announcement attracted very little attention at the time. A few clear-sighted scientists immediately recognized its truth and the wide application claimed for it by Ohm. Their appreciation was well nigh-nigh overwhelmed by a savage attack on the statement by a well-known professor in the University of Berlin, who declared that the law was untrue and Ohm's work of no value.

This criticism coming from a high official source brought on a controversy in German scientific circles which ultimately caused Ohm to send in his resignation.

He failed to get another professional appointment and spent the next six years of his life tutoring military students in mathematics, in Berlin, at a salary of about \$300 a year.

Meanwhile, though Ohm was poor and neglected at home, his little book had found its way abroad and was working for him. In many a laboratory in France, Holland and England his experiments were repeated and his law verified. These foreign scientists soon acknowledged the value of his discovery and after a time their praise began to penetrate even the stuffed ears of German officialdom.

The first fruit of this recognition was found in Ohm being given the chair of physics at the Polytechnic School in Nuremberg, Bavaria. Here he continued his studies for fifteen years, but devoted more time to light and sound than to electricity; "to round out his knowledge" he said. In both these fields he made important discoveries, showing the relation of light to electricity and magnetism.

His earlier work in electricity became more and more famous and his little book was translated into English, Dutch and French. The leading workers in electrical science, extending their knowledge in line with his great discovery, made increased efforts to express their debt to him and finally in 1841 he was awarded the Copley medal—founded as a reward for important work in the domain of natural sciences—by the Royal Society of England. This honor, the highest the Society could give, only once before had fallen to a German scientist. In 1849 he was appointed full professor of physics at the University of Munich and for the first time in his life was well enough off to quit living in boarding houses and set up an establishment of his own. He was then past 60 and had never married.

He was greatly admired and loved by all who knew him and remained active to the end of his life, which came suddenly. On Thursday, July 6th, 1854, he delivered a lecture. That night, at ten o'clock, he died, after an illness of a few moments.

Ohm's Law is his monument. But 27 years after his death his name was given to the unit of measurement of electrical resistance, whose nature he had done so much to make clear.

Italy, with the volt; France, with the ampere; and Germany with the ohm, were thus honored in the naming of the three first units of electrical measurement.

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# EDITORIAL

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## Water Power Development

The investigation of the country's water-power development by the Department of Agriculture, which we abstract on another page, at least establishes certain points as being true for the time. It shows that the public service companies account for about one-fourth of the total primary electric power of the country and about half of the developed water-power. It also shows that sixty-eight per cent. of the total public service company power is in the hands of about eighty-five corporations, of which six control one-fourth, and that these corporations are closely related as to holdings and ownership.

All this is not very new and could have been pretty closely forecasted by anyone conversant with the facts. But a feature of the report that has caused some comment is that which shows that the development of water-powers during the three years just passed has been three times as great as that of steam-power, and that the development in the Mountain and Pacific Coast States has been over twice as rapid as that of the country at large.

As these Western States contain nearly three fourths of the country's total water-power, it is to be expected that the principal development would take place here. That this fact has been brought out by the report is not particularly comforting to many of the opponents of the existing laws, whose efforts in Congress resulted in its making. It has been persistently claimed that the present laws relating to the development of water-power on public lands were throttling the progress of the country, particularly of the Western country. This view has been behind much of the agitation about water-power and has had credence in high places. It has been expressed by the President, Secretary of the Interior Lane and most committees that have investigated the matter.

At first glance it would seem that there is no ground for the belief that public land water-power development has been checked. On the contrary, the report calls the present situation in the West an "over-development." Its conclusion is that not only has the present regime fostered the investment of capital in water-power but that it has gone too far and over-stimulated it.

Is this opinion based on the fact that electrically generated water-power per capita in the States in question is from 120 horsepower per 1000 inhabitants in the Mountain States to 160 in the Pacific States as against 30 for the country at large? If so, it is apparent to some that it stands on a poor foundation.

If a reason is sought for the four-fold production of water-power per capita in the West as compared with that of the rest of the country, it is not to be found in the enticements to capital offered by the existing laws and regulations. It lies, figuratively and actually, much deeper—it is to be found in the lack of coal out there.

If this section of our country is to progress industrial-

ly it must progress by means of oil-power and water-power and in spite of lack of coal power. That electrically generated water-power there is more than four-fold that of the country at large is so because of the demand for cheapest power available in that section—nothing else.

For this reason, all will not agree with those who are satisfied with the present state of affairs. Why should not the preponderance of water-power per 1000 inhabitants in the West be five-fold or ten-fold greater than for the country at large? In many places the actual excess cost price of coal as compared to the average cost for the country at large approaches that proportion. Therein lies the real reason of hydroelectric development.

In the Eastern and Central States the coal mine is still actively competing with water-power. In the West the latter has the advantage. And, from all points of view, it is probable that the actual effect of the present laws on this subject has been to hold back legitimate growth. Hence the persistent efforts that are being made to reform them.

Sound regulation of these resources demands that there should be no unnecessary clog to needed developments. If there are features of the existing laws that have this effect, then the growth of water-power use, as shown, has progressed in spite of these adverse factors. If they are removed, none can deny that it will be all the better for the industry.

The legislation now pending in Congress is drawn, for the most part, with this in mind and its passage may be expected to improve the situation as regards the terms imposed on capital seeking investment in this field.

\* \* \*

## "Spring House Wiring Campaign"

The "campaign" for house-wiring that is to be pushed from March 15th to April 15th represents the spirit of "get-together" that found its first practical expression in the formation of the Society for Electrical Development.

There is no doubt that the unwired house within easy reach of existing lines is the widest domestic field that is open to the enterprising electric light and power company. Nowhere is this more true than in the big Eastern cities, where there are solid blocks of expensive residences that are still in the dark and odorous age of gas lighting.

And the lighting is now but the small end of the business, too. In the not remote past too much stress in seeking new business has been placed merely on lighting. This was natural, as up to a few years ago lighting service was all there was to offer.

Times have changed now and the central station management that advertises electric lighting only, also advertises that it has not quite caught up to date.

Many a family to-day finds that the "house electrical"

is one in which the domestic work can be done with a tithe of the labor that would have been required even ten years ago. As a result there are thousands of dollars that formerly were out for domestic service that are now being earned by the electrical service companies.

This turn of affairs has the three-fold advantage of; 1st, Promoting health and inducing economy in the home. 2nd, Releasing domestic labor for better and more productive work elsewhere. 3rd, Increasing the usefulness and earning of the electric service company.

The aim of the campaign to add 100,000 residences to the country's central station-load may or may not be realized, but the skillful and vigorous prosecution of this work will undoubtedly bring in results well worth the effort.

Its success cannot be estimated by the returns in the limits of the month involved. Seeds will be sown that will come to bearing all along through the coming summer and fall. It will be interesting, not to say instructive, to learn just how many new consumers taken on during 1916 can be traced to the campaign, and it is hoped that the companies participating will make efforts to get and record this information as accurately as possible.

The cost of so doing should be practically nil and the results will be of much value for work in the future.

\* \* \*

### **The Life of Out-door Steel Structures**

The collapse of a steel tower, used for lighting purposes in San Jose, California, during the recent gales on the Pacific Coast will cause many people in electrical circles to again question the durability of the modern steels for out-door structures.

This tower was thirty-five years old and 265 feet high. Expert examinations of the structure, one made a few months, another a few weeks before it fell, evidently failed to disclose its true condition, for it was used for carrying hundreds of lights before it went down.

There was some of the usual talk about crystallization resulting from vibration, but the fact remains that the tower—always well painted and cared for—simply crumbled up one night, just as any old, rotten pole might have done. Would not a wooden tower equally carefully maintained have lasted longer?

There are many engineers who think that the prevailing use of steel, as it is now made, in the slender members employed for out-door structures will eventually be found costly and disappointing under the climatic conditions existing in most parts of the country. The best railroad practice, after many years of experience, is getting away from its use in bridges wherever possible. The transmission structures of twenty years hence, if there are any, will probably be of concrete. By that time there will have accumulated a mass of experience as to the actual life of steel structures, that will remove the question from the field of discussion.

\* \* \*

### **Electric Industries in War Time**

Electrical industry as it stands to-day is essentially a growth of peace. Born, bred and growing up for the

most part, in England, the only country of Europe that for hundreds of years had never felt the foot of the foreigner on its soil, and in the United States, it was adopted by the rest of the world. France pushed it to a point in some respects further ahead than in its mother lands. Germany has turned its possibilities to the making of modern war.

We know that the past year is really the first in which this complicated creation of fifty years of peace has had to face the stress of war. As to what effect this has had on the German electrical industries, we know very little. Practically, the only thing that is certain is that the militarized industries of the German hive have produced an output of war-material that has, so far, enabled the nation to more than hold its own in the field, and has amazed the on-looking world. As to just how this is done, the censor has let us have a few details.

The situation in England is somewhat clearer.

From all reports we gather that the high cost of fuel and nearly all materials and labor entering in the manufacture of a doperation of electric machinery have exercised a depressing tendency on business in general, but to the credit of British solidarity it appears that the better organization of industry, the replacement to a large extent of competition by cooperation and the united effort of all interested to reduce every form of waste and pull strongly together for the welfare of the industry and the country, have more than overcome the handicaps.

One of the more noticeable of these latter is the wide-spread reduction of residential lighting. This is the national response to the frantic appeals of the leading financial interests for economy. The adverse effect of this phase of the war activities is more than over balanced, so far as concern revenues, by the enormous expansion of the manufacture of war material, which everywhere is running on full time of three shifts of eight hours each.

According to all indications the mobilization of these industries has been able to neutralize nearly all the disadvantages imposed by war conditions, except possibly the absorption of capital and labor by the marine and military, which, of course, cannot be compensated for directly. Nevertheless, on the whole, the shock of war and its effects have been well sustained, and generally the English electrical industries appear to be more than holding their own. Another year of war may reveal a different state of affairs.

\* \* \*

### **Testing of High-Voltage Line Insulators**

The improvement in the reliability of high-voltage transmission lines, which is very noticeable of recent years, has undoubtedly been due to the development of insulator testing and the periodical determination of the resistances of line insulators in place.

This sort of test has become standard on all high-voltage lines that lay stress on absolute continuity of service and has proved to be the stitch in time that saves nine thousand.

The testing of other apparatus is just as important and reasons and ways for carrying out such tests are given in an article that we present on another page.

# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## Arrangement and Ventilation of Storage Battery Rooms

By L. R. Watterson

A study of the method ascribed in the article of the November issue, entitled "How to Install Storage Batteries" leads to the belief that there are several features of the method given which could be improved upon.

For the installation of these types of storage plants most any sort of a building is generally placed in service, but a little remodeling should be done so as to give good ventilation, thereby eliminating the dangers, as far as possible, created by acid fumes; for these plants, in a majority of the installations, are left in inexperienced hands to maintain; therefore extra caution should be taken.

In regard to the arrangement of a complete 30-volt storage plant as shown in the illustration, there are several points capable of improvement.

1. The generator should not be placed in the immediate vicinity of open storage cells, as the fumes, consisting of hydrogen, oxygen, and acid, will in time damage the same.

2. The system is so placed in relation to the window that the outside air currents will at all times force the acid fumes away from the generator, switchboard and engine.

installation. Note again the relation of the ventilators to the battery, which draws the fumes away from connections, etc., into the open air. The roof of the battery room should of course be absolutely tight.

The battery shelves have to be very strong, and it is best to give them two or three coats of good acid resisting paint or varnish, to keep them in a sound condition (If they are wood or reinforced concrete.)

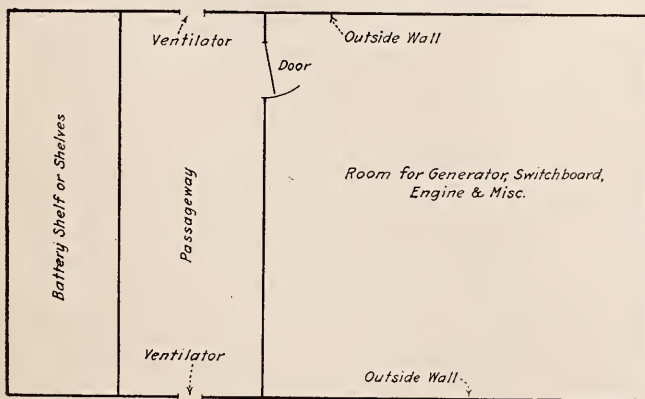


Fig. 1—Plan of Battery Room

In Fig. 1, is shown a drawing for a floor plan, which has often been used and found to be very satisfactory. Note the relation of the ventilators to the battery. The inside partition should be tight.

The generator, switchboard and engine may be placed anywhere in the outer room to advantage, although the switchboard is generally placed as close as possible to, or on the dividing partition.

Fig. 2, shows the side elevation of the same method of

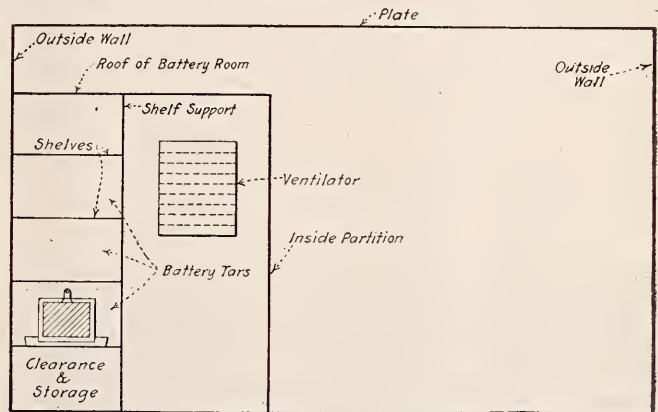


Fig. 2—Side Elevation of Battery Room

Fig. 3, is the method of putting the wooden baffle bars or plates in the ventilators, these ought to remain loose so that they may be removed when necessary. A shutter should be provided for cold climates.

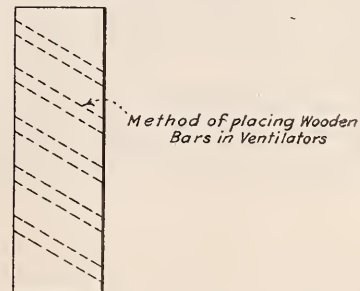


Fig. 3—Arrangement of Shutter

As for the wiring: just before entering battery room it is best to use either lead sheathed wire or cable, or wooden trunking (such as used by the railroads in the signal department). In the later case, ordinary insulated wire is bu-

ried in tar in the trunking and the leads brought out so as to have them exposed as little as possible. On the exposed leads, paraffin and paper, grease, or tar (the latter is mixed with linseed oil to make it pliable) may be placed as a resistance to the action of the acid.

When counter or end cells are used, added caution should be taken on account of the increased amount of fumes.

\* \* \*

### Concentric Wiring

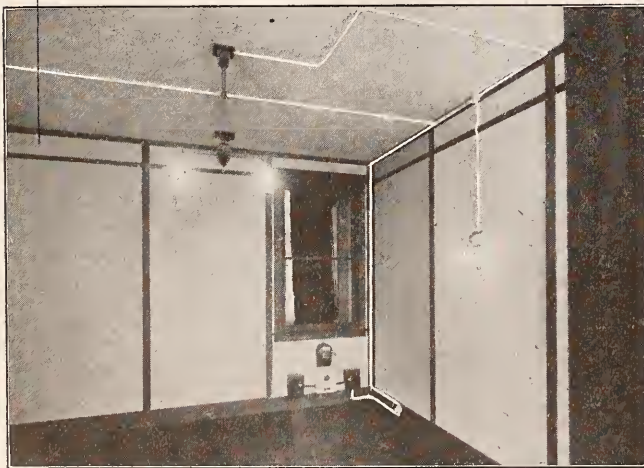
There are two factors involved in the discussion now in progress about concentric wiring. One of these is the matter of safety, the other that of cost. Unless the concentric system of wiring is less costly than other methods it will find little demand. On the other hand, if it is less safe, but less costly, it should not be used. This is about the status of the matter at the present time.

The matter of safety centers round that of grounding. To be safe it would be necessary to insist on rigid, frequent and strong grounding. There are difficulties in obtaining a really good ground, and it is not always possible to maintain it in this condition.

The suggestion by Querist that neither conductor be grounded would not be acted upon, the writer feels sure, for such a suggestion is too radical.

The concentric method of wiring as generally understood consists of a No. 14 copper wire rubber covered and braided. Outside this is wrapped a thin tinned water-tight copper sheath. The interior wire is the "hot" wire, the outer covering being connected to the neutral or grounded wire. Those in authority are very strong in their objections against concealing the wires, and insist that the concentric wiring be used for branch circuits only, and it is to enforce this ruling that the interior wire has not been made larger than No. 14 copper. At the time of writing the concentric method of wiring has not been formally approved by the underwriters or local municipal authorities of Chicago.

The concentric wiring is used quite extensively in Europe, especially in Italy and Germany for the wiring of workmens' cottages. On the other hand in England in many municipalities its use is not permitted at all.



Room With Concentric Wiring

An interesting installation is shown in the accompanying photograph. This installation was made at the Hotel Sherman for purposes of demonstration during the convention of the Western Association of Electrical Inspectors held from January 25th to 28th. The fittings were made by the General Electric Company.

Considerable interesting information on the concentric sys-

tem of wiring will be found in the Transaction (Commercial) of the National Electric Light Association recently issued from the press.

There is a field for concentric wiring, where it will be safe, economical; on the other hand there are times when it should not be used. If all concerned will remember this there should be no trouble from fire or accident from electric shock. Like everything new it meets with opposition, disinterested and otherwise.

K. R.

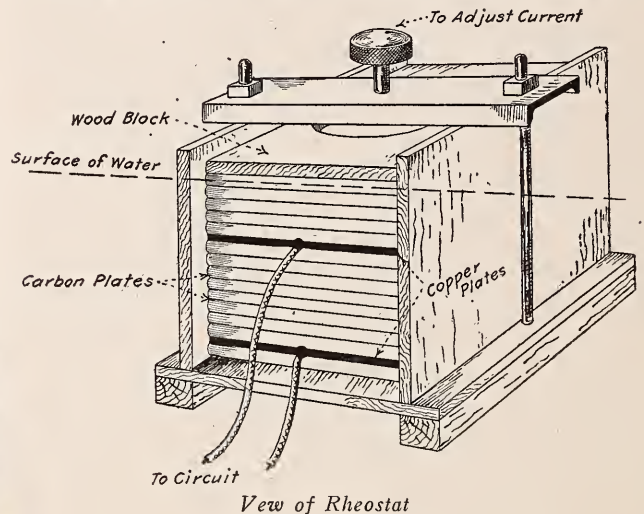
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### A Simple, Low-Voltage Rheostat

Rheostats for the control of moderate and large currents at low voltage are usually bulky and expensive, especially if a considerable range of adjustment is necessary. Not only is difficulty found in disposing of the heat but contact resistance at low voltage is especially troublesome. On account of their comparatively high resistance and instability, water rheostats are not ordinarily desirable.

The writer recently built a rheostat for a range of from 10 to 200 amperes at a voltage varying from 4 to 7 volts. The main requirement was the ability to adjust the current accurately at any point and maintain it at that value through a 40 per cent. fluctuation of voltage.

No data being available for its construction, fifteen carbon plates  $7 \times 7 \times \frac{3}{8}$  inches were laid horizontally in a wooden frame by  $\frac{1}{2}$ -inch bolts coming up from the bottom. This channel iron was tapped at the middle to take a  $\frac{1}{2}$ -inch machine bolt to which a hand wheel had been screwed and by means of



which the plates could be compressed. An iron plate was placed on the top of the carbon plates and under the screw to prevent breakage. Two copper plates  $7 \times 8 \times 1-16$  inches were made and terminal wires of No. 2 stranded copper connected to them by lugs. The copper plates were placed between the carbon plates after the manner of the usual carbon stack and the whole rheostat set in a small tank of water with the hand wheel projecting above the surface.

By varying the number of carbon plates between the copper terminals for each wide change of current and getting all adjustments to allow for voltage variation by compressing the plates, this rheostat gave perfect satisfaction and could probably have carried much more than 200 amperes.

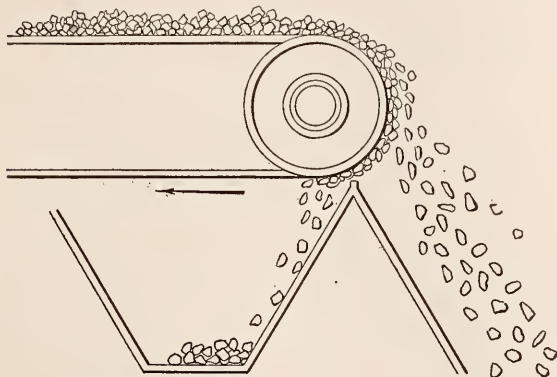
Trial showed that only eight plates were necessary for the above range, each additional carbon plate reducing the current, roughly speaking, 25 amperes. The resistance was remarkably constant and very little attention was necessary while the voltage remained constant. It might be interesting to note that his same rheostat when not immersed in water, ignited the wooden frame at 100 amperes.

M. M. F.



## Unique Magnetic Separator Pulley

The accompanying sketch shows the design of novel magnetic separator pulleys which are useful wherever it is desired to continuously remove the magnetic content from non-magnetic bulk material. For example, they are used with success in removing pick-heads and coupling pins, from coal passing to a crusher which would be damaged by the entrance of such material. They are used for similar purposes at phosphate rock mines and quarries. In the production of sulphite fibre paper stock, they are used to remove stray iron and steel from the wood chips before these are delivered to the sulphate tanks.



*Arrangement of Magnetic Separator Pulley*

These magnetic separator pulleys are also used in the production of cement, gypsum, limestone, clay for terra cotta manufacture, as well as in the freeing of grain and tobacco from bits of iron or steel before grinding. They also find employment in city refuse disposal plants, for removing tin cans, horse shoes, and nails from the worthless material. The magnetic separator pulleys are used for the separation of any stray iron and magnetic content from bulk materials, and for the protection of grinding, crushing and pulverizing machinery.

As to the principle of operation, the magnetizing of the pulley is accomplished by means of passing direct current through windings in the interior of the pulley. The current sets up a magnetic flux which passes through the belt and attracts any iron or steel that may be contained in the material carried by the belt. As a result these pieces are held in contact with the belt until the latter leaves the pulley underneath. Here they are dropped and may be collected in a box or kept separate (by means of a barrier) from the other material which is projected beyond the pulley.

The disposal of the materials is cared for according to the amount and kind of product handled. These separating pulleys can often be used to replace the existing head sheave where a belt conveyor is being used. The small diameter pulley is unsuitable for driving long or steep conveyor flights.

It is often necessary to install a short conveyor, say about six feet long, onto which the main conveyor discharges. The magnetic separator pulley can then be used on the discharge end of this short conveyor. A similar arrangement is used where the material to be separated is being discharged from a chute. Direct current is required to energize the magnetic separator pulley when in operation. The pulleys can be connected, therefore, to any 110 or 220-volt direct-current electric system, although in some cases, pulleys are operated on 500-volt direct-current circuits.

These pulleys consist of a number of steel discs keyed to a shaft, an electro-magnetic winding being placed between alternate discs. The magnetizing coils are wound on steel bobbins, which are dowelled to the discs to prevent shifting. The coils are all connected in series and terminal wires brought through a hole in the center of the shaft to a pair of collector rings located far enough beyond the edge of the pulley to permit the location of a bearing between the collector rings and the pulleys.

It will be seen that the use of a steel bobbin secures all the advantages of the bobbin type construction without the disadvantage of reduced space efficiency which attends the use of a non-magnetic bobbin. A tubular brass spacer, which also performs the function of a coil shield, is placed between adjoining steel discs.

It is of interest to note that the magnetic pull varies as the square of the number of lines of force per square inch of pole area, from which it may be seen that a small reduction as from 100,000 lines per square inch to 90,000 lines per square inch reduces the pull to 81 per cent. Too much steel in the poles reduces the number of lines of force per square inch just as too little copper does. The windings, if placed near the shaft instead of near the outside of the pulley, will require much less copper but the efficiency will be reduced on account of excessive leakages.

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## Feeder Regulators Interchanged

Notwithstanding the closest attention to details, slips will occur in the simplest as well as in the most elaborately checked and counter-checked routine systems, because in the end, a great deal depends on the individual and no individual is infallible: if he were he would not be part of a routine.

A large Western city included a main power station in connection with several smaller auxiliary stations. Feeder voltage regulators were being received for all. There was little difference in the regulators as far as size and appearance were concerned, but there was considerable difference in their regulating ranges and in their current capacities.

The regulators were promptly installed and they had not been in operation long before one of them began to evidence undue heating. The local force disassembled the unit and it was subjected to the usual inspections and tests for poor connections, wrong connections, short-circuits and grounds, but nothing unusual could be found except evidence of excessive heating of the secondary. While the inspections and tests were being conducted, a correspondence school operator in another station that had had no trouble, noticed that the current rating of one of his new regulators, far exceed the current capacity of the feeder with which the regulator was being used. On calling attention to what he had noticed, the trouble with the hot regulator was at once suspected.—It was of the wrong rating, as was proven by investigation.

It seems that each parcel had its destination marked on it, but the truckman, who had never been known to make such a mistake before he made one this time and had delivered the wrong regulator although he had shown the right receipt.

If the regulator had heated only slightly instead of very much, probably it would have burned out in course of time, because the over-heating would have escaped notice until too late.

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## Operating a Mexican Plant

The big water-power electric plant of the Mexican Light & Power Company at Necaxa, out in the wilds of the Mexican mountains, has had its share of attention from the bands of scoundrels who have been terrorizing the adjacent country for the past eight months.

The "rebels" tried to cut the transmission lines by climbing the towers, but 44,000 volts soon discouraged that. They also tried to shoot up the insulators, but owing to their notoriously poor marksmanship and rotten ammunition little damage has been done in that manner.

At the plant itself a powerful searchlight is mounted on the building and the single road that approaches the place is lit by tungsten lamps controlled from the inside. In addition to the arming of the operating forces with rifles, the government has a company of picked soldiers with a Hotchkiss rapid-firer and two Colt machines to garrison the place, which, thanks to these precautions, still continues to furnish light and power to the capital 130 miles away.

## Getting Shocks From Grounded Conductors

As there has been considerable interest in the discussion of the matter of the danger of touching grounded guy wires while same were in contact with a live conductor, we believe that an experience of this nature that occurred in a town in the State of Washington as sent in by a correspondent will prove of more than passing interest:

The secondary lighting distribution is 110-220 volt, 3-wire alternating current, single phase; the primary circuits being 3-phase. All secondary circuits have their neutrals grounded. In most cases the transformers are not interconnected. Each transformer feeding its own secondary system. In one case in the center of town, two lighting transformers, located on different poles two blocks apart, are interconnected in open delta to secure 220 volts 3-phase for some small 3-phase motors. In this case the neutral of one transformer only is grounded. The grounds are made by driving 1½ in. pipe 4 to 5 feet into the ground and placing salt around them.

Last winter on a wet day when the streets were soft and muddy, one side of the service to a blacksmith shop became grounded at the point of entrance to the building, on the corrugated iron siding of the building. The first intimation we had of any trouble was when the report came in that the street around a certain pole was charged with electricity.

The pole reported was the one carrying the ground wire for the above mentioned transformer bank, and was 3 blocks from the building where the ground causing the trouble was located. Our informant stated that a delivery man was driving along near the pole when his horse was suddenly knocked flat down, and that the men trying to get him up all experienced shocks when standing in the street. The report was taken for a joke, but "safety first," and a lineman was sent out to investigate. He promptly reported that the condition did exist, and that just as he arrived, a team being driven by near the center of the street had suddenly attempted to run away when opposite the pole.

We secured a volt meter, some wire, and a couple of sheet iron plates about 6 x 12 ins., and hurried to the scene.

Voltage tests revealed the following conditions existing. Voltage from ground pipe to center of street, 160 volts. Voltage from ground pipe to earth one foot from ground pipe, 25 volts. Voltage from one foot from ground pipe to a point 15 feet distant towards center of street, 110 volts. The voltage did not get any stronger after the center of the street was passed, or an equal distance in the direction of the blacksmith shop. In the two opposite directions there was very little voltage difference.

A person could stand with his feet apart, extending toward and away from the poles, anywhere within 20 feet of it on the two sides of the pole, and get all the shock he wanted to take; the further apart the feet the stronger the shock.

It was some days before we were able to locate the ground that was causing the trouble, and until we did we had to keep the neutral ground disconnected.

A few days later the same thing was reported in another part of town. In this case there were only 3 blocks of line and 4 residences on the transformer, and we were able to locate the trouble at once.

The lower floor of one of the residences is wired in metal moulding. The metal moulding being grounded to the water pipes in the basement. The ground occurred in a fixture attached to the metal moulding.

The voltage difference around the ground rod was not so great in this case as in the one of the 3-phase bank. There was a potential of 94 volts from the ground rod to a wire fence 10 ft. from it and running parallel to the line for 50 ft. towards the house in which the ground occurred, and at no point nearer

the house than 300 ft. A slight shock could also be felt by standing in the mud near this ground rod. The most peculiar phenomenon was at the house where the ground occurred. One could stand on the lawn and get a shock by touching water hydrants that came up out of the ground. These hydrants were a part of the pipe system to which the metal moulding was grounded. In this pipe system there were some three or four hundred feet of pipe under ground, and a pump, the suction pipe of which extended down into the water of the well. All were metallically connected, and it would seem that if there were ever a chance for a perfect ground it were here. Yet sufficient current would come up out of the ground on any hydrant on the system, to flow through the body and back to the ground again through the shoes, to give an appreciable shock.

While these cases are somewhat different from the case of a grounded guy rod, yet they are analogous in the existing potential gradients in the adjacent earth, under certain conditions. And if on the low secondary voltage present in these cases there was a difference of potential of 110 volts in 15 ft., what proportion might it not assume in the grounding through guy rods, of 20,000 to 60,000 volts?

\* \* \*

Another correspondent writes:

"One of my friends, who is an electrician, going home to spend his Christmas vacation, was called into a neighbor's house and asked to explain why it was that when the kitchen floor was damp, one touching the faucet of the water pipe was liable to get a shock strong enough to knock him down, and the same results followed on touching the gas pipes. The special mystery in this case was that there was no electric service in the house.

"An investigation resulted in finding that on the street in front of the house the power company had a ground plate located 12 feet below the surface. One side of this plate was 6 feet away from the water main, and the other was about 8 feet away from the gas main. The loss of potential in the vicinity of this plate was sufficient to build up a voltage on the gas pipe and also on the water pipe. The amount of the voltage in this case can be judged from the fact that my friend's remedy was to tie the gas and the water pipe together by a wire and connected a 12½ volt series street lamp between this cross wire and the ground, which lamp he kindly installed in the kitchen. It burns day and night, and so long as it is burning no shock is experienced upon touching the water or gas main, but if it is turned out the difference is at once felt. The family now turn it out and with a few wires from the water pipe around the house make it also serve the purpose of a burglar alarm.

"What the power company thinks about all this is not related in the story."

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### Washing "Filthy Lucre" Electrically

Thousands of dollars of greenbacks and yellowbacks of all denominations are now being washed daily by the United States Treasury Department in specially built electrical washing, drying and ironing machines. By constant use bills become dirty and grimy in a short time. To destroy such bills and issue new ones when they were not otherwise damaged was found to be very expensive and highly inefficient. Machines were therefore installed into which dirty and crumpled bills are introduced at one end to come out of the other end in a couple of minutes looking like new. One of these machines was exhibited at the recent New York Electrical Show. It is motor-driven and capable of washing, rinsing and pressing 6,000 bills an hour. Banks from all parts of the city sent dirty money to be electrically laundered.

# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

## Testing Series Street Light Circuits

By H. E. Weightman

Answering the question on testing for open circuits, or grounds in series street light circuits, one of the best recommended methods for general testing is the Evans method for locating opens. This is as follows: referring to Fig. 1; I represents an induction coil; one terminal of the secondary is grounded and the other connected to a point A, which is the junction of two resistances, at least one of which, say n, must be adjustable. BAC could be a high-resistance slide wire, A being the point that is adjusted along the slide wire, or m, n

$m + y = \frac{x}{n}$ . Now, reverse the connections of the loop with the bridge, joining BF to D and DE to B. Obtain a new balance on the bridge, then  $\frac{m' + x}{n'} = \frac{y}{p'}$ . Solving these two equations for x gives the following formula:

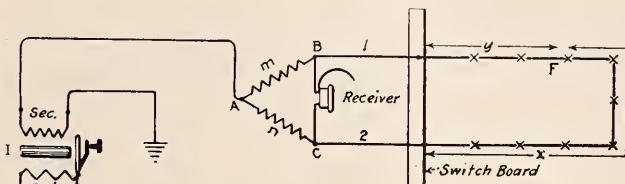


Fig. 1—Illustrating Testing for Open Circuit

could be the two arms of a Wheatstone bridge. BFC represents the circuit which is open at a point F. A telephone receiver is connected across BC. Adjust the resistance n, or the position of the point A, if BAC is a slide wire, until the sound produced in the receiver by the current from the secondary coil, as it charges the open line, is reduced to zero or at least to a minimum. The bridge arrangement is then balanced and we have

$$m : n :: \frac{y}{x}$$

capacity, but the opposition of a condenser to an alternating current is inversely proportional to its capacity. Hence, the resistances m, n are inversely proportional to the lengths of the open wires, as stated in the proportion. Solving the proportion for x, the distance along the broken wire to the fault F, gives

$$x = \frac{my}{n} \quad \text{As } x + y = L \text{ then } x = \frac{mL}{n + m}$$

If L is given in feet then x will be in feet. Leads 1 and 2 should be of the same resistance.

TO LOCATE GROUNDS

The following modification of the Murray loop test gives a very simple and quick method of testing where the resistance of the circuit loop is not known. Referring to Fig. 2, the loop BED is connected to the bridge and a balance obtained. Then,

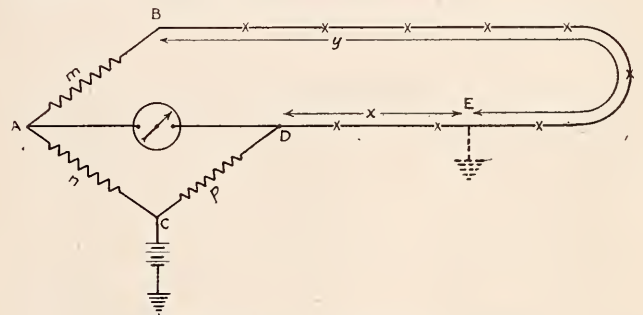


Fig. 2—Diagram for Testing for Ground

$$x = \frac{p(mn' + p'm')}{nn' - pp'}$$

This formula simplifies when m, m', n, and n' are multiples of 10, as they usually are in practice. A measurement made by this method is independent of the resistance of the fault.

### Testing by Magneto

Answering E. A.'s question in the January issue in regard to "locating open or grounded lines on series street light circuits," the quickest and easiest way to find an open circuit is to ground one side of line at plant or generator as shown in Fig. 1 accompanying diagram. Commence the test about the

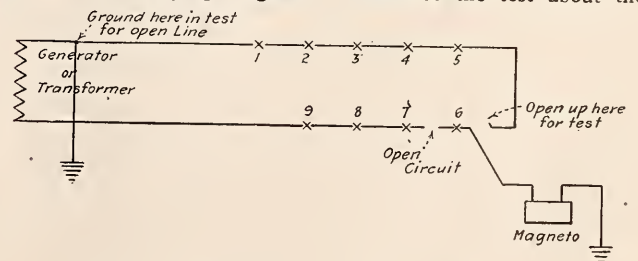


Fig. 1—Diagram for Testing Open Circuit

middle of the troubled circuit and disconnect a wire from one side of a lamp (as per diagram, lamp No. 6 for instance) and

connect one wire of magneto to disconnected wire and ground the other magneto wire. If you get a ring on this test, the line is O. K. from there to plant. Now remove magneto wire from line and connect to lamp (as per diagram No. 6 lamp, Fig. 1) and if there is an open circuit there will be no ring that way. Connect up that lamp again and go ahead six or seven lamps. Make the same test again at another lamp, and when there is a ring on the line in the direction the test is being made then the break has been passed. Now go back a lamp at a time and the trouble will be found very readily. This method has been tested out many times and we have always found the trouble in a reasonable length of time.

A grounded circuit is tested out in pretty much the same way as an open circuit, only the line must be disconnected on side of generator or transformer instead of being grounded,

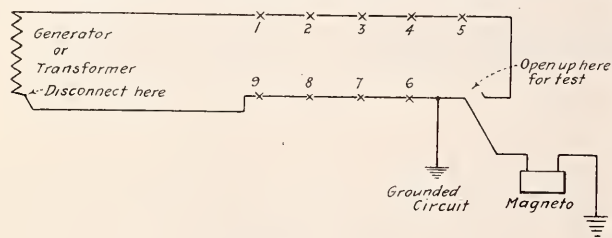


Fig. 2—Illustrating Ground Test

as per Fig. 2. Then proceed as in test for open circuit. Disconnect a wire from a lamp located about the center of the line and connect magneto as previously explained. If there is no ring, the line is O. K. from this point to the power house. Now, connecting the magneto to the lamp, test the other way and there will be a ring if the line is grounded. Proceed as before, going ahead five or six lamps at a time, until upon testing, the magneto fails to ring. Then the ground has been passed and by going back a lamp at a time until there is a ring the ground is readily located.

Care must be taken to reconnect the lamps in circuit, for to leave one disconnected will be confusing for a time. D. H.

The above method can also be worked by connecting the one side of the street light circuit after it has been disconnected from the generator or transformer, to some convenient grounded low-voltage circuit, and thence test out on the line to ground with a lamp or two. This avoids the need of using the magneto.

Ed.

Answers to this problem have been received from C. M. H., K. F. R., E. S. O. and others.

\* \* \*

### Voltage Rise in Series Transformer

The best way to understand this is to consider that the iron in a series transformer, with the secondary circuit closed through a comparatively low resistance, has the magnetism induced in it by the primary turn or turns pretty well counter-balanced by the current circulating in the closed secondary circuit. In this case, therefore, the magnetic induction in the iron is very small and the effect on the primary circuit is approximately as if the resistance of the winding was the only thing inserted. A millivoltmeter, connected across the ends of the primary turn, would show only a small drop.

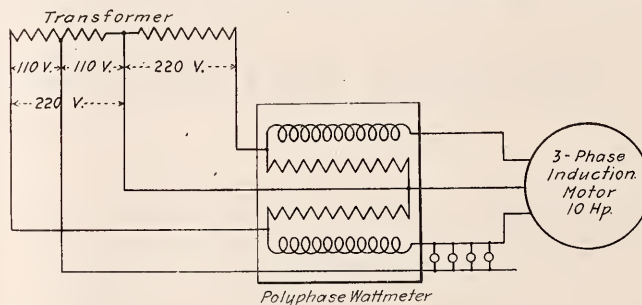
As soon as the secondary circuit is opened, this balancing effect of its ampere turns disappear. The induction in the iron increases greatly and tends to induce a correspondingly high voltage in the open-circuited secondary. This is what causes the trouble referred to. The series transformer under these conditions is like a choke coil in the primary circuit and has an increase in the voltage in the voltage across its terminals, proportional to the induction of the coil, which, of course, depends on the amount of current in the primary circuit. W. K.

Correct answers to this problem have been received from A. P. B., S. T., K. R., A. J. W., J. S. H., and J. A. F.

### Metering Lamps on a Motor Load

Answering question regarding meter connection in February Issue:

The amount of power registered by the meter at 110 volts will always be twice as great as the true amount. The power recorded by the meter is that due to the sum of the power flowing through the two meter elements, which is proportional to the algebraic sum of the power in the three phases. The total current in the one element of the wattmeter connected in the phase that carries single-phase lighting load as well as three-phase power load is the algebraic sum of the currents due to the lighting and the power, since the power load has comparatively low and the lighting comparatively high power factor.



Mixed Load Meter Connection

This total current is metered as if it were at a potential of 220 volts entirely, whereas part of it is at a potential of only 110 volts. It can be seen, therefore, that the error of registration of the lighting or single-phase load is exactly 100 per cent., irrespective of what the percentage error may be. To be able to express the extent of the error as a percentage of the total amount of power recorded by the meter it would be necessary to know the relative proportion of lighting load to the power load.

K. R.

Correct answers to this problem have also been received from C. E., E. L. D., A. M. H., H. A. F., and J. S. H.

\* \* \*

### Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

Can you give us any reliable information as to the cost of concrete poles—both reinforced and non-reinforced—for transmission and distribution lines? M. N.

What is the simplest and best way to find the power factor of a current by the use of a watt meter only? What are the conditions under which it can be done? M. S.

\* \* \*

### A Correction

R. M. E., E. H. W., and several other correspondents have pointed out that the upper inside cut on page 47 of the January issue entitled Fig. 3 should be correctly represented as shown below.

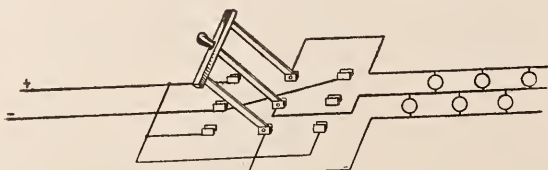


Fig. 3 of Page 47, January Issue, Correctly Drawn

**Induction Motor Won't Reverse**

Regarding question about induction motor in the February issue, in view of the fact that the motor reverses sometimes and not at others, the writer is inclined to believe that there must be a loose or poor connection in the winding connections of the motor, or on the switching device. Any three-phase motor whose starting apparatus is properly connected to a motor whose windings are all right will reverse when any two of the wires to the motor are reversed. A. P. B.

The exact reason for this action is not known. It is a well known fact, however, that the torque of the third harmonic current is in the opposite direction to the main torque. The main torque tends to reverse the motor when the connections are reversed, while the torque of the third harmonic tends to maintain the original direction at one-third the speed.

If the triple frequency current is very strong the torque set up by it might be sufficient to overcome the main torque which is reduced at time of reversing phases. This would tend to keep the motor running in the original direction at but one third of the normal speed.

If the characteristics of the motor are such as to favor third harmonics, this counter torque may be of sufficient magnitude to prevent the reversal, especially as the main torque is relatively small at that time. Occasionally this effect is present in two speed motors preventing them from operating at their proper speeds. This trouble occurs more frequently with two-phase than with three-phase motors as the higher harmonics are more pronounced. The probable cause of this is that the pitch of the coils is too small.

It may also be due to a distortion of the rotating magnetic field caused by poor contacts on the squirrel cage winding and has sometimes been cured by changing the winding.

It might also be caused by a partial short circuit or ground on one phase of the stator winding. W. K.

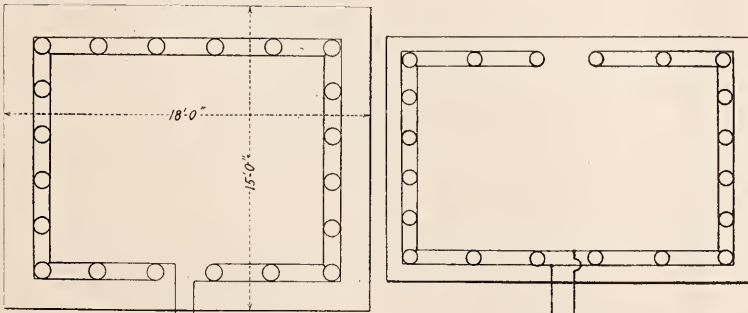
Answers to this problem have also been received from E. S., C. M. F. and A. J. K.



**Minimum Wiring**

As a solution of the problem in "Minimum Wiring" proposed in the February issue, the following diagram is submitted.

If the result can be accomplished with less wiring than shown here, an explanation of the method of doing so will be welcome. W. D. B.



W. D. B.'s Solution

C. M. F.'s Solution

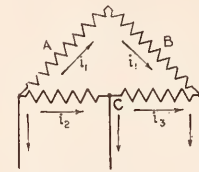
The following is submitted as the answer to E. L. V.'s problem on "Minimum Wiring" in February issue.

The above arrangement will also place the center of distribution correctly and at the same time take the minimum amount of wire. C. M. F.

Answers similar to this have been received from E. B. S. and A. J. K.

**Current Division in Transformers**

To find current division in case proposed in January issue: The connection shown is a simple closed delta with connection from one transformer and the other two in parallel, as shown in the sketch.



Simplified Diagram of Connections in January Issue

For balanced load, A and B carry the same current which is half that in C because their impedance is twice as much and load division of transformers in parallel with equal induced voltages, depends on the impedances.

If the current is not balanced the total impedance drop in C must equal that in A and B. Then if Z is the impedance of each transformer

$$2 I_1 Z = \frac{I_2 Z + I_3 Z}{2}$$

$$\text{Solving } I_1 = \frac{I_2 + I_3}{4} = \frac{I_{av}}{2}$$

where  $I_{av}$  is the average current in C and  $I_1$  is the current in A and B? R. H. W.



**Changing Current Again**

Referring to J. E. M.'s question regarding the charging current in a transmission line in the December issue: the following calculations may be of interest.

$$I = \frac{2 \times 3.14 N C E}{10^{-6}}$$

where I = charging current  
 N = frequency  
 C = capacity of circuit  
 E = voltage between lines and neutral in three-phase  
 $\frac{1}{\sqrt{3}}$  line =  $\frac{1}{\sqrt{3}}$  x line voltage and  $C = \frac{25 L}{\log 2D}$   
 d

l = length of line in cm.  
 D = distance between lines  
 d = dia. of wire  
 substituting the values given by J. E. M.

$$I = \frac{2 \times 3.14 \times C \times 25 \times 46,000}{10^{-6} \times \sqrt{3}} \quad C = \frac{.25 \times 10^{-6} \times 1}{\log 2 \times 12}$$

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C = 2.07  
 . . . I = 8.63

This is only the approximate or average value. Each section of the line should be calculated separately as the charging current is not the same over the entire line. However, for practical purposes, the transmission line can be considered as one condenser.

The above calculations do not agree with E. J. F.'s calculations in the January number, in which the results would seem to be too large. H. H. W.

### Three-phase, Four-Wire Distribution

Four-wire, three-phase is used on both transmission and distribution. For transmission, the transformers are connected in star on the high tension side and the neutral is grounded. A grounded neutral wire is frequently run on the towers above all other wires to serve as protection against static and lightning disturbance. As the load on a transmission system is nearly always balanced between phases, the neutral wire carries little or no current and its size is determined from mechanical considerations and the size desirable to ensure successfully carrying off static discharges.

For distribution systems the load is generally unbalanced (single phase lighting). On account of different location and height of poles lighting protection is less important than in transmission. For distribution, four-wire, three-phase is useful because, like the Edison three wire d. c. system, it admits distribution at higher voltages with standard voltage apparatus. By carrying 4,000 volts between lines the voltage from neutral to live is about 2300 which is standard distribution voltage. If the loads are fairly well balanced the neutral wire carries little current and most of the energy is distributed at 4000 volts, saving considerable copper. The size of the neutral wire depends on how nearly the single-phase loads are balanced. Any three phase load will not affect it. The minimum size of neutral is determined from mechanical strength or ability to handle short circuit. To keep the stock of wire down it is common practice to use the same size wire for neutral and live. Under worst conditions it need be no larger.

For single-phase load, one transformer is needed connected from neutral to a live wire. For three phase two transformers in V or three in delta would be best. In either case the neutral would not be used.

For overhead distribution the wire size will be determined by the allowable voltage drop. Each case must be figured by itself and in some cases factors may be disregarded which would have a big effect in others. The example below is not intended as a formula but just as a particular case.

Assume—lighting load, 5 per cent. allowable drop, distribution of load as in table, load on line at once assumed to be 2-3 of connected load. Since the drop varies directly with the distance it is possible to get for each phase an "equivalent load at 1000 feet" by multiplying each load by its distance, adding the results and dividing by the distance chosen (1000 ft.). Get equivalent currents for all phases. Get neutral current by adding three line currents at 120.0 (can be done graphically). The heaviest drop will be on phase C and will be the same as that due to 1000 amps in the live wire and 370 amps in the neutral. For simplicity assume neutral same size as live. If R is resistance per 1000 ft. the total drop is

$$1000 R + 370 R = \text{Drop}$$

Phase	Equivalent Amps. at 1,000 ft.	Load-Amps.	Distance from Power House	Amp. ft.	Amp.
A	150	100	1,000	100,000	
B	300	200	1,200	240,000	
A	75	50	2,000	100,000	
C	300	200	2,500	500,000	
B	300	200	3,500	700,000	
A	150	100	4,000	400,000	
C	150	100	5,000	500,000	
		Phase A total		600,000	600
		Phase B total		940,000	940
		Phase C total		1,000,000	1,000
		Neutral total			370

Allowable drop is 5 per cent. of line voltage (2300) which is, 115.

$$1370 R = 115$$

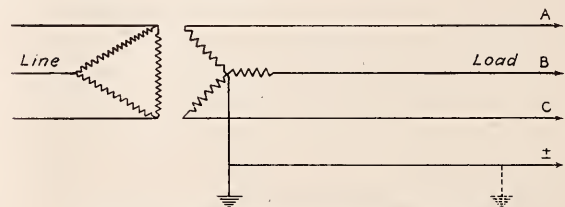
$$R = .084$$

The nearest commercial wire size is No. 00 which has .078 ohms per 1000 ft.

R. H. W.

### Grounding a Neutral

It is usually considered the better practice to ground the neutral of the four-wire, three-phase circuit. The ground should, however, exist at one place only, and that place should preferably be at the station from which the circuit emanates, for there a good ground can usually be obtained. By grounding the neutral it is held stable and at ground potential. Since there might be considerable voltage drop in the fourth wire under heavy unbalanced load grounding at the station will reduce somewhat the potential strain of the instruments, also of the transformer winding. At such low voltages as 220 there is really no need to consider this, however; and it makes little difference whether or not the neutral is grounded, or if it is whether at one or more places. If the ground exists at more than one place the possibility of inductive interference with neighboring telephone and telegraph lines must be taken into consideration; and there is always the likelihood that duplex grounding will offer a low-resistance path to foreign or vagabond currents from the street railway return and other sources, which flowing in the neutral is always in parallel with the earth return, as shown in the sketch.



Neutral Ground on 3-phase, 4-wire Circuit

The chief reason for using the four-wire instead of the three-wire circuit is very often on account of its ability to serve single phase loads that are badly unbalanced with the greatest flexibility, economy and best control of voltage. Three single-phase regulators are used for this purpose, one in each phase, for regulating its own phase according to the load requirements. With balanced loads practically no load-current flows in the neutral and the fourth wire serves little purpose. With badly unbalanced loads, however, the current flowing in the neutral may be very heavy. To assist in the voltage regulation in such instances neutral compensators are often installed to compensate for line drop in the fourth conductor. When this is done, and the neutral is grounded at more than one place, the additional current—foreign current—may seriously interfere with the voltage regulation.

Circumstances alter cases. In the present instance there may be good reasons for grounding the neutral at both ends. If so, it is an exceptional case. It is better to adhere to only one ground, and let that be at the station, or at the transformers as the case may be, where there is a good ground and where it can be properly maintained.

\* \* \*

K. R.

### Closed Conducting Shell

The theory of all grounded over-head protection against lightning and other such disturbances is based on the fact long ago discovered by Faraday that there are no electrical forces inside of a closed conductor. Such a system is called a "conducting shell," and its efficiency is immediately impaired by openings in the shell. The relation of this to the grounded wire is well explained by Steinmetz in the following extract from one of his books:

"If a transmission system is placed in an enclosed conducting shell, i. e., put underground, atmospheric disturbances can not enter it. Since a transmission line cannot be put underground the next best means of protecting a system against lightning charges is to place the ground above the transmission line. That is by putting a grounded wire or a system of these above the transmission wires. The nearer these approach a perfectly grounded enclosing shell the nearer perfect will be the protection against outside disturbances.

### Grounding of Neutral on Same Ground as Lightning Arrester

Many people think there should be separate grounds. In a substation, where everything is grounded to a common ground, the separate grounding of the lightning arrester and the secondary circuit is not necessary. In general if the ground is a good capacious ground with heavy wires there is no reason for having separate leads to it.

Where the transformer and lightning arrester are on a pole and grounded to a pipe or plate it may be better probably to ground the secondary on another pole or some distance from the primary ground, though where the grounds are well the advantage gained in so doing is rather theoretical than practical.

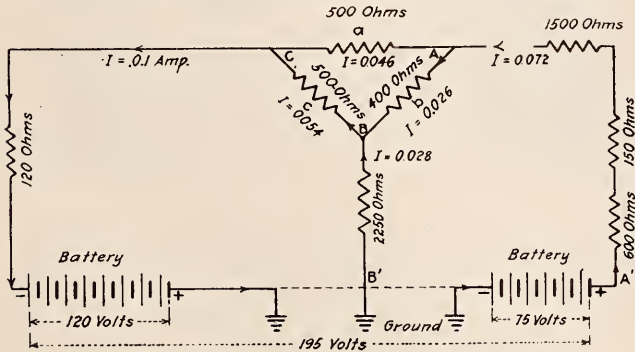
S. E.



### Divided Battery Circuits

Answering E. R. H.'s problem on divided circuits in the December issue of ELECTRICAL AGE, it is to be noted that the solution of this problem is only possible by assuming that the resistance between the three grounds shown is negligible, and also the resistance of the wires connecting various resistances is negligible.

A simplified diagram of these circuits can then be constructed as shown in which the dotted lines at the bottom show the equivalent circuit with one ground, or without any ground, so far as the solution of the problem is concerned. This is really a circuit of three meshes and the current in the meshes is in direct proportion to the respective conductances and the solution depends on the law that the conductance of any number of circuits in parallel, such as a, b and c, is equal to the sum of the conductances of the individual circuits.



Simplified Diagram of Divided Circuits

To find the various currents; consider first the resistance of the triangle A B C as taken between A and B. There are two 500-ohm coils in series with each other and a 400-ohm coil in parallel. Lettering the coils, as shown, a, b and c, then the total resistance, R<sub>1</sub> between these points is as follows:

$$R_1 = \frac{1}{\frac{1}{a+c} + \frac{1}{b}} = \frac{1}{\frac{1}{500+500} + \frac{1}{400}} = \frac{1}{\frac{7}{2000}} = 285.7 \text{ ohms.}$$

Similarly for resistance between B and C we have

$$R_2 = \frac{1}{\frac{1}{a+b} + \frac{1}{c}} = \frac{1}{\frac{1}{400+500} + \frac{1}{500}} = \frac{1}{\frac{14}{4500}} = 321.4 \text{ ohms.}$$

And for resistance between A and C. we have

$$R_3 = \frac{1}{\frac{1}{b+c} + \frac{1}{a}} = \frac{1}{\frac{1}{500+400} + \frac{1}{500}} = \frac{1}{\frac{14}{4500}} = 321.4 \text{ ohms.}$$

To determine the separate currents in each of the three main circuits, consider the triangle as one resistance unit, which, as we have just shown, will be different for two of the circuits.

$$\text{By Ohm's law, } I = \frac{E}{R}, \text{ where } I = \text{current, } E = \text{volts.}$$

R = resistance. Hence, for current circulating in right hand mesh, A' to B', we have

$$R = 600 + 150 + 1500 + 285.7 + 2250 = 4785.7 \text{ ohms}$$

$$E = 75 \text{ volts}$$

hence

$$I = \frac{75}{4785.7} = .0158 \text{ amperes}$$

Similarly, for current in left-hand mesh, B' to C',

$$R = 2250 + 321.4 + 120 = 2691.4 \text{ ohms}$$

$$E = 120 \text{ volts}$$

hence

$$I = \frac{120}{2691.4} = .044 \text{ amperes}$$

and finally, for entire circuit A' C',

$$R = 600 + 150 + 1500 + 321.4 + 120 = 2691.4 \text{ ohms}$$

$$E = 195$$

hence

$$I = \frac{195}{2691.4} = .0724 \text{ amperes}$$

By Kirchoff's law, in any network of circuits the sum of the currents flowing towards a point must be equal to the sum of those flowing away therefrom. Considering each mesh of the circuit in connection with the above calculated results and diagram it will be seen that the branch B B' has current tending to flow both ways; .0158 ampere flowing downward and .044 ampere flowing upward.

By the above law the net current will be the difference of these two, or .044 - .0158 = .0282 amp. flowing upward as indicated on diagram. On branch C C' we have .072 amp. plus the above current .028 amp. flowing out at B', hence the total current in branch C' is the sum of these two, or .1 amp. In the same way the total current at A' is .072 amp., as indicated. These are the values of the current as calculated in the three main legs of the circuit.

The calculation of the current in the three branches of the triangle, is based on the proportion of the conductivity of each branch to the total conductivity of the circuit.

Numbering the three resistances of the triangle a, b and c respectively, we find from the same consideration as given in the third paragraph above that the current through the resistances b and c will equal 5/14 of the total current, and the current through resistance a will equal 9/14 of the total.

As above shown, the total current was .072 amp. so the current, coming from A', in resistances b and c equals 5/14 of .072, or .026 amp., and current in resistance a equals 9/14 of .072, or .046 amp. as indicated on the diagram.

By the same method the proportion of the current in resistances b and a coming from B' equals 5/14 of unbalanced current in branch B' or 5/14 of .028, or .01 amp.; and similarly, the proportion of the current in resistance, coming from B', equals 9/14 of above quantity, or .0118.

It is also seen that the total current in resistance c is equal to the sum of .026 + .028, or .054 amp., as shown on the diagram.

Finally, for the total current in the left-hand leg at point C we have the sum of the total current in coils a and c or .046 + .054 equals .1 ampere. This also equals combined current in A' C' and B' C' as shown above.

The arrows in the diagram indicate the direction of the currents and voltages throughout, and the whole problem is solvable, under the conditions assumed, as shown, by the use of Ohm's and Kirchoff's laws.

E. J. F.

# Questions and Answers

Of two distributing systems, one 3-wire direct current with grounded neutral, the other 3-wire alternating with grounded neutral, does the one have any greater liability to trouble from lighting than the other? **T. L. H.**

From what we know about it, it cannot be said that one of these systems is any more liable to trouble than the other, if all other things concerned are equal. As alternating current motors and machines are, generally speaking, more rugged than the same kinds of direct current devices, it is probable that there would be less trouble with the apparatus connected to the alternating current system than with the other.

A 5-hp., 4-pole, 60-cycle induction motor runs at about 1400 r.p.m. and will hardly start under load. What do you think is the matter with it? **M. S.**

*Ans.* You had better look for wrong connections in connecting up the stator winding. The scheme published in the January issue will help you in testing out these connections. The given full-load slip is entirely too great.

What is meant by a storage battery "floating" in the circuit across which it is connected? **R. P. L.**

*Ans.* A storage battery is said to float on the line when it is connected across the mains at some distance from the power station, so that a heavy load on the line within the range of the battery influence causes sufficient drop in the line to allow the battery to discharge. With a light load on the line, on the contrary, the drop is small, and the impressed voltage at the battery is high enough to send a charge into the battery. The floating of batteries on the line is confined usually to electric railway service, where there is a large variation in line voltage. It boosts the electrical pressure when it falls, due to temporary over loads.

Why is it impractical to charge storage batteries from a series dynamo? **S. L. A.**

*Ans.*—The reason is that as the counter-electromotive force of the storage battery begins to increase with the charging of the battery, it opposes the electromotive force of the dynamo, which reduces the current therefrom. This in turn weakens the field and causes a further reduction of the current. This effect keeps on until it may reach a point when the battery will overpower the dynamo and discharge through it.

The only way this can be avoided is by constantly watching the circuit and adjusting the field resistance of the dynamo as the battery voltage builds up. This is not very practical, hence series machines are not in favor for battery work.

Is there any way to prevent or stop the humming noise coming from most alternating current apparatus, particularly from transformers? **K. M.**

*Ans.*—This noise is found to some extent in nearly all alternating devices containing coils with iron in them. It comes from the rapid reversals of the magnetism in the iron with each alternation. The only way to reduce it is to have the iron not too highly magnetized and held as tightly clamped as possible. Noisy transformers have sometimes been made less obnoxious by tightening of the clamping bolts of the frames that contain the iron cores. Where such methods fail there is little that can be done. The noise in many alternating current motors comes from the way the air is disturbed by the speed of the motor. Heavy, high-speed motors are apt to be more noisy than motor. Hence, high-speed motors are apt to be more noisy than reduce the noise, and some makes of this class apparatus are noticeably more noiseless than others.

Is it considered good practice to provide only one ammeter for measuring current from a three-phase alternator? **W. K. T.**

*Ans.*—That all depends on how nearly the load on the three-phases are balanced and what need there is for knowing the currents. Therefore in some cases it would be all right to furnish one ammeter, while in another case where it is important to know the value of the current in each phase, and the loads are unbalanced, it would not be good practice.

The tensile strength of copper wire of a certain degree of hardness is given at 50,000 pounds per square inch. Will you tell me if it is safe to assume that this has remained constant through a long period of time? **E. N. V.**

*Ans.*—So far as is known, if a wire is not over-stressed over-heated or chemically attacked in any way, the tensile strength as well as the rest of its properties remains unchanged indefinitely. If you are considering the possibilities of the change in strength of a wire that has been used in an overhead conductor for a long time you had better be sure that none of the above forces has been at work.

Is there any distinction between "voltaic" current and "galvanic" current? **A. M.**

*Ans.*—No. Both terms are applied to electric currents coming from primary batteries. Since Volta has been commemorated by the volt, however, there has been a tendency among some people to use the adjective "galvanic" for battery currents. There is no reason for using either. Both are almost obsolete in this connection.

Please explain why shifting the brushes from the best commutation position on a direct-current motor makes it run faster. **E. L. T.**

*Ans.*—Shifting the brushes from the normal commutating position changes the counter-electromotive force of the armature. If this counter-electromotive force is at a maximum in one position of the brushes, any change of them from that position, either way, will decrease the counter-electromotive force, by causing a certain number of armature coils on each side of the normal plane to oppose each other. The motor tends to speed up sufficiently to compensate for the loss in counter-electromotive force.

Why are series-wound motors always used on electric cars, cranes and similar machinery? Should they always be direct-coupled or geared to their load? If so, why? **S. L.**

*Ans.* Series motors are preferable wherever a strong pull or torque at low speed is required. A shunt motor is essentially a constant speed machine and its torque at other than the proper speeds always diminishes.

The torque in a series motor is proportional to the square of the current; in a shunt motor the torque is directly proportional to the current. With a current strength of 10 amperes in both instances, the series motor develops a torque ten times as strong as the shunt motor. The fact that the torque in a series motor is largest when the speed is slowest, makes it just the kind of motor for crane or vehicle work. The greater the load the slower the speed and the greater the torque or pull to move the load. In a series motor when the load drops to zero, the armature will race—it will go faster and faster until it disrupts. For this reason, series motors are connected either directly, or by cog wheels, to the machines they are to drive, so that they can never escape their load.

Will an alternating current wattmeter reverse if the direction of the power in the circuit is reversed? 2. Will a power factor of less than 50 per cent. reverse it? **S. E.**

*Ans.*—Yes. Most meters of power will reverse if the direction of the flow of power through them is reversed. 2. Low power-factor has no influence on the direction of rotation of meters.



# New Fans and Improvements for 1916

The gradual settling into the fixed lines of standard construction, shape and finish that has been evolved through long practice is the evident feature of the season's output of fans for the year 1916.

The generous productions of the small, "popular priced" fan is the sign of the manufacturer's realizing that there is still room for a "Ford" in the fan trade and money for those who can supply the demand.

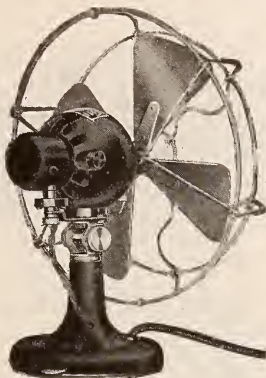
The making of light models, the reduction of noise, a slight increase in efficiency, make up about all that can be done to improve the electric fan, aside from the matter of price reduction.

Very probably the fan of 1916 will be readily recognized as the descendant of that of 1916. This is one of the increasing number of electrical products which has about finished its course of evolution and almost reached its permanent form.

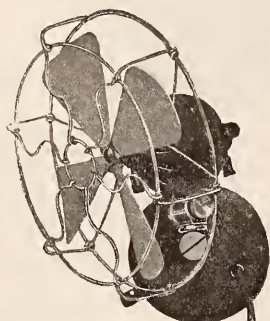


### Carleton Company

A small but highly developed line of fans, wound for alternating or direct current, adjustable for either desk or bracket use is that of the Carleton Company, Boston, Mass.



Carleton 8-inch Oscillator



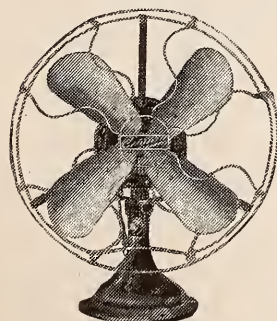
Carleton 8-inch Bracket Fan

These are made in 8-inch size only. Their distinguishing features are the fine balance of the motor, which runs very noiselessly on both alternating and direct current at nearly the same speed, their careful finish and blade efficiency.

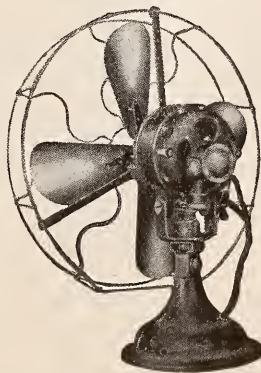


### Century Electric Company

The well-known line of fans made by the Century Electric Company, St. Louis, Mo., has had but few changes made for 1916. The alternating current fans are, as before, operated by a split-phase motor which has no moving wires in its con-



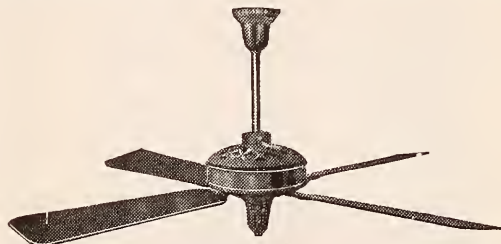
Century 12 and 16-inch Desk and Wall Swivel Fan



Century 12 and 16-inch Desk and Oscillating Fan

struction. They are made both oscillating and non-oscillating, typical illustration of each being shown.

They have a five point switch and speed coil, drawn steel bases and the usual liberal provision for lubrication. Adjustable oscillating devices working on ball bearings are among the many refinements used.



Century 58-inch, 135-watt Ceiling Fan

The ceiling fans, usually made with 58-inch blades, running at about 240 r.p.m., are turned out in a standard line of 25, 30, 40, 50 and 60 cycles at 125 volts with or without electrolier attachment. Other voltages and frequencies to order.



### Diehl Manufacturing Company

The Diehl line of fans for the year of 1916 consists of 8, 12 and 16-inch desk and bracket, oscillating and non-oscillating fans, nine varieties of plain and ornamental types of ceiling fans, and small ventilating and exhaust fans for alternating and direct current. This line of fans embraces every distinctly commercial type of fan standardized by popular demand and a choice can readily be made from its variety to fit any special need.



Diehl 8-inch Die Cast Oscillating Fan



Diehl 16-inch Die Cast Oscillating Fan

Diehl adjustable desk and bracket fans of both mechanical oscillating and stationary non-oscillating types embody a new design which is in keeping with the general trend of modern artistic furniture. The bodies are one piece die castings unbroken by angles or protuberances flowing in stately curves to the rounded base which is closely clasped by a soft rubber pad giving a positive non-scratch seating to the fan. A detachable dust proof fitting end covering gives access to the motor. A convenient joint changes the angle of the fan body when bracket mounting is desired. A wing screw which is turned by the fingers governs this desirable feature. Three speed regulators of approved design give a choice of three running speeds which can be instantly shifted as desired.

Eight-inch oscillating fans are a very delightful furnishing for the modern house or office. They are powerful, breezy, light in weight and use an insignificant amount of electricity for their operation.

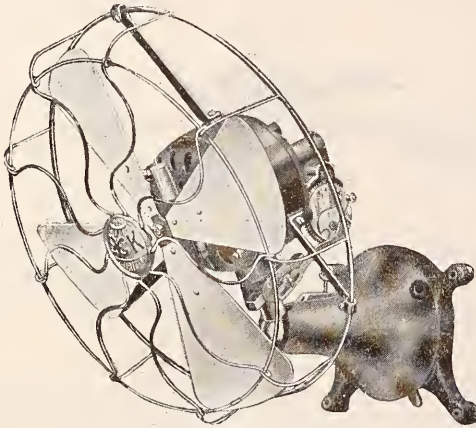
The one piece die cast body and special care used in centering the end cover give perfect alignment to the bearing sleeves and even wear to the shaft.

There are nine different Diehl ceiling fans for direct current and three for alternating current.



**Eck Dynamo & Motor Company**

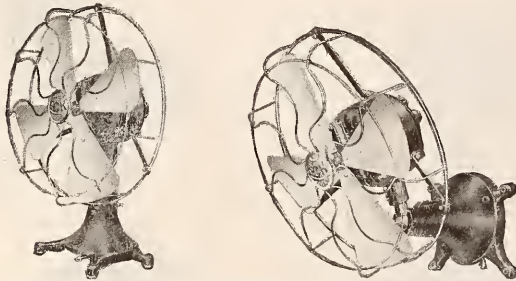
The line of fans shown by the Eck Dynamo and Motor Company, Belleville, N. J., represents the result of so many years experience that few changes have been necessary from last year models.



*Eck "Hurricane" Oscillating Fan*

The "Hurricane" 12 and 16-inch direct current oscillating fans shown are specially recommended for their durability, particularly in respect to their rugged oscillating mechanism, which has stood the test of nine years in many cases.

Another direct current machine is the adjustable desk fan, also turned out in the 12 and 16-inch sizes, and for voltage ranging from 100 to 250.



*Eck "Hurricane" 3-speed Desk or Bracket Fan*

A low priced, reliable, 3-speed alternating current fan, adjustable for either wall or desk is shown and also an 8-inch fan turned out for either direct or alternating.

All of these fans are noted for quiet operation.



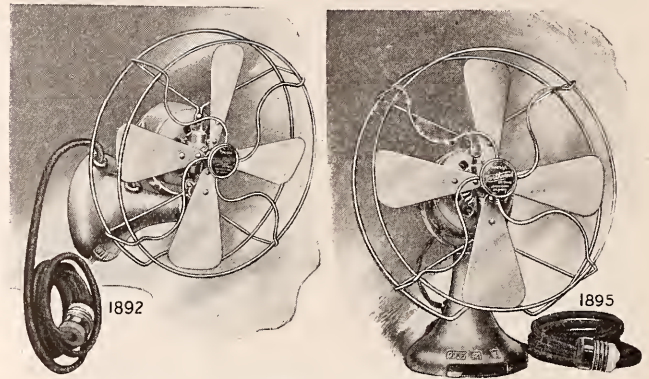
**Emerson Electric Manufacturing Company**

"Northwind" is the name of the newest 100-120-volt alternating or direct current, 8-inch, 4-pound fan made by the Emerson Electric Mfg. Company, St. Louis, Mo., but marketed as a separate and distinct product from the Emerson line of fan motors.

The motor has 3/16-inch ground shaft, bronze bearings, wick-filled oil wells, 3/16-inch square carbon brushes, removable cartridge type brush holders covered with insulating material, and 22-segment molded commutator of high grade copper.

Northwind fans have two speeds with switch in base. Speed regulation is very unusual on small universal fans. The fan is complete with plug and 6-foot cord.

"Northwind" is large enough to have satisfactory breeze-throwing power at medium speeds; it operates without the objectionable noise and vibration which have characterized some



*Emerson "Northwind" Bracket and Desk Fans*

smaller and less substantial fans of the universal type recently marketed.

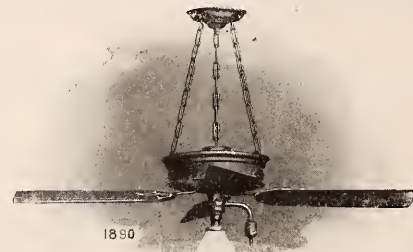
Other 1916 model Emerson fans are the 9-inch model shown below and the line of 2 and 3-speed ceiling fans which are



*Emerson 9-inch Desk Fan and 52-inch Ceiling Fan*

made as shown, either for chain or rod suspension and with or without electrolier.

All these fans are substantially the same well-tried Emerson



*Emerson Chain Suspension Ceiling Fan*

model as last year with the changes in details and finish called for by the prevailing taste of the present year. Some minor changes in manufacturing methods will render the fans of this season even more satisfactory than their predecessors.



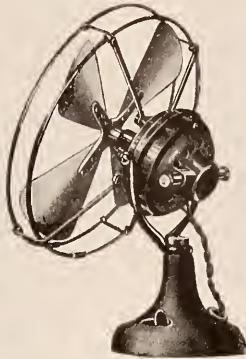
**Fidelity Electric Company**

The Fidelity Electric Co., Lancaster, Pa., has this season placed on the market a new 110-volt standard line of 8 and 12-inch fans for which special merit is claimed.

They are designed with a single bearing, thus doing away with the older self-aligning double type, which unless fitted more or less loosely were liable to bind the shaft.

This single bearing is of ample size, rigidly fitted into the bearing bracket, and is so placed that a balance is obtained between the fan blades and the armature, thus equalizing the strain and insuring minimum wear. The bearing is phosphor bronze, and is lubricated by one wick oiler.

Another point of improvement is in the support for the motor head. This support is of the swivel-trunnion type, and instead of being rigid as heretofore is made resilient. This acts as a cushion which dissipates to a large degree any vibration and this conduces to smooth running.



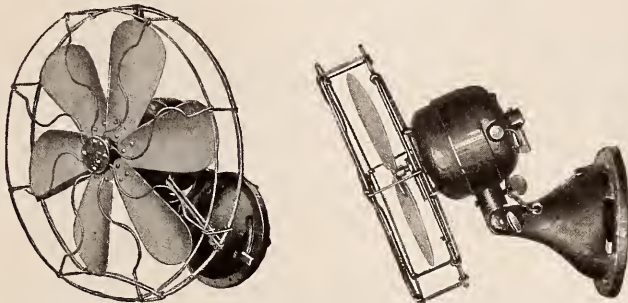
*"Fidelity" 8 and 12-inch Single-Bearing Desk Fans*

All of this line of fans are furnished with a so-called "universal winding" which at the rated voltage allows operation on alternating current of any frequency from 60 cycles down, and also on direct current of the same voltage.



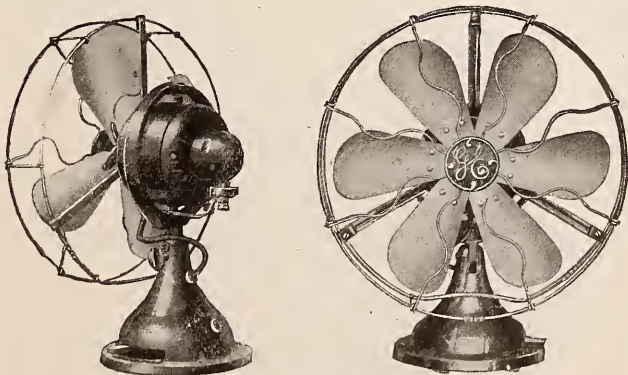
**General Electric Company**

For 1916, the General Electric Company, Schenectady, N. Y., has added to its long list of all kinds of fans, a full line of 9-inch apparatus, especially designed to meet the views of those who consider the 8-inch fan too small for effective service.



*"G.-E." Oscillating and Non-Oscillating 9-inch, 4-Blade Desk and Bracket Fans*

This line is made for all commercial alternating and direct current voltages and frequencies and has the same noted qualities of design and finish as the earlier types of the company's output.



*"G.-E." Non-oscillating 6-Blade Residence Fans*

The silent running feature of the six-blade fan is responsible for a complete stock of these types, of which a pair of non-oscillating 12-inch and 16-inch fans is shown.

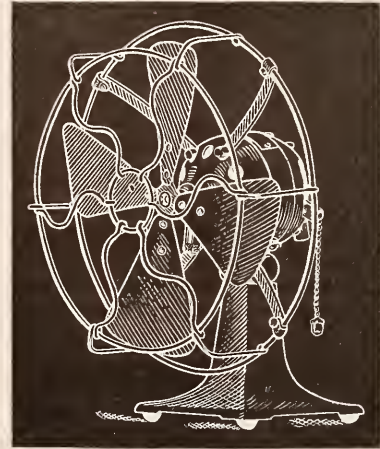
In common with all series of desk and bracket "G.-E." fans,

they are designed for three speeds and with proper care have an indefinite life.



**Hamilton-Beach Company**

The "Cyclone" universal fan, equipped with special air-cooled motor, wound for operation on either alternating or direct current at from 105 to 120 volts, is the principal contribution to the season's line of fans by the Hamilton-Beach Manufacturing Company, Racine, Wisconsin.



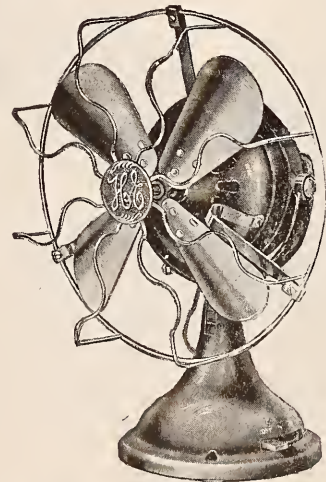
*H-B "Cyclone" Desk Fan*

This is one of the neatest, most substantial machines of its price on the market and is deservedly popular. It has six speeds and the usual accessories and guarantees, and is finished in highly polished nickel plate.



**Hunter Fan and Motor Company**

The Hunter Fan and Motor Company, of New York, has a full line of electric fans for the 1916 fan season which will be of the same high grade quality and appearance as that of last season with the exception that this year they are bringing out a new type of ceiling fan known as the adjustable blade ceiling fan.

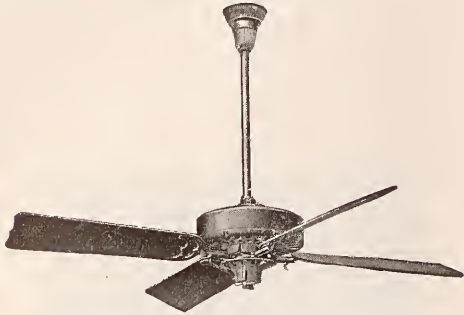


*Hunter Fan & Motor Company's 12-inch Desk Fan*

These fans are so arranged with a patented adjustable device that the blades can be directed to blow full blast to the ceiling or to the floor, or the blades can be adjusted to any intermediate point to suit the requirements of the user.

It is believed that this new type of adjustable ceiling fan will meet the requirements of café, dining rooms and all places where it is objectionable to have a blast of air blowing direct on the people.

By blowing the air to the ceiling it has been proven that a complete movement of air is obtained without the objectionable features of blowing the air toward the floor.



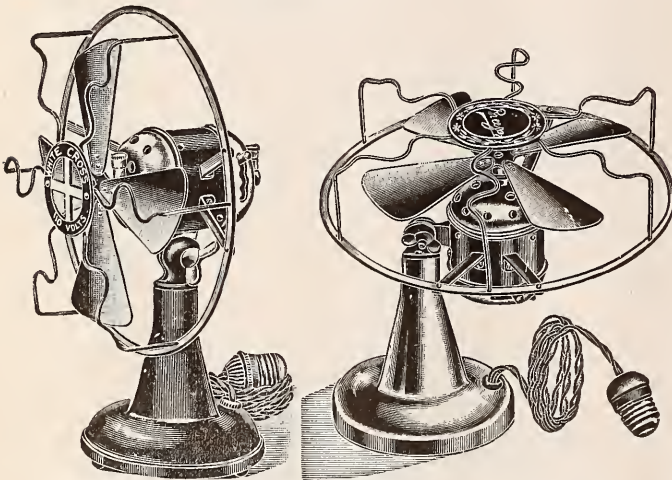
"Tuerk" Adjustable Blade Ceiling Fan

The adjustment of these fans can be made without the use of a screwdriver or any other tool and can be made, if necessary, while the fan is in motion.

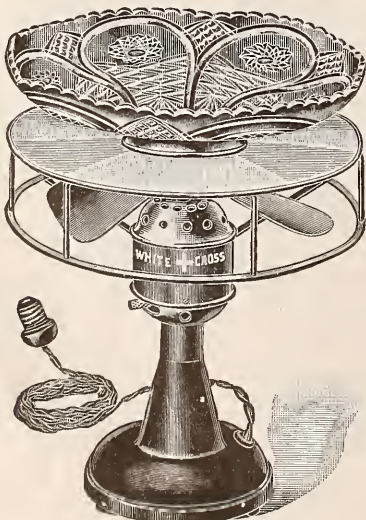
The Company expects that this fan will be used extensively in places where of late oscillating fans have been used on side walls in restaurants, dining rooms and picture theaters, and is looking forward to large sales during the coming season.

#### Lindstrom-Smith Company

The output of the Lindstrom-Smith Company, Chicago, is widely advertised under the trade name of "White Cross." These fans are made in the desk, bracket and table styles only and are of the non-oscillating type.



"White Cross" 8-inch, Non-Oscillating Desk-Bracket Fan

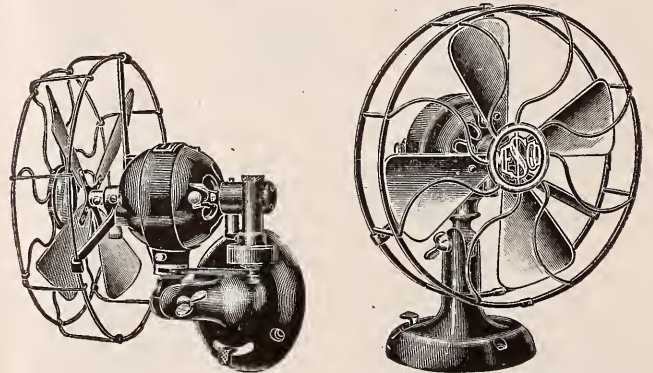


"White Cross" Table Fan with flower or fruit bowl

They are all provided with the "Universal" type of motor which operate on either alternating or direct current, and are single speed. They are made in the adjustable type, with the exception of the table fan, which is shown here. This pleasing fan diffuses the air evenly in all directions over a space more than ten feet in diameter. With a bowlfull of flowers whose fragrance is spread by the breeze, this fan combines beauty and utility in a way that has caused it to be extensively adopted in high-class hotels and cafes, as well as in private residences.

#### Manhattan Electric Supply Company

A well-known line of direct-current adjustable and oscillating fans is the "Mesco," which is made by the Manhattan Electric Supply Co., New York.



"Mesco" Oscillator as a Bracket Fan

"Mesco" Adjustable as a Desk Fan

These fans are made for the two standard direct-current voltages and three speeds, 900, 1400 and 1800 r.p.m. They are very flexible in their arrangements for controlling the air currents. They come in 16 and 18-inch sizes with the usual accessories.

A small size is the "Junior" 8-inch desk or wall fan, also 3 speed and wound for 110 or 220 volts.

#### Menominee Electric Manufacturing Company

In line with the tendency of this season, the Menominee Electric Manufacturing Company, Menominee, Wis., has brought out a popular priced, 8-inch four-bladed fan which is guaranteed to give satisfactory service. It is built in the same substantial manner as the company's higher priced fans. Equipped with bronze bearings, and wick lubrication, it will run two seasons without refilling grease cups. It is designed for alternating current, 110 volts, one speed, and comes with the usual plug and 8 feet of cord, as shown.

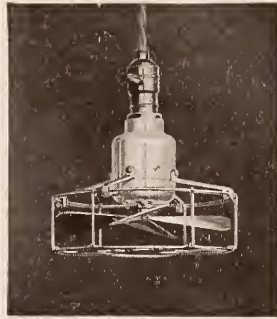


Menominee 8-inch Desk Fan

Other fans from the Company are the universal table fan, which throws its air current horizontally in all directions, and also the socket fans, both of which are shown. These fans



Menominee Horizontal Draft Table Fan



Menominee Socket Fan

are all 3-speed, 8-inch machines that will run on either alternating or direct current, and in common with the rest of this company's well-known line are furnished with or without oscillating mechanism and are guaranteed against electrical or mechanical defects.



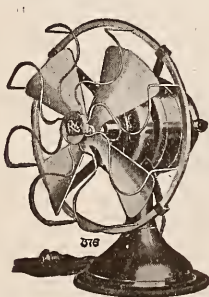
**Robbins & Myers Company**

For the 1916 season the Robbins & Myers Company, Springfield, O., have brought out a complete new line of desk and oscillating fans in the drawn steel frame construction. In this line two new sizes have been developed—the six-inch desk fan and the nine-inch oscillator.

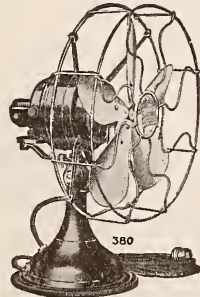
All sizes except the six-inch and nine-inch fans are furnished regularly with six blades. The six-inch has four blades and the nine-inch size has five blades. The advantages claimed for six blades over four blades is a lower speed for a given volume of air, with less air hum.

The oscillating mechanism is the gear type, the same as previously used and all fans are equipped with 10 feet of cord and a plug.

The six-inch desk fan has a universal alternating or direct current motor and will operate on direct current of any voltage from 100 to 120 volts and on alternating current of any frequency from 25 to 60 cycles and any voltage from 100 to 120 volts. As it is small and light it can be carried by the traveler in his hand bag, and as it will operate on the majority of commercial circuits, he can use it in almost any hotel. A switch in the base provides two speeds and the fan will give a good breeze.



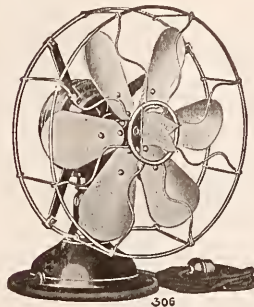
R. & M. 9-inch Oscillator Fan



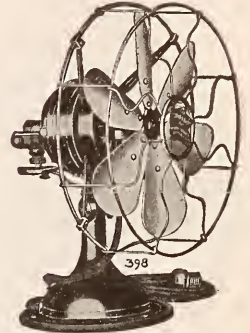
R. & M. 6-inch Breezer

The nine-inch oscillator fan has five blades and is an excellent type for all household services. It is made for alternating current and direct, the gear type oscillating mechanism being the same as is used in the larger fans. The motor is the series type and the speeds for direct current and alternating current are the same. A three-speed switch is provided. In addition to the 110 and 220-volt types, the direct current fans can be furnished in low voltages for operation from storage batteries.

The twelve and sixteen-inch desk fans have six blades in both types. The motor is the induction type in the alternating current model and both fans have a three-speed switch, felt pad on base and is equipped with ten feet of cord and separable plug.



R. & M. 12 and 16-inch Oscillator Fan



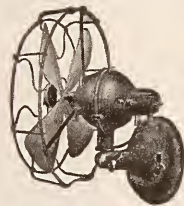
The alternating current fan of the twelve and sixteen-inch oscillator type has an induction type motor and no centrifugal or automatic starting switch is required. It is regularly furnished with six blades in both the twelve and sixteen-inch sizes. The rear bearing does not depend upon the gear box for lubrication but has a separate wick oiler the same as the front bearing.

The 1916 ceiling fan is equipped with a motor of the self-starting, shading pole type and has a three-speed switch, giving speeds for 215, 175 and 120 r.p.m. on 60 cycles and 165, 145 and 125 r.p.m. on 50 cycles. The wattages are 175, 160 and 135 and 140, 127 and 115 watts on 60 and 50 cycles respectively. The sweep is 54 inches.



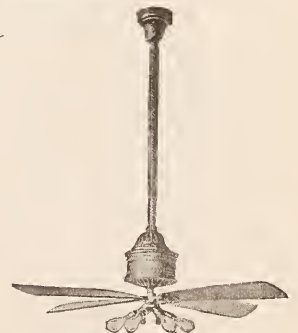
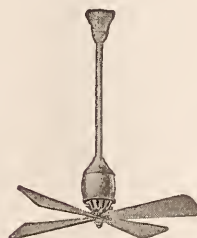
**Sprague Electric Works**

Direct-current fans have been made for twenty-four years by the Sprague Electric Works of New York, whose 1916 line has been improved by the addition of a full line of 9-inch fans and also by many refinements of manufacture suggested by long experience in the business.



Sprague-Lundell 12 and 16-inch Universal Joint Fans

A sample of the 12 and 16-inch universal joint direct current fans, which are made both in the non-oscillating and oscillating types are shown. A feature of the line is that by the use of a simple, and low priced separate oscillating mechanism these fans can be readily converted into oscillators.

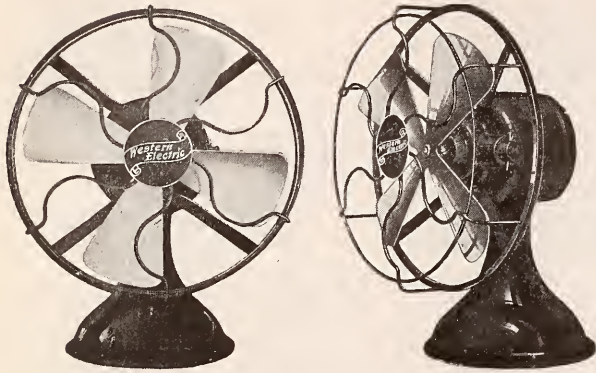


Sprague-Lundell Ceiling Fans

The "Midget" 32-inch, direct current ceiling fan and the full-sized, 56-inch, direct current fan with electrolier attachment are typical of the very complete lines of well-tried apparatus turned out by this company.

### Western Electric Company

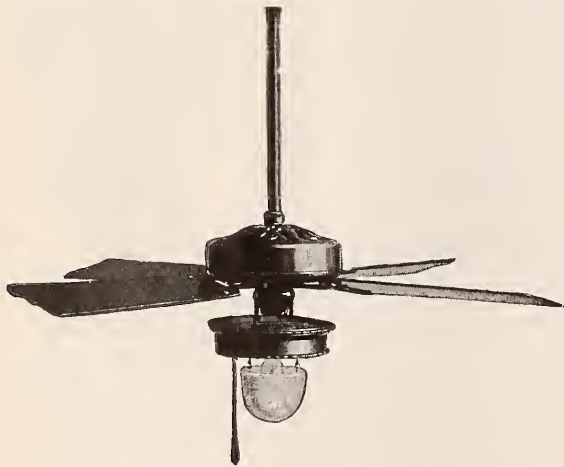
The new fans for 1916 of the Western Electric Company, New York and Chicago, comprise the new "Western Electric Six," which is designed to meet the demand for popular priced apparatus.



*The "Western Electric Six"*

This 6-inch fan weighs only five pounds, and is not a toy—it's a real fan that furnishes a steady, satisfactory, invigorating breeze and furnishes it quietly, without any fuss or attention. It has a universal motor that runs equally well on alternating or direct current at current consumption that is almost negligible. The frame and base are in one piece, finished a dull black, and the fan is furnished with cord and plug.

Other new fans are the addition of an 8-inch oscillating and a 9-inch oscillating and non-oscillating design. Also several new styles of ceiling and column fans which are provided with



*"Western Electric" Adjustable Blade Ceiling Fan*

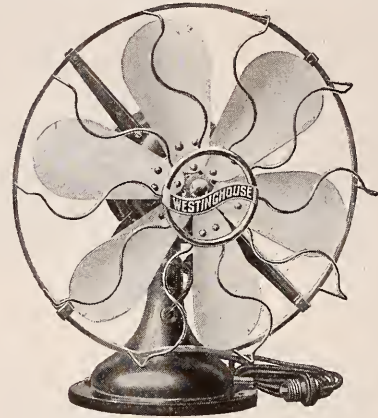
adjustable blades. On these fans the position of the blades can be adjusted at will, even when the fan is running, by means of the screw at the bottom. By these devices the air can be forced either upwards or downwards to any degree.

There are many advantages to this arrangement. As an example, an installation of these fans in a large assembly hall can be so arranged that the air now can be controlled so as to get a maximum of efficiency by having the fans in the rear of the hall draw the air upward, and those in front of the hall blow it down, thus maintaining a constant circulation of air.

The company has also brought out an oscillating fan arranged for an indirect lighting attachment. The 5-speed deflector type ceiling fan, designed for large halls, offices and theaters is now provided with electrolier attachments, if desired.

### Westinghouse Electric & Manufacturing Company

The 1916 Westinghouse fans retain the features that have made this line so popular in the past. A few of these are efficiency, low maintenance cost, pleasing appearance and quietness. A great aid in securing the last named feature has been the "Silent Six," made in 8-inch, 12-inch and 16-inch, serving



*Westinghouse "Silent Six" Fan*

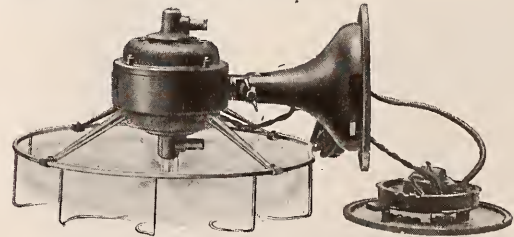
for both alternating and direct currents. The introduction of the extra blades enables these fans to move the necessary quantity of air at a lower operating speed, which reduces the noise.



*Westinghouse Turn Alternating Current and Direct Current Fans*

Typical alternating current and direct current 12-inch oscillating fans are shown above illustrating the similarity of construction of two types.

Accessibility of the speed regulator is an important factor in taking care of these fans. Drawn-metal construction and high class finish, together with graceful proportions in design are the secret of their handsome appearance.



*Dis-assembled Fan Showing Regulator*

The double gyrating fans are turned out in both ceiling and column designs. These fans are of the noiseless six-blade type and revolving almost seven times a minute throwing the air as far as 35 feet.

They are turned out for direct current as well as for 25, 40, 50 and 60 cycle alternating current, and with or without the electrolier attachments. They are more carefully made than ever and may be expected to give better service than ever.

# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## "Wire Your Home" Week

### The "Servant" Feature of Electric Service

In the forthcoming effort to stimulate the wiring of the thousands of houses now without electric service, though situated close to electric lines, it is hoped that due emphasis will be placed on the fact that electricity in the house is really a domestic servant.



### Come and See The "Silent Servant" at Work

**E**LECTRICITY, the silent servant, is on duty daily at our demonstration rooms, Third and Sycamore Streets.

Drop in the next time you're down town, have a cup of coffee with us—Electric Percolator coffee—and see demonstrated the many useful and economical electric appliances that hundreds of Milwaukee housewives have found to be a wonderful help in housekeeping—home making.

**The Electric Company**  
T. M. E. R. & L. Company  
Public Service Bldg., and 429 Mitchell Street.

As now supplied and applied, it is a servant who is never cross, "sassy," sick or late, who never strikes and seldom refuses to work, and then only for a short time. It is a servant with those numerous advantages of impersonality that no flesh-and-blood servant ever attains—except, perhaps, those high-priced immobile English butlers that figure so extensively in current fiction.

The feature is well pointed out in the advertisement shown. A reference to the sweeper and washer would have made it even stronger.

### Nation-Wide House-Wiring Campaign

A nation-wide house wiring campaign which promises greatly to stimulate business for all who participate, has been instituted by the united electrical interests for the month of March 15th to April 15th. It is to be known as "Wire Your Home" Month.

It is wisely considered by those who instituted the movement that a co-ordinated, far-reaching, shoulder-to-shoulder drive by the industry as a whole, will accomplish more for all concerned than a series of widely separated individual movements. Such a campaign sweeping all parts of the country simultaneously is likely to interest many prospects where efforts of a purely local nature would fail.

The central organization in charge of carrying out the general plans is the Society for Electrical Development. It is a fact worthy of note that this organization directed the "Electrical Prosperity Week" celebration of last fall which proved to be one of the most successful trade campaigns in history. Much of the detail incidental to the "Wire Your Home" movement will be carried out by the members of the society's staff who are all experts in their various lines.

#### GENERAL PUBLICITY

A bulletin known as the "Electrifier" will be issued by the Society for Electrical Development to stimulate the campaign. It will be similar to the "Exciter," published during "Electrical Prosperity Week." It will have a circulation of 25,000 chiefly among the central stations, electrical dealers, jobbers, contractors and other electrical interests of the country. This publication will carry news of the movement, suggestions as to how to put on local house wiring campaigns and will tell what the various interests will do and where they can get material.

The society will issue to its members a special service of window display suggestions. It will also handle the general publicity in the trade press and newspapers, including its electrical page service to the newspapers.

Ten thousand copies of a special window display will be sent out to central stations, jobbers and contractors by the manufacturers. It is a display with a strong appeal which cannot fail to draw people into the store or display room. It has a center piece, a switch from which strips of tape or ribbon run to a series of circular transparencies in colors which illustrate the conveniences of a wired home.

The lamp manufacturers will furnish plenty of special newspaper advertising cuts, mats and, in short, everything that they would supply in their regular individual spring campaign.

Twenty-five thousand copies of a 28-page booklet entitled "Successful House Wiring Plans" are being distributed free by the Society for Electrical Development. This publication contains a large number of plans for securing house wiring business that have been tried by the electrical interests in cities throughout the country and found thoroughly successful.

The society has also distributed 25,000 special announcements of the campaign.

# Electrical Sign Advertising

*Useful Points on Getting the Best Results*

*By John A. Randolph*

The electric sign comprises one of the most effective and profitable means of advertising in use to-day. It is one of those utilities which have come into existence within the last thirty years to become indispensable in the spheres which they occupy. There are thousands of electric signs now in use and the demand is growing.

The most successful advertising is that which attracts and holds the attention. Nothing is more effective for this purpose than bright light. The electrically lighted sign is the one that gets an audience. Other signs may be observed, but still fail to hold the attention. The electric, on the other hand is generally sufficiently compelling to become forcefully fixed on mind and memory.

thoroughly familiar with these details. The man that can answer questions intelligently and point out convincingly to the prospect how he will profit by the use of an electric sign will be far more successful than the man who talks only in generalities.

## LOCATION

The electric sign is primarily a commercial proposition operating on a dollars and cents basis. It is in many cases spectacular, but in no sense is it a luxury. In the installation of a sign there are many points to be considered. A most important element in this connection is the location. A wide selection is usually available where the sign is not to be placed on the premises of the firm who is advertising. In the deter-



*A Typical New York Example of Sign Lighting in Quantity*

In securing electric sign business the best results can be obtained only by specially trained salesmen. In talking to a prospect the salesman should be able to definitely recommend the type of sign which would be most effective for the proposed location, to state its approximate cost and the expense of operation. The sign business requires a thorough application of artistic design combined with engineering technique. Unless a sign harmonizes with its surroundings and is pleasing to the eye, it will fail of its purpose. Again, its method of construction is highly important. The salesman should be

mination of the location it should be considered as advertising space and its value determined accordingly. The highest priced location is not necessarily the most expensive, considered as to sale results. The value of the location depends chiefly upon the average number of people who will daily pass that way and read the sign's message.

Many merchants have vacant roofs which would afford excellent sites for signs. In such cases, the merchants are losing money through what is virtually an idle investment. Such a roof comprises advertising space that is not being used. It is



comparable to paid advertising space in magazines which is not utilized. This fact should be brought home to the merchant by the salesman. He should be shown wherein an attractive sign placed upon his roof will draw people to his store as effectively as a brightly lighted show window.

#### OPERATING COSTS DECREASING

Conditions have never been more opportune for electrical advertising. The trend in the cost of operation is manifestly downward. Recent developments in the manufacture of incandescent lamps have reduced the cost of operation fully 75 per cent. below what it was a few years ago. Mazda lamps of 5-watt rating are now taking the place of the carbon lamps

formerly used and producing illumination equally as satisfactory. The average power rate for electric signs throughout the country is 8 cents per kw. At this rate the operation of a used and producing illumination equally as satisfactory. The average power rate for electric signs throughout the country is 8 cents per kw. At this rate the operation of a hundred 5-watt hundred 5-watt lamps for an hour cost but 4 cents.

#### CONSTRUCTION

A paramount element of electric signs is the construction. The injunction "Safety First" should always be well considered in the installation of a sign. A cheap sign may be the most expensive in the end. A heavy storm may wreck such a sign causing not only the loss of the sign itself but possible damage to adjacent property or to individuals. A sturdy sign of good quality is always to be recommended.

The design of the sign considered from an artistic standpoint is another highly important consideration. The sign should be well proportioned and brilliant, yet dignified. The salesman should bear this point constantly in mind and recommend only such signs as will raise the artistic standard of the community. A tastefully designed sign is not necessarily more costly than one which is displeasing to the eye. The advertising value of a sign, on the other hand is always directly proportional to its attractiveness.

The sign should not be so large as to be out of harmony with the architectural symmetry of the building, nor should it be so small as to look insignificant.

#### LAMP SPACING

The proper spacing of the lamps in the sign depends upon the size of the sign, the construction of the letters and the location. For signs mounted over the sidewalk and which are intended to supply a certain amount of illumination to pedestrians a spacing of 4 inches is to be recommended for flush-faced letters. Grooved letters, as a rule, require fewer lamps for good reading effects, but they do not throw as much light on the sidewalk. The choice between the two types of letters is a technical question that is largely dependent upon local conditions.

The spacing for roof signs with flush faced letters should be about 6 inches. It should not exceed this distance inasmuch as a wider spacing is likely to produce a spotted effect. For large letters measuring 15 or 20 feet high a double row of lamps, one on each edge of the letter will produce the best results, although one row can be used if the lamps are of a sufficiently high candlepower rating.

#### CHOICE BETWEEN MOVING AND STILL TYPES

In choosing between signs of the still, the talking, the flashing, or motion types, it can be said that those signs which show movement are to be preferred to those whose lighting remains stationary. Anything in the nature of motion or flashing effects attracts the eye. With the attention arrested, the observer becomes interested in the sign and reads its message.

#### A SATISFIED CUSTOMER A VALUABLE ASSET

The sign salesman should be trained to point out these facts intelligently and convincingly to his prospects. It should be borne in mind that a satisfied customer is likely to become, in effect, an ex-officio salesman for the company who sells the signs whereas, a customer who is displeased is likely to do the sign men an incalculable amount of injury through speaking disparagingly of the sign men and their products to his friends and neighbors. It is not sufficient to the electric sign industry, merely to sell signs. They should be sold with a view to placing the right sign in the right place—to harmonizing the sign with its surroundings in such a manner that every person who sees it will carry away a pleasant and lasting impression.



An Example of Efficient Sign Lighting

## Getting More Electric Fan Business

*Hints Passed on Past Experience That May Work Out Well  
During the Next Season*

*By G. D. Crain, Jr.*

A certain electrical dealer has between 200 and 300 fans in stock, which will be used for rental purposes next summer, as they have been heretofore. While this trade needs careful watching, it opens up a field which in his opinion cannot be reached by sales, and which is quite capable of producing profits.

The fan renter is either a person who has no storage facilities of any kind, and doesn't want to carry a fan through the winter; a transient, or one whose finances will not stand the strain of a purchase. The necessity of careful handling of the credit feature is almost obvious from this statement of the situation.

The dealer referred to handles the business on a strictly cash-in-advance basis, charging \$2.50 a month. At the expirations of the month, if the second payment is not forthcoming, the fan is taken in. Even with these precautions against loss, there is a good deal of trouble experienced occasionally through removals from the city, damage to fans, fans being tied up in bankruptcy proceedings, etc.; and though the dealer gets his fan back, the time and trouble taken to repossess amount to a good deal.

Fans which are rented late in the season are put out at the rate of \$3 per month, in view of the short term which is open. No oscillating fans are rented, on the ground that they are too liable to injury, for it is proverbial that the renter is careless of the property which belongs to somebody else.

The same rent is charged on all fans, no matter what size, inasmuch as it would hardly be practicable to complicate the books by having a sliding scale of charges, depending on the size of the fan. The dealer referred to said that he had had to keep two people busy on this feature—one handling the office and accounts and another looking after collections, repairs, deliveries, etc.

"The only way to make money on this end of the business," he said, after describing the situation, "is to handle it on a large scale. I have been in the renting field for several seasons, and the cost of my fans is pretty well charged off. This year, consequently, I am in a good position to do well, but it is only by having the volume that this is possible."

### Allowances on Used Fans

A used fan, like any other piece of merchandise, should be considered by the dealer who accepts it in part payment for a new one as an article to be put in stock and resold, and the charges which must be put on it should be deducted from the market value, if the dealer is to come out at the large end of the horn.

Suppose, for example, that a customer comes in with a direct-current fan which, in good condition, would sell at \$8 over the counter. Should the dealer therefore allow the customer \$8 credit on a new alternating-current fan, assuming that the local central station, whose service determines the market for fans in that community, is furnishing only a.c. current?

The first thing to consider is that if \$8 credit is allowed, and this is all that the fan can be sold for, the profit on the sale of the new fan is tied up in the old. In other words, the dealer is putting his profits into what, in the last analysis, is undesirable goods—junk from a good many standpoints.

The fan must be taken and put in good condition. The bearings must be examined, and worn ones replaced. Missing parts must be supplied—and on oscillating fans taken in trade, there is nearly always something gone. Bent blades must be straightened and the whole mechanism overhauled. Say \$2 worth of work is expended on the fan. That reduces its value to the dealer to \$6.

But it will cost something to sell it. The overhead expenses of the concern are, say, 20 per cent. If the fan is to be sold for \$8, the cost of selling is \$1.60, which further reduces the allowance that it is possible to make to \$4.40. But the dealer, if he is sensible, must make a profit on that sale, as well as on the sale of a new fan. He cannot afford to handle the old one, adding all of the expense of doing business to it, for one profit. If 10 per cent. is a fair net profit, take 80 cents more off the allowance price, which brings it down to \$3.60.

That means that if the dealer allows \$3.50 for the fan, he can fix it up for sale, handle it and make a reasonable profit on it. Yet where is the man who has the nerve to put his allowance on this basis, and is not misled by the prospect of making the sale of the new fan into giving most of his profit on it away in the form of an excessive allowance?

Dealers in every city could profitably get together and establish a trade discount list, which should be applied on all old fans which are handled.

And such a list would cut the price on direct-current fans further than indicated in the foregoing, because of the obviously more limited market and greater selling expenses which would have to be put into them.

Another feature worth developing is sales to hospitals and other institutions. Electric fans almost belong in the category of therapeutic apparatus, for the reason that they have come to be regarded as almost indispensable in the sick-room during the summer months. Proper solicitation of the leading hospitals, especially private institutions whose charges are high enough to enable them to take care of extra service of this kind, would doubtless develop some important business.

### Getting After Repair Work

The time to start after fan repair work is early in the season.

If you wait until the user gets out his fan and tries to put it in operation, you may get his business; but you run the risk of having the repair job sent somewhere else, and also of having a flood of this work, all coming in at the same time. The proper plan would be to compile a list right now of people who have bought fans heretofore, possibly adding a supplementary list of those who it may be taken for granted are fan users; and then, before the real hot weather starts, circularize them on the repair proposition. A return postcard, which would enable replies to be made easily, could be enclosed, and those who found that their fans needed attention would probably make use of the card to have the dealer call for them. Of course, this would not take the place of newspaper and other general advertising, because the concern wants repairs on all fans, those sold by other dealers as well as itself; but it would get direct results from a good many customers who might overlook the point otherwise.

### Fans for Window Display

A great many electric fans are used for winter displays, and this is a field which, while hard to work, can be developed by general educational effort. There are many sorts of displays which require motive power of some kind, and where the materials in the window are light, the fan serves excellently. For instance, a toy dealer displaying a new idea in put-together toys, recently had a merry-go-round and a windmill turning in life-like manner by means of a concealed fan. A coal dealer, trying to attract the interest of those whose bins needed filling, showed a red devil standing over a coal-fire, the flames of which were represented by red tissue paper strips, blown by a fan underneath. Hundreds of other displays are given life and interest by motion, and this motion is furnished conveniently and cheaply by an electric fan.

# New Products And How to Use Them

**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

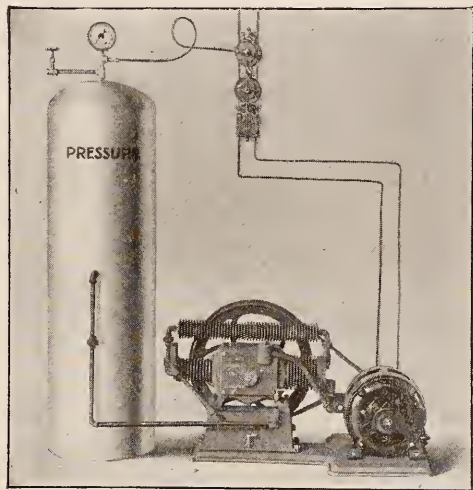
*The Names of Manufacturers not appearing in this Section will be gladly supplied on Request.*

## Automatically Controlled Electric Driven Air Compressor Plant

The outfit illustrated has recently been developed for garages, factories, air drill service, etc.

This outfit is made as nearly fool-proof as possible, and when once properly installed, can be left to take care of itself for a long time.

The two stage compressor is belt-connected to a  $\frac{1}{2}$  H. P. single-phase or direct current motor. The tension is maintained on the belt by an automatic belt tightener. The cylinders of the compressor are opposed and are provided with rings to increase the heat radiating surface. The connection between the two cylinders is also similarly equipped.



*Electrically Controlled Air Compressor Set*

The outfit is self-oiling and it is necessary to replenish the oil about once in two months. Every working part runs in oil and no oil cups are used. The bearings are bronze with babbitt lining. All working parts are enclosed to keep out dust. There are no stuffing boxes to cause leakage or require re-packing. The body is cast in one piece to insure alignment of the pistons. The valves are steel balls in bronze seats and each pump is equipped with a safety valve to prevent accident from too much pressure. The cylinders are  $3\frac{1}{2}$  inch by 3 inch stroke and the pump has a capacity of 5,000 cu. inches per minute. The shipping weight is 140 pounds and the floor space required is 14 by 24 inches.

The outfit is supplied complete with 30 gallon seamless tank, automatic controller, gauge, valves, compressor, Robbins & Myers motor, direct or alternating current, oil trap, safety valve, automatic belt tightener and belt with all necessary piping as shown, all mounted on a large metal sub-base.

## Improved All-Metal Washing Machine

Several novel features are claimed for the clean-cut, business-like appearing, electric washing machine shown in the illustration.

Metal construction throughout makes it extremely strong and rigid, light in weight, easy to clean, perfectly sanitary and insures long life. The tank is made of heavy sheet metal, double seamed and soldered, and is water tight and rust proof. There is no wood to warp, shrink, rot or cause mildew. The cylinder is made of extra heavy galvanized steel and the frame of steel angles, rigidly braced and double riveted.

Such construction renders the machine able to stand up under the hard usage that these devices often have to withstand.



*Improved All-Metal Washing Machine*

A standard Westinghouse small motor operates both the washer and the wringer. It rests on a steel foundation and is belted to the washer mechanism, giving more flexibility than direct gear drive. All gears in the operating mechanism of the washer, and between the washer and the wringer, run at low speed in hard oil contained in grease proof cases. A gas burner under the tank allows the water to be kept hot for a long time.

All operations are controlled by two small levers at the side of the machine. A safety device on the wringer safeguards the operator and the mechanism from injury. The capacity of the cylinder is sufficient to care for the needs of the ordinary family.

### New Type Recording Meters

A line of graphic voltmeters and ammeters, for which many new features are claimed, has recently been placed on the market by one of the well-known Western instrument manufacturers.

As shown in the illustration, the meter is extremely compact in design and though designed for rugged service and good accuracy, weighs but 9½ lbs. Low energy consumption, about 25



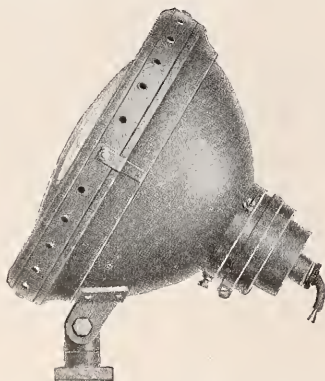
*Recording Meter*

watts at 110 volts, eight-day charts and ink well and high-grade feeding mechanism as well as very accessible parts are among the claims made for these instruments. There are five sizes of volt-meter ranges and from 0 to 5 amperes on ammeter sizes, the latter being designed for use with instrument transformers for greater ranges. In addition to the above advantage, they are very reasonable in price.

\* \* \*

### Flood Lighting Reflector

The comparatively new idea of flood lighting is creating a strong demand for scientifically designed reflectors. To meet this one firm has brought out a new type of silver mirrored reflector for flood lighting. The silver reflecting surface is protected from injury by a special heat resisting backing, which materially lengthens its life.



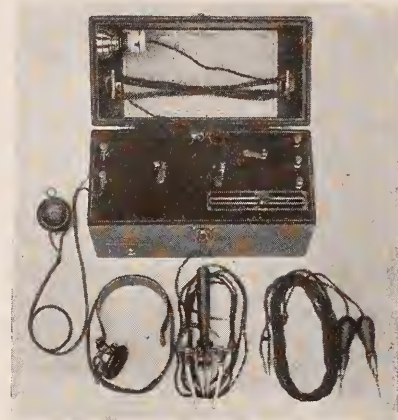
*Variable Focus Lighting Reflector*

This reflecting unit is designed for use with metallic filament stereopticon lamps of 100 or 250 watt sizes and is not corrugated.

With the 250-watt lamp at the focus, the main beam has a divergence of 12 degrees and a maximum apparent candle power of 67,750; with the lamp moved forward ¼ inch in the reflector, the divergence of the main beam is increased 20 degrees and the maximum candle-power correspondingly reduced to 28,400. The reflector is designed to utilize the maximum percentage of the light flux from the lamp in the main beam and at the same time keep down the dimensions of the reflector within practical limits.

### Field and Armature Coil Tester

Unsuspected short circuits in field and armature coils are among the most frequent causes of trouble with electric apparatus. An improved instrument for finding defects of this sort has lately been brought out.

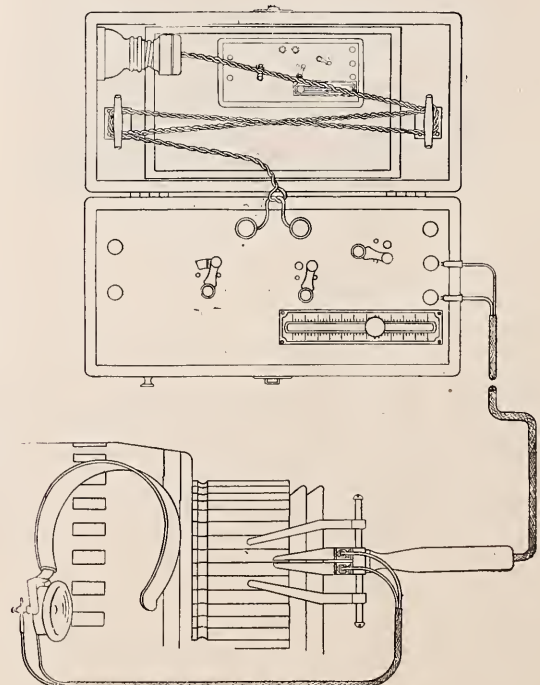


*Coil Tester*

The general appearance of the device is shown in the upper illustration. It finds a wide application in electric railways, mines, power plants, industrial plants and repair shops. Much time can be saved by its use.

A diagram of this instrument and the manner of using it on a direct current armature in a bar-to-bar test is shown.

The two outside contacts are adjustable and should be spread apart to the point where a convenient deflection of the pointer is secured. The two center contacts are stationary. It will test any type or size of motor or generator armature. To make the test it is simply necessary to press the two center contacts on each of the adjoining bars of the commutator in consecutive order. The two outside contacts are arranged to make connections at the same time without any attention from the operator. If the armature should be in good condition there would be the same reading from each of the bars. In the case of a short



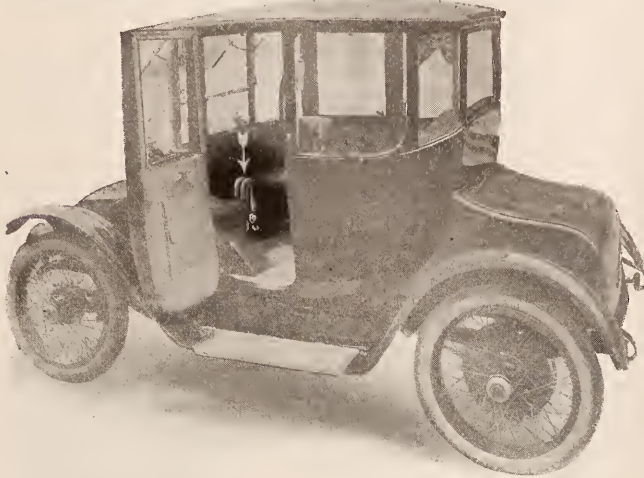
*Method of Using Tester*

circuit the reading would be less than normal, the amount of deflection depending upon its location and nature. If there should be an open circuit the reading would be the same as when full current is passed through the meter, which reading is easily ascertained. If by mischance there should be a wrong connection it could not escape detection. Any ordinary armature can be tested complete in less than two minutes.



**Electric Automobile Heater**

A new type of electric heater for automobiles has been brought out recently by a Western manufacturer. It is designed along the lines of the well-known portable radiator made by the same concern, which consists essentially of an open coil submerged in a circulating, non-corroding, non-freezing, insulating liquid. The unit is hermetically sealed; therefore no evaporation. The coil is contained in the bottom longitudinal passage of the radiators, and by use of the liquid as a circulating medium a steadiness and uniformity of heat is produced. The fundamental principle of circulation is carried out to perfection.



*Warming the Automobile*

This heater is built of cast iron in two sections, each 15 inches high and exposes three square feet of radiating surface. Operating on an 80-volt battery it uses about 3.9 amperes to reach a heat of about 190 deg. F. It is provided with a plate for attaching it to the floor of the vehicle to insure its stability.



**Electric Door Switch with Frictionless Tip**

An electric door switch with a frictionless revolving button in the tip of the plunger has been put on the market by a well-known New England firm.



*Improved Electric Door Switch*

When the door is closed, the striking plate slides across the top of the plunger while pressing the plunger down. Before this frictionless tip was designed, the sidewise thrust was a very great strain on the mechanism, and decreased materially the life of the switch.

This switch is designed with a compensating mechanism so that a considerable shrinking or swelling of the woodwork will not affect the working of the switch.

**Non-Short-Circuiting Flashlight**

It is well-known that the life of the ordinary flash-light battery and lamp is very often greatly shortened by accidental short circuits. To overcome this a well known New York manufacturer of electric novelties has placed on the market a newly-patented fibre covered non-short-circuiting flashlight, which, they state, cannot be short-circuited under any conditions, saving both the battery and the flashlight. These non-short-circuiting



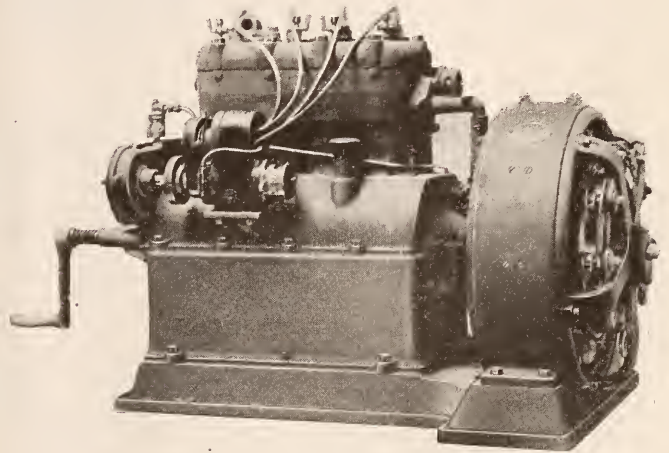
*Non-Short-Circuiting Flashlight*

flashlights are now being made in eight different sizes ranging from the "baby" tubular, illustrated, which can easily be slipped into the pocket, to big, powerful miner's lights for hard usage. The advantage of a non-short-circuiting flashlight to motorists, engineers, mechanics and everybody else whose work brings them into contact with metal objects are apparent. There will be a strong demand for this device.



**Improved Direct-Connected Lighting Plant**

Among the improved small lighting units lately perfected is the 4-kilowatt direct-connected, direct-current engine generator set of the built-in-type shown below. The armature takes the place of the flywheel in the ordinary set. The engine is four cylinder, four cycle and operates nominally between 1000 and 1100 r.p.m.



*4-kw. Direct-Connected Generating Set*

The unit is supplied in 60 or 110-volts as desired and is good for 25 per cent. overload.

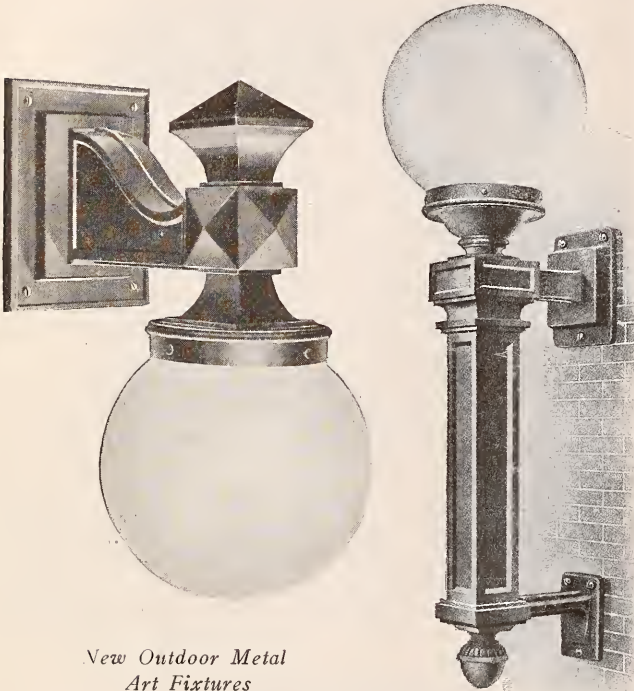
The sensitive throttling governors runs in oil and is entirely enclosed, in fact the entire oiling system is automatic so that the operator need only keep the base supplied with oil and the machine will take care of itself, running as long as desired and giving a perfectly steady non-flickering light equal to the best turbine-operated plants. This 4-kw. set is supplied with a high-tension magneto and float feed carburetor and the capacity is sufficient to handle the picture arc and additional house lighting, electric fans, etc.

This set is designed for any place in which a steady electric light is needed, such as farm, small villages, motor-boats or similar places, where current from central stations is not available.

**Electric Outdoor Art Fixtures**

The handsome fixtures, shown in the accompanying illustrations, have just been brought out by the Herwig Art Shade and Lamp Company, 2140 N. Halsted St., Chicago.

These fixtures are designed especially for use on the outside of buildings, such as power plants, substations and public, or semi-public buildings in general.



*New Outdoor Metal Art Fixtures*

They are made of cast iron subjected to weatherproofing treatment, and are 28 inches, and 10¾ inches, to top of holders, respectively. They are topped with an opalescent globe arranged to enclose a gas-filled lamp and form a notable addition to the large line of outdoor art metal fixtures turned out by this company.



**Mogul "Shurlock" Socket**

For a long time there has been a demand for a mogul-base socket from which it should be impossible for an unauthorized person to remove the lamp, this demand has been met by the introduction of the "Shurlok." This socket is fitted with the double Shurlok device which holds the lamp base rigidly without in any way distorting the base of the lamp, thus the lamp remains straight. The ease with which the lamp may be locked, or removed, by the proper person is the talking point in favor of the installation of these sockets wherever a highly efficient unit is desired to be permanently located. It is not so much the loss of the lamp itself as it is the fact that the space to be illuminated, will be left in darkness should the lamp be removed or stolen. Therefore, the value of this device which is designed to prevent the removal or theft of lamps.

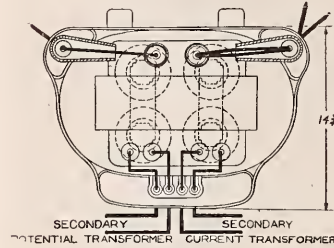


*"Shurlock" Socket*

**Combined Potential and Current Metering Transformers**

To fill the demand which every central station has felt for weather-proof metering transformers, a well-known manufacturer has perfected a line of combination potential and current single-phase metering transformers.

Figure 1, shows one of these transformers as it appears from an external view.

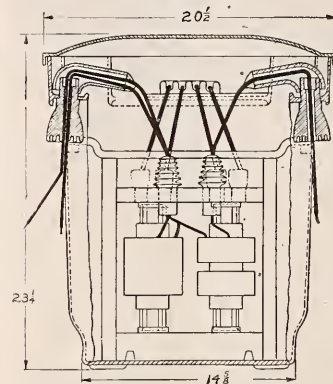


*Fig. 1  
Current and Potential Metering Transformers*



*Fig. 2*

The elements are entirely immersed in oil which serves the purpose of cooling and insulating the unit. The coils are form wound with double cotton covered wire, each layer properly spaced for the operating voltage with treated varnish cloth of their own make. The top turns of the coils are reinforced with flexible mica pads wound in between coil layers, to give additional insulation to protect against line surges which may be caused by high tension switching or lightning. The cores are made of silicon alloy steel of double cruciform section which gives sixteen (16) oil circulation ducts between coils and core.



*Fig. 4—Detail of Bushing*



*Transformer  
Fig. 3—Plain View of*

Figures 2 and 3, show sectional and top views. Both elements are mounted within homogeneous light grey cast iron cases, which have received two coats of flexible black enamel baked on.

The bell shaped part of the bushing extends from the case and affords ample mechanical strength and sufficient leakage surface to protect the leads from ground even during the most severe weather conditions.

The terminals of the high voltage coils are carried through the case in specially designed tripple petticoat two piece porcelain bushings. Figure 4.

The protector part covers the leads inside the case and removes all possibility of the leads being shoved back against the case cover.

For single phase metering, one transformer is required and for poly phase, two transformers connected on the high voltage side in standard open Delta or V. The capacity of the potential element on stock transformers is 50 watts and 30 watts on the current element. The secondary voltage is 110 volts and the current 5 amps. at full load. This permits the use of standard 5 ampere 110 volt watt hour meters with multiplying constant.

The Columbia Metal Box Company, New York, has developed a line of cabinets for the new Starrett panels.

Five different standard types of cabinets are manufactured to take each of the 258 different Starett panels.



The illustration shows a Type SC cabinet. This is the best Columbia panel board cabinet made. Four other types are made; Type SA is designed to be used for exposed work where wires go out of cabinet directly opposite terminals; Type SR is a cabinet without door and trim and is designed for flush work where wood or other door and trim will be furnished; Type SPS Exposed. Type SPF Flush is a cabinet with a removable door and trim. The trim is plain without ornamentation. All cabinets have knockout holes for 1/2-in. conduit evenly spaced on all sides. The standard finish is a brilliant baked black enamel. Special finishes can be had to order.

### A Dry Storage Battery

A new "dry" storage battery of about the same size and shape as a standard dry cell, which has six times the life and efficiency of the dry cell, according to its makers, has been placed on the market by the Venus Electric Lamp Company, 64 Second Ave., Detroit, Mich.



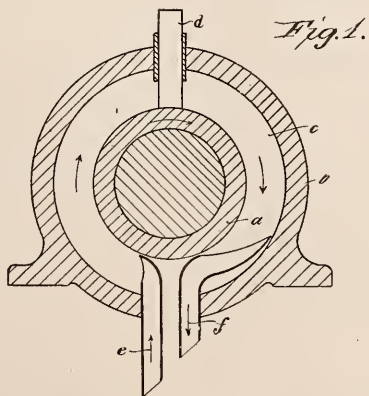
No liquid electrolyte is used. Long experiment has shown that the greatest efficiency is to be secured from a compact, solid mass, packed close around the plates. The electrolyte is prepared after a secret formula, and absolutely cannot spill or the electrolyte, insuring almost perpetual life. Plates are a variation from the conventional type and of peculiar endless construction, wherein is found one of the secrets of the e-f-leak from the battery. No additional moisture is required. A mineral condenser at the top of the battery automatically returns all evaporated moisture to efficiency of the "Venus" battery.

The case is of turnplate steel, lined with acid-proof material, insuring great rigidity and long life, making the battery practically indestructible.

The output is 36 ampere hours or 3 amperes at 12 hours for ordinary discharge rate. With the cost of the ordinary dry cell ranging from twenty-five to fifty cents in various parts of the country, it is no difficult problem in mathematics to estimate the saving to the user of the "Venus" battery, for which a re-charging cost of but a few cents, it should pay for itself many times over during its lifetime, not only in actual dollars and cents but also in time and trouble saved.

## Recent Electric Patents of Interest

COOLING DEVICE FOR DYNAMOS.—With the development of modern high-speed machines such as turbo-generators and the like, the problem of cooling the sliding contacts such as slip-rings or commutators is serious. In machinery of this kind the cooling of the contacts is rendered difficult because the air is prevented from having proper access to the parts to be cooled. This is due to the centrifugal action caused by the high speed of the dynamo.



Cross-Section Showing Arrangement of Cooling Device

According to an invention of Wilhelm Gscheidlen of Berlin-Schmargendorf, Germany, the commutator or slip-rings are enclosed in a casing concentric with the axis of the sliding contact surface and the brushes extend through this casing into contact with the surface. The casing confines the air which is thus held against the contact surfaces and suitable nozzles or tubes provide circulation through the casing. The construction is clearly indicated in the cut wherein *a* is the dynamo member to be cooled, for instance a slip-ring, as shown in the drawing, mounted upon the axle of a dynamo and *b* the case surrounding said slip-ring at some distance therefrom and concentrically in such a manner that a circular, preferably cylindrical intermediate space *c* will be provided into which the cooling air is introduced by the nozzle *e* and from which it will be discharged by a nozzle or similar device *f*. The cooling medium or air is introduced in the direction of rotation of the slip-ring *a*, so that the rotary motion itself will be utilized for imparting proper motion to the cooling air.

*d* are brushes which are led in through the casing *b* and contact with the slip-ring *a*.

The nozzle *f* is so constructed that it will be able to draw in the air from the space *c* and discharge the same toward the outside.

If the rotary motion of the slip-ring or commutator is not sufficient for importing the proper velocity thereto, the air may either be introduced under pressure into the nozzle *e* or sucked off by the nozzle *f*. Patent No. 1,170,444.

SYSTEM FOR SUPPLYING ELECTRICITY.—An interesting system for supplying electricity, having different characteristics for different purposes, from a single generator is set forth in a patent issued to Irving J. Reuter, of Anderson, Ind. This system is especially applicable to the supply of ignition and lighting on automobiles. In such ignition it is desirable that the voltage supplied to the ignition apparatus increase with increasing speed, because of the shorter intervals of closure of the timer contacts and also to permit the voltage supplied to act against the self-induction of the ignition coil. On the other hand the lights require a substantially constant voltage and all these conditions must be obtained from a variable drive. In the diagram of Fig. 1, the generator has a commutator 11 and three brushes 12, 13 and 14. The load brushes 12 and 13 are located at the neutral points while the brush 14 is displaced from the brush 12 in the direction opposed to the direction of rotation. The field magnet 10 is provided with a winding 15, one terminal of which is connected to the brush 13 and the other to a brush 14.

The generator supplies current to a storage battery 16 and lamps 17 controlled by switches 18. One terminal of the battery is connected by conductor 20 to brush 12 while the other is connected by conductor 21 to brush 13. Between the generator and the battery is a switch 22 of a suitable automatic type which opens when the generator is idle or its voltage is less than that of the battery. The lamps, in series with a field winding 24, are in parallel with the battery and therefore connected across the brushes 12 and 13, so that the field is strengthened when the lamps are in use.

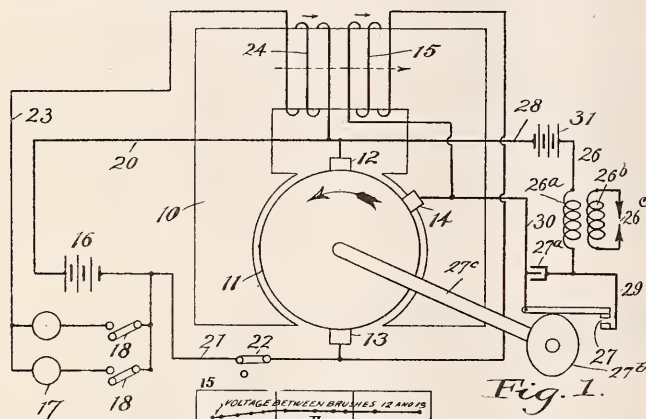


Fig. 1.

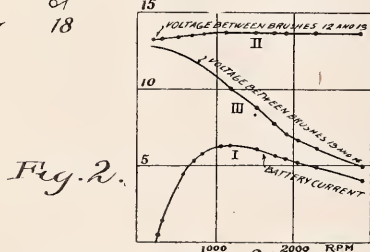


Diagram of Motor Vehicle Supply Scheme

The ignition system includes an induction coil 26 having a primary 26a and secondary 26b connected to a spark plug 26c, a circuit breaker 27 in the primary circuit, and a condenser 27<sup>2</sup> bridging the contacts of the circuit breaker. The circuit breaker is operated by a cam 27b rotated by the generator through the shaft 27c. The primary of the induction coil 26 is connected to the generator brushes 12 and 14. One terminal of the primary is connected to brush 12 by conductor 28 while the other terminal is connected by conductor 29 with one contact of the circuit breaker, the other contact being connected by conductor 30 to brush 14. There is included in the primary circuit a battery 31 which is not in all cases essential. The field winding 15 is connected between the brushes 13 and 14 and, the ignition circuit being connected between the brushes 12 and 14, the voltage at the terminals of the load circuit remains practically constant by reason of the characteristics of the storage battery,

but the voltage impressed by the generator on the ignition circuit rises rapidly as the speed increases.

Voltage and current curves of the machine are shown in Fig. 2, from which it will be seen that the voltage across the brushes 12 and 13 remains constant for different speeds while the voltage between the brushes 13 and 14 falls off with the speed. As the voltage across the brushes 12 and 14 is the constant voltage across the brushes 12 and 13 minus the decreasing voltage between the brushes 13 and 14, it will be apparent that the voltage applied to the ignition circuit increases with the speed.

The phenomena just stated is due to the action of the "cross flux" and the characteristics of the storage battery. The distortion of the field by the "cross flux" increases with the speed and decreases the voltage between the brushes 13 and 14. The voltage across the load brushes 12 and 13 is unaffected by the "cross flux" and is substantially constant, due chiefly to the storage battery in the load circuit and to the fact that the field created by the current in coil 15 is weakened when the speed increases and strengthened when the speed decreases. In consequence, the coil 15 having its terminals connected to the brushes 13 and 14 (across which the voltage decreases with the speed) operates as an exciting and regulating coil so as to cause the machine to have a current output which does not vary materially with change of speed. The generator therefore serves as a constant current and voltage machine so far as the lighting circuit is concerned while its voltage increases with the speed for supplying the ignition circuit.

The regulation occurring when the lamps are turned off is as previously described, but when the lamps are on the current passing between the generator and the lamps passes through the winding 24 thereby increasing the main flux and the output of the machine. The increase of current, however, is controlled and limited by the increase of "cross flux," with resulting reduction of current in the winding 15 as above referred to. Patent No. 1,169,866.

\* \* \*

### Scientific Note

#### Tests of the Thermophone in London

According to the Electrician, of London, it is understood that the British postoffice is investigating the Thermophone, invented by M. de Lange, and has ordered a dozen telephones for its research department, so that life tests may be made.

Among the points that at once arise in connection with this instrument are the possibility of fusion of the wire, and the question whether the instrument is fragile. In regard to the first point, James Swinburne has reported that, after testing some of the telephones for speaking, the current was then increased to the fusing point. One telephone required an increase of 115 per cent., another 67 per cent., and a third 70 per cent. to cause fusion. As the resistance of the wire rises on heating, this means a very large margin of power, and shows that on circuits of small resistance the instruments largely protect themselves, taking something in the neighborhood of four to eight times the speaking electric power to cause fusion.

With regard to the question of fragility, W. Llewellyn Preece has tested one of the telephones by dropping it down a flight of stairs. After this treatment it was as serviceable as before, so that it cannot in any way be considered as delicate. Mr. Preece points out that, although the telephone is not yet suitable for long distance telephony, the instrument is a distinct improvement on the magnetic telephone where the distances are short, as in houses, ships or aeroplanes, owing to the greater clearness of the speech, excellent articulation and an ample volume of sound.

M. de Lange has now produced small portable sets for the use of deaf people, and recently gave a demonstration of the uses of the Thermophone for such purposes before the Council of the Otological Section of the Royal Society of Medicine.



# TRADE LITERATURE

# Catalogs and Books

## A Review of the Latest Publications

**1916 Robbins & Myers Fans** are the subject of a well-gotten catalog of the Robbins & Myers Co., Springfield, Ohio, describing the 1916 fan output and emphasizing the new features.

As a help to the fan dealer this firm has also issued a big, handsome folder illustrating the booklets, folders, lantern slides, electrotypes and other advertising aids that it has prepared in order to stimulate sales.

\* \* \*

**Electric Lighting, Ignition and Charging Outfits** for automobiles and motorboats, or any other use for which they may be needed, are described and illustrated in the 1916 bulletin on the subject just issued by the Carleton Company, of Boston, Mass., who specialize on them.

\* \* \*

**Alternating Current Fans**, as made by the Century Electric Company of St. Louis, Mo., are described in a lavender, blue and crimson cover catalog, beautifully printed and illustrated and lately issued as Bulletin No. 23.

\* \* \*

**Electric Specialties**, the varied and reliable line of them turned out by the Knapp Electric & Novelty Company, New York, are detailed in their Bulletin No. 25.

\* \* \*

**"Copper History"** is the subject of a little folder sent out by the Rome Wire Company, Rome, N. Y., which gives the average monthly price of copper from 1885 to 1915 inclusive. It will be sent free of charge to any one interested.

\* \* \*

**Electric Heating Devices and Co-operative Selling** are to be promoted by the two new serials entitled "Hotpoint Co-operation" and "Day Load Bulletin" that have lately been started by the Hotpoint Electric Heating Company, Ontario, Calif. They are being mailed to electric lighting companies and dealers and are claimed not to be "house organs" in any sense of the word, but to be devoted strictly to co-operative selling service.

\* \* \*

**Megger Testing Sets**, the well-known insulating apparatus made by James G. Biddle, of Philadelphia, is told about in a booklet entitled "A Stitch in Time," referring to the use of the megger for periodic testing of electrical apparatus, to find out insulation defects before they become critical.

\* \* \*

**Trade Discounts** on the line of standard and special electric supplies made by Harvey Hubbell, Incorporated, Bridgeport, Conn., have lately been reissued.

**Direct Current Motors and Generators** are described and illustrated in Bulletin No. 217 issued by the B. F. Sturtevant Co., Hyde Park, Boston, Mass.

\* \* \*

**Automatic Rural Lighting Plants** manufactured by the Strong Electric Company, Des Moines, Iowa, are the subject of a twenty-four page catalog, telling of its line of automatic gasoline power plants for country use, with storage battery auxiliary.

\* \* \*

**Electric Air Compressors** made by the United States Air Compressor Company are described in its Catalog No. 16.

**Metal Panel Cabinets** of the type made by the Columbia Metal Box Company, New York, which are turned out in a number of different styles, are listed in a compact bulletin just issued. By devising a novel though simple way of listing over 300 different panels and the corresponding cabinets, the orders can be made out quickly, accurately and without any trouble or risk of confusion.

\* \* \*

**Direct Current Circuit-Breakers**, made by the Roller-Smith Company, New York, are advertised in a leaflet showing the oscillogram of a stock 80-ampere, 600-volt breaker that opened a circuit 3310 amperes without injury in .037 sec.

\* \* \*

**"Sherarduct" Steel Conduit**, a widely used product of the National Metal Molding Company, Pittsburgh, Pa., is well described in a booklet just sent out. The high-class qualities of the conduit and the way that these are obtained are briefly told, and there are illustrations of some of the numerous buildings in which it has been installed.

\* \* \*

**"Monocoil" Toy Motors**, made by the C. D. Wood Electric Company, New York, are illustrated and described in a leaflet sent out by it.

\* \* \*

**"Deltabeston" Wires and Insulating Materials**, as now turned out by the D. & W. Fuse Company, Providence, R. I. are the subject of a catalog just issued.

\* \* \*

**Small Motors** of the Robbins & Myers Company, Springfield, O., and the method used for advertising them are described in a recently issued folder.

\* \* \*

**Electric Ranges** are the subject of a neatly gotten-up illustrated catalog No. 10 sent out by the Estate Stove Company, Hamilton, O.

\* \* \*

**Electric Equipment** of various kinds are described by the Westinghouse Electric & Manufacturing Company in the following leaflets: No. 3832, on its No. 307-CV railway motor; No. 3504-A, on the selection of type CI alternating-current motors for intermittent service; No. 3513-A on machine-tool controllers for direct-current motors; No. 3834, on its No. 306-CV railway motors; No. 3766-A, on its large slip-ring type CW induction motors; No. 3836, on its No. 548-A railway motors, and No. 3848, on its types B and R rheostatic drum controllers.

\* \* \*

**A Story Without Words.** "Some Pictures and a Few Words" is the title of a new booklet produced by the New York Edison Company, which sets forth pictorially the advantages of the electric automobile over the horse drawn vehicle. No end of material has been written on this subject and volumes of statistics prepared, but practically the whole story is told simply and graphically in a score of pictures in this little book which has not a line of copy except the captions of the pictures. The keynote of the superiority of the electric vehicle is comparative economy, economy in operating cost, in care, in room occupied when not in use, in space occupied at the loading platform or at the curb and its dependability under adverse weather conditions.

## General Notes

### Increase in Exports to Africa

The Bureau of Commerce reports that the United States is now supplying 30% of South Africa's purchase of electrical machinery as against 20% before the war, and 36% of the mining machinery as against 20%.

### X-Ray Improvement

In the medical and surgical field great advance has been made in the use, the so-called X-Ray, due to the great improvement in localizing the rays by means of the Coolidge tube and also by the use of the new Stanley ray which has great penetrating power without any burning effect.

### Sewage Disposal

Sewage disposal by the Lindreth electrolytic process comprises screening, electrolytic treatment with the addition of lime, sedimentation and filter pressing the resulting sludge. An experimental 500,000 gallon experimental plant was installed at New York in April, 1915. Tests show that 85 kilowatt hours are required per million gallons treated electrolytically, 76 kilowatt hours additional being required for the mechanical handling. The effluent is of such high degree of purity that it may be safely discharged into water courses.

### Dynamo Troubles

The suggestions below are offered as possible solutions as the subject of dynamo troubles. Close daily observation on the part of an attendant to the action of a commutator often explains the "mystery" of commutator trouble. The following items might be checked as likely remedies:

Examine mica closely after commutator is well heated to see if it has high mica, if so, remove pitting by a cut and undercut mica.

Be sure you have the proper grade brush; since the war manufacturers are having a great deal of trouble getting the grade of brush they have been accustomed to use.

Look out for oil soaked commutator, loose brush yoke, and any changed conditions of operation at the lamp.

### Wet Batteries

For a proper solution do not use more sal ammoniac than will dissolve readily, usually 6 ounces will be found sufficient. It is unnecessary to fill the jars more than three-quarters full of sal ammoniac solution. Keep the battery and parts in clean condition. See that cover and connections are tight. Covering the exposed parts with paraffine is good practice. Do not locate the battery in a warm place, as this will tend to cause evaporation. However, keep it well covered to prevent freezing. After some service the solution will become turbid or milky in appearance. Then fresh sal ammoniac should be added to make a mixture equal to that originally used.

\* \* \*

## Legal Notes

### Uninsulated Wire

The Supreme Court, Pennsylvania, has handed down an interesting decision in a case brought against the West Penn. Railway Company, holding that a company cannot be held liable for an accident occurring through the maintenance of an uninsulated wire at some distance from the ground, carrying a heavy current of electric energy. In the case at issue, boys threw a piece of wire which they found on the road over the transmission line of the company, resulting in the injury of one of the boys who took hold of the thrown wire. The Court states that there was no obligation on the part of the company to anticipate such an occurrence.

### Construction of Lines

In connection with the Maine state law providing that corporations or individuals engaged in operating telephones shall not construct lines "upon and along" highways and pub-

lic roads without permission from officials of the respective locality, the Supreme Court of that State has rendered an important decision in a case brought against the Lewiston Street Railway. The Court holds that this statute also prohibits the placing of telephone lines across highways by persons not so authorized, as the word "across" must here be considered as synonymous with the words, "upon" and "along."

### Disclosure of Contents of Telegram

In a case brought against the Western Union Telegraph Company for disclosing the contents of a telegraph message, the Supreme Court of Mississippi exonerates the company from any liability, stating that a person cannot hold a telegraph company liable in damages for his or her humiliation and loss of social caste, or loss of business opportunities through its disclosure to strangers of the contents of a message.

### Contributory Negligence in Electrical Work

The Supreme Court of Maine has rendered an important decision in a case brought against the Bar Harbor & Union River Company for damages for the death of an employe occurring while engaged in the course of his duties. The employe, an experienced electrician, was killed while connecting an electric motor to the service lines of the company, carrying 2300-volts along the main lines and reduced to 550-volts for operation by a transformers; it was shown that the employe did not protect the exposed ends of the wires by temporary insulation, or by adopting other safeguards, although he knew that the service lines were connected to the power transmission system of the company, and was fully aware of the risk he ran. In holding that the employe was guilty of contributory negligence, barring any recovery of damages by his heirs, the Court says:

"We must hold upon the evidence and upon all probabilities, that the deceased knew that the connections outside had been made, that the current was on and that he undertook to do a dangerous work without adopting any safeguards. He was an experienced electrician; experience and familiarity not infrequently breed carelessness. Experienced men, confident of themselves, take chances; they are familiar with danger. They know how to avoid it; they expect to avoid it; they do not always avoid it.

"We cannot but think and hold that this unfortunate accident was due to a fatal want of care on the part of the deceased, while engaged in work the danger of which he knew full well and had assumed."

### Fire Due to Defective Insulator

In a case brought by the Milton Weaving Company, Milton, Pa., against the Northumberland County Gas & Electric Company for damages from the destruction of its plant by fire due to defective insulation, the Supreme Court of the state has handed down an interesting decision, finding for the defendant company. In its ruling, the Court brings out the following important considerations: (1) That an electric company is not bound to inspect appliances owned and maintained by its customers, nor is it liable for damages from defects therein; (2) That in such an action as at issue, where the primary question was whether the defectively insulated wires were installed by the company, evidence as to the custom of electric companies in respect to insulating wires should properly be excluded; and (3) That where the only testimony presented that the defective wiring was done by the company was given by a witness who refused to make positive statements, as in this case, and which testimony was contradicted by positive evidence, a verdict should be rendered for the defendant electric company.

# Review of the Month

A Complete Record of Important News Edited for Busy Readers

The United Electric Light Company are planning to extend their plant in Springfield, Mass., and it is said that it will be the largest steam-driven electrical plant in western New England when finished. Steam will be generated by twelve boilers of 700-hp., capable of 300 per cent. rating, equipped with automatic stokers. A 20,000-kw. turbo-generator with jet condenser will also be installed.

\* \* \*

It is reported that the City of Eugene, Ore., has purchased the distribution system of the Oregon Electric Company at an approximate price of \$150,000, and commercial and street lighting will hereafter be conducted by the city.

\* \* \*

The construction of a third pipe line, 6000 ft. long, is being planned by the Ontario Power Company, to bring the amount of power it can generate at Niagara Falls to about 180,000 hp. It will be of concrete, 18 ft. in diameter. When completed, which will be in about two years, the equipment of the Ontario power house will include sixteen units; the largest unit now in operation there is rated at 14,000.

\* \* \*

Wm. B. Scaife & Sons Co., Pittsburgh, Pa., have contracted with the Standard Oil Company, of Ohio, to install a 30,000-gal. per hour system at No. 1 works, and a 15,000-gal. per hr. system at No. 2 Works in Cleveland. They will also install a 74,000-gal. per hr. system for Corrigan, McKenney & Company at the plant of the River Furnace Co., Cleveland, O.

\* \* \*

Wakefield, Mass., is contemplating the sale of its municipal lighting plant in order to reduce the expenditures for appropriations.

\* \* \*

The municipal plant at Bucklin, Kan., is to be shut down and service will be furnished by the Midland Water, Light & Ice Company, Dodge City, thirty miles away. The extension will cost \$20,000. The rate for service will be 25 per cent. less than the municipal plant rates.

\* \* \*

The Narragansett Electric Lighting Company has agreed to a reduction of 10 per cent. in rates for residence lighting in Providence, R. I., reducing the kilowatt hour from 10 cents to 9 cents, and will become effective July 1 1916 if ratified by the city council. Rates for lighting the city streets were also reduced, resulting in an annual saving of \$15,000.

\* \* \*

According to a statement of S. Wilkinson before the British Institution of Electrical Engineers, the necessary amount of power required for heating a room with electric radiators was, on the average, 1.5 watts to 2 watts per cubic foot of air space.

\* \* \*

A force of engineers will make a survey of the lower Niagara River in order to promote a power development scheme similar to that of the Lower River Power Company some years ago, but which was never developed.

\* \* \*

The Eastern Massachusetts Electric Co., Salem, Mass., has applied to the State Gas & Electric Light Commissioners for permission to issue \$250,000 capital stock. It is planning a large development of the Salem Electric Light Company at Salem.

The Rochester Railway & Light Company, Rochester, N. Y., contemplates making a practical test of concentric wiring, and will adopt its use should the test meet expectations.

\* \* \*

The United Electric Light Company, Springfield, Mass., will enlarge their plant, and install a 20,000-kw. turbo generator, 12 boilers of 700 hp. each, with automatic stokers, etc.

\* \* \*

A bill amending the electricians' licensing act of 1915, in Massachusetts, to remove the five-year experience exemption and require all applicants to take examination, and to make mandatory upon officers of the law the prosecution of unauthorized workmen, was heard by the committee of the legislature, Feb. 17. The amendments offered have been agreed to by the State examiners, the contractors and labor interests.

\* \* \*

The Denver Gas & Electric Co. expects to have its new switchboard and distributing system in operation this summer. The present single-phase, 2,000-volt system will be changed to a 4,000-volt, three-phase, four-wire grounded neutral system. Estimated cost \$160,000.

\* \* \*

The generating plant of the Alaska-Gastineau Mining Co., of Juneau, Alaska, has been increased by 12,000-hp., through tunnelling a mountain and tapping the bottom of Annex Lake, which give the company 18,000 hp. for use at the mines.

\* \* \*

\$20,000 in bonuses were distributed by the Hartford Electric Light Company on New Year's Day among its employees on the basis of 1.5 per cent. of a year's wages for each year of continuous employment, several employees receiving the maximum bonus of \$200.

\* \* \*

In the iron and steel regions of northern Ohio, the use of electrical energy in steel mills has resulted in a large increase of business for the electrical light and power companies. In many cases the power used for this purpose has more than doubled in the last couple of years.

\* \* \*

The Connecticut River Transmission Company, Bradley Building, Worcester, Mass., is contemplating the development of the Connecticut River along the Fifteen Mile Falls in New Hampshire. The estimated expenditure in the original plans is \$6,000,000 and provides for the construction of three dams, the first across the river at Monroe, 160 ft. high, at a cost of \$2,000,000; the second at Waterford, 100 ft. high and the third at the head of the Fifteen Mile Falls, near North Littleton, 80 ft. high. The company plans to supply electricity as far north as Groveston, and in Littleton, Lisbon, St. Johnsbury and other towns.

\* \* \*

The Baltimore Sheet & Tinplate Company, of Baltimore, Md., are planning the construction of a tin-plate plant with an annual capacity of 100,000,000 lbs., to be driven by electric power.

\* \* \*

Receivers have been appointed for the Olympic Power Company, of Port Angeles, Washington. The power company owns a plant on the Elwha river, seven miles west of Port Angeles, which has been offered to the city of Seattle at a price of \$2,000,000.

Operations on the Holter Development, Wolf Creek, Mont., which were suspended in 1910 by the Missouri River Power Co., will be resumed by the Montana Power Company at Helena, according to an announcement of Mr. F. M. Kerr, general manager. A 6,000-hp. generating plant will be constructed, also a dam across the Missouri River, 1400 ft. at the highest elevation and an average height of 130 ft. Seven main hydraulic units, three exciter units and an auxiliary unit are also provided for in the original plans. The dam, which will create a lake 25 miles long, together with the power plant, will cost from \$3,000,000 to \$3,500,000, will take from two to two and a half years to build.

\* \* \*

The increase in the number of electric vehicles manufactured during five years was 22.9 per cent. according to the Government census of 1914, which shows that the number manufactured that year was 4715 against 3835 in 1909.

\* \* \*

The Duquesne Lighting Company, of Pittsburgh, will reduce its rate for energy to domestic and commercial consumers from 11 cents per kilowatt-hour with 1 cent discount for prompt payment to 10 cents per kilowatt-hour and 1 cent for prompt payment. Decreasing expense for operation and transmission has made this possible. The reduction will go into effect April 1st.

\* \* \*

According to reports of the Pennsylvania Bureau of Industrial Statistics the labor cost of more than \$30,000,000 worth of electrical supplies manufactured in the State in 1912 was 38 per cent. of the total value, which is the largest percentage of labor cost next to mining and the preparation of coal of all industries in the State of Pennsylvania.

\* \* \*

A mammoth power and irrigation project to water 73,000 acres of land near Pasco, Wash., is being considered by the local Chamber of Commerce. The construction of a 40-ft. dam on the Snake River at Five-Mile Rapids and the development of 40,000 hp. available throughout the year is being contemplated. According to a statement of E. G. Hopson, of Portland, Ore., consulting engineer of the U. S. Reclamation Service, who has been engaged to make investigations and estimates of cost, a plant by a new installation could produce additional 80,000 hp. as secondary power for ten months of the year, and that surplus horsepower could be sold at \$10.00 per hp. at the plant at a profit sufficient to cover entirely the operation and maintenance charges of the system.

\* \* \*

The Niagara, Lockport & Ontario Power Co. is constructing a new 8-mile power-transmission line to furnish the Union Carbide Company at Niagara Falls with 20,000 additional horsepower, in which copper cables will be used entirely.

\* \* \*

The average electric bill for residences in Detroit during 1915 was \$18.90 against \$19.50 in 1914, according to the statement of Alex. Dow, president of the Edison Illuminating Co., of Detroit.

\* \* \*

Secretary of Navy Daniels has refused to publish the result of the investigations of the recent explosion of Submarine E-2, reported to have been caused by the ignition of hydrogen gas generated by the nickel-iron storage battery. He stated, however, that the Court of Inquiry recommended that Submarine E-2 be used as a laboratory for the continuation of experiments with this new battery.

\* \* \*

The Fall River Electric Light Company reports that due to increase in cost of materials on account of the war, it did not care to renew the contract for lighting the streets of Fall River for less than a term of five years. Copper wire has advanced 100 per cent. over the cost of a year ago.

A committee of electro-chemists has been appointed to investigate the power possibilities of Niagara Falls. It is reported that the electro-chemical plants at the Falls have replaced the chemical supply cut off from Germany and that Falls industries should not be under-estimated in carrying out a preparedness program.

\* \* \*

Chairman McLeod, of the Boston Public Service Commission has suggested that the surplus energy generated by a railway company be used by factories after the workmen have been delivered to the mills in the morning and closing before the evening rush homeward, as it is stated that the cost of furnishing street railway service to workmen at times of peak-load on the system represents a larger expense to the transportation company than for service furnished the rest of the day.

\* \* \*

The city council of Columbus, Ohio, has invited the Railway Power & Light Co. to reduce its rate for domestic electric service from 7 cents net to 5 cents net.

\* \* \*

The Riverton (Kansas) plant of the Empire District Electric Company, of Joplin, Mo., expects to add a 10,000 horsepower steam turbine unit together with necessary transformers, auxiliary machinery and buildings.

\* \* \*

The River Falls Power Company, of Madison, Wis., has increased its capital stock from \$75,000 to \$100,000.

\* \* \*

The city administration of South Bend, Ind., is considering the proposition of establishing a municipal lighting plant.

\* \* \*

A corporation under the title The World's Cheapest Power Company has been chartered in the State of Delaware, with a capital stock of \$100,000. Purpose given, to maintain and operate water power plants for generating electricity.

\* \* \*

F. H. Chamberlain, general manager of the Alabama Power Company, Birmingham, Ala., announces that the company has arranged to install at Anniston, Ala., an electric steel furnace for the manufacture of high grade steel. The initial investment in the plant will probably be over \$100,000.

\* \* \*

The Cohoes Company, of Cohoes, N. Y., announces that they expect to place in operation on or about May 1, 1916, the initial installation of 30,000 H. P. of its proposed ultimate 50,000 H. P. hydro-electric development at Cohoes Falls, on the Mohawk river.

\* \* \*

The Shaw Insulator Company, of Newark, N. J., have just completed a new plant for the molding of composition into insulating parts for all purposes. The plant is equipped with the most modern machinery.

\* \* \*

The Electric Fountain Co., of New York, have recently opened a Chicago Branch, at 531 Wabash Avenue, South, in charge of H. H. Hoops, Jr.

\* \* \*

It is reported that the Light and Development Company, a corporation capitalized at \$1,500,000, is offering electric light at a 5-cent net rate in St. Louis, Mo. The company operates three plants in St. Louis, and 30 other plants in various sections of the Mississippi Valley.

\* \* \*

The City of Memphis, Tenn., is to take over the plant of the Merchants Power Company, according to recent reports, and operate it as a municipal plant. An offer by the power company to reduce the rates has been rejected by the city.

### Among the Associations

The mid-winter convention of the Illuminating Engineering Society was held at the Engineering Societies Building, New York, February 10th and 11th. A feature was the election to the first honorary membership of Mr. T. A. Edison.

\* \* \*

The National Electrical Contractors' Association will hold its sixteenth annual convention at New York from July 17th to 22nd.

\* \* \*

The annual convention of the Ohio Electric Light Association will be held at Cedar Point, July 18th to 21st. Wednesday will be "Technical Day" and Thursday will be "Commercial Day."

\* \* \*

At a meeting of the New York Electrical Society, held at the Engineers Societies Building, New York City, on February 25, Mr. Elmer A. Sperry, president, delivered an address on "The Principles and Operation of the Gyroscope."

\* \* \*

A meeting of the Radio Club of America was held at Columbia University, New York City, on Feb. 18, at which time Prof. J. Zenneck was made honorary member. A very interesting paper on two methods of transmitting signals was read by Prof. Zenneck.

\* \* \*

The seventh annual banquet of the Boston sections of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Boston Society of Civil Engineers was held at the Boston City Club on Feb. 8. About 500 engineers were present.

The annual convention of the National Electrical Contractors' Association will be held at the Hotel McAlpin, New York City, July 18-22. Secretary, G. H. Duffield, 41 Martin Bldg., Utica, N. Y.

\* \* \*

The Wisconsin Electrical Association will hold their annual convention at Milwaukee, March 16 and 17, 1916, with headquarters at Hotel Pfister.

The New York Section of the Electric Vehicle Company of America was held on Feb. 23rd. Jos. H. Tracy, asst. chief engineer of the Electric Storage Battery Co., presented a paper on "High-Rate Discharging and Charging of Lead-Acid Batteries."

\* \* \*

A reorganization of the Oregon Electrical Contractors and Dealers took place at their recent meeting in Portland, Ore., when a new set of by-laws was adopted, under which central-station men, jobbers and others not actually retailing or contracting in the electrical line, but who manufacture or deal in electrical equipment are eligible to associate membership in the State organization.

\* \* \*

The American Society of Mechanical Engineers will meet at the Hotel Grunewald, New Orleans, La., from April 11 to April 14.

\* \* \*

The Chicago Section of the Illuminating Engineering Society, and the American Institute of Electrical Engineers held a joint meeting at the rooms of the Western Society of Engineers in the Monadnock Building on February 28th.

\* \* \*

A new electrical society has been organized in Seattle (Wash.) formed of men interested and engaged in electrical development. There will be monthly meetings at which new inventions and electrical appliances will be discussed.

\* \* \*

The American Electrochemical Society will hold its semi-annual meeting in Washington, D. C., April 27-29. Secretary, J. W. Richards, Leigh Univer., So. Bethlehem, Pa.

### Personal

Mr. C. H. Abbott, of the Moloney Electric Company, of St. Louis, Mo., has been appointed manager of the company's recently opened New York office at 50 Church St.

Mr. Ralph B. Coleman, formerly with the Electric Machinery Company, of Minneapolis, has become traveling representative of the Moloney Electric Company in the Chicago district.

Mr. Channing R. Dooley, of the Westinghouse Electric & Manufacturing Company, East Pittsburg, is now manager of the Company's Educational Department.

Mr. B. T. Klein, for some years manager of the Chicago office of the Bristol Company, Waterbury, Conn., has been appointed manager of the company's newly established San Francisco office.

Mr. F. G. Frost, for some time with the Lancaster Electric Company, of Lancaster, Pa., has returned to Houston, Texas, as superintendent of the Houston Power & Light Co.

Mr. Emerson McMillan, of New York, president of the American Light & Traction Company, has endowed another scholarship in the engineering department of the University of Detroit.

Mr. George C. Knott, formerly manager of the Benjamin Electric Manufacturing Company of Canada, Toronto, has become associated with the Wirt Electric Specialty Company, Philadelphia, Pa.

\* \* \*

### Obituary

Dr. Louis Duncan, one of the pioneers in modern electrical engineering, and one of the leading members of his profession, died on February 13th at his home near New York City in his fifty-fourth year.

He was a graduate of the Naval Academy and was associated with Professor H. A. Roland at Johns Hopkins University in the classic experiments that led to the determination of the international ohm as the unit of resistance.

The first electrification of the elevated railroads in New York and of the Baltimore and Ohio railroad tunnels in Baltimore were done under his supervision. He was connected with the faculties of Johns Hopkins University and the Massachusetts Institute of Technology, and was past president of the American Institute of Electrical Engineers.

He was a clear and brilliant thinker and one of the best engineers and lecturers on technical subjects that this country has produced and will be long remembered by his many friends.

Professor Nathaniel Craighill, director of the Brooklyn Edison Company's school, died suddenly February 7, following a very brief illness. Professor Craighill was, in 1904, a member of the staff of the old *American Electrician*.

J. Rae Wilson, district engineer of the Canadian Westinghouse Company, Ltd., Vancouver, B. C., was killed in the wreck on the Great Northern Railway, January 22, caused by a snow-slide near Corea, Wash.

Frederick Bucherer, a pioneer salesman in the electrical field, died February 7, after a short illness. Mr. Bucherer had been salesman for the Diehl Manufacturing Co., Elizabeth, N. J., for more than twenty-two years.

# BUSINESS OPPORTUNITIES

## ALABAMA

Hurtsboro.—The city will extend electric-light plant and waterworks and have voted \$9,000 bonds for this purpose. Wheeler Williams, Mayor.

## COLORADO

Boulder.—The Western Light & Power Co. anticipates improving its plants at an approximate cost of \$140,000.

## DELAWARE

Dover.—It is reported that a new power plant to cost approximately \$200,000 will be erected here by the Eastern Pennsylvania Power Co. of New Jersey.

## FLORIDA

Lake Worth.—The Lake Worth Light, Water & Ice Co. will install internal-combustion engine, generator and exciter, with switchboard; also may construct 21 miles of line work.

Melbourne.—An electric light plant and ice factory will be installed here by the Peninsula Engineering & Electric Co. of St. Petersburg. Prices are requested on a second-hand 50 hp. or 60 hp. oil engine and a 37½ kv-a. single-phase or three-phase, 60-cycle, 2300-volt generator with exciter and switchboard.

Plant City.—It is reported that the city will construct an electric light plant at an approximate cost of \$50,000. Address Board of Public Works.

Punta Gorda.—City contemplates installing series street-lighting systems. R. M. Morgan, Supt.

South Jacksonville.—The Board of Bond Trustees are contemplating the installation of a 175-kw., 60-cycle, 2300-volt generating unit (directly-connected). T. A. Murwin, Supt.

## GEORGIA

Acworth.—City voted \$5,000 bonds to install new light and water-plants and extend systems.

Adel.—It is reported that the town will install a 3 hp. motor-driven centrifugal pump, capacity 50 gal. per minute, 22-ft. suction and 35-ft. head. T. R. Sutton, Supt.

Blakely.—City expects to improve electric-light plant. E. R. Adams, Supt.

Brunswick.—Among the improvements contemplated for the City electric-light plant will be the installation of a motor-driven or steam turbine-driven centrifugal pump of 500 to 600 gal. capacity per minute under 150-ft head. E. R. Adams, Supt.

Commerce.—The City has the establishment of an electric-light plant under advisement. Address Mayor Hood.

Ellaville.—City contemplates voting on \$5,000 bonds for the construction of an electric-light plant and water works. Address the Mayor.

Columbus.—The Columbus River Power Co. expects to install within the next twelve months one bank of three 1333-kw., 13,200-60,000-volt step-up transformers in Goat Rock Station; one 750-kw. motor generator set and exciter for same in Station No. 4 to furnish electricity for street railway service; one 1,000 kv-a. synchronous condenser for power factor correction at Hogansville, Ga. J. S. Bleeker is manager.

Fairburn.—The Fairburn Electric Railway Company intend to invest \$50,000 for the purpose of replacing their present cars operated with gasoline with storage battery cars.

Millen.—City contemplates installing 50-kw. generating unit, directly connected in electric-light plant. H. B. Davis, Supt.

Statesboro.—The City electric-light plant will install a 250-

hp. boiler with stokers and other equipment, and possibly additional lighting arresters. Dan. R. Gould, Supt.

## ILLINOIS

Galesburg.—Improvements to the extent of \$225,000 will be made by the Galesburg Railway, Light & Power Co., and will include extensions to the boiler plant, a new generating unit in the electric department, etc.

Liberty.—The Liberty Electric Co., recently organized with a capital of \$2,500, will build a power plant.

Sibley.—Bonds will be issued for the installation of an electric light plant.

## INDIANA

Indianapolis.—A new power plant, estimated to cost \$4,000,000 will be constructed by the Indianapolis Light & Heat Co. on the site of its present plant on Kentucky Ave.

Indianapolis.—The Indianapolis and Cincinnati Traction Co. is contemplating the extension of its railway from Kushville to Cincinnati, 62 miles. The city of Cincinnati will vote on a proposal to issue \$6,000,000 in bonds for the construction of a 15-mile terminal loop.

Loogootee.—The installation of a storage battery for charging vehicles is being constructed by the Loogootee El. Lt., Power & Wtr. Co. Jesse Rutledge is Secretary and Manager.

## IOWA

Algona.—The municipal electric light plant will install a new engine and make other improvements, involving an expenditure of approximately \$18,000. J. W. Kelly, Supt.

Cambridge.—W. A. Curtis, owner of the local electric light plant contemplates the purchasing of two 10 kw. 6600-220 volt transformers and four miles of No. 6 wire.

Des Moines.—It is reported that an ornamental street lighting system will be installed on Polk Boulevard.

Orient.—\$10,000 in bonds will be issued for the installation of a municipal electric-light plant.

Oskaloosa.—The Oskaloosa Vitrified Brick Company has the installation of a power plant under consideration.

Vinton.—The Iowa Railway & Lighting Company is contemplating the extension of its transmission line from Vinton to Shellsburg, Benton Co., and to Reinbeck, Grundy Co.

## KANSAS

Holton.—A 23-mile transmission line is contemplated by the municipal electric-light and water-works department. The following material will be required: 50-kw., 2300/13,200-volt step-up transformer, lightning arresters, recording watt-hour meter, switchboard panel, oil switch, etc.; also pole-type substation, 10 kw., 13,200, 110/200 volt step-down transformer, disconnecting switches, etc.

## LOUISIANA

Leesville.—It is reported that the Leesville Light & Water Works will install a new generating unit, consisting of 120-kw., 60-cycle, three-phase, 2300-volt generator and engine (directly connected) to furnish electricity for lighting purposes. W. K. Ferguson, Supt.

## MAINE

Houlton.—The Houlton Mills & Light Company will install forty or fifty new meters. T. C. S. Berry, proprietor.

## MARYLAND

Eckhart.—Cumberland & Westernport Electric Ry. Co., J. E. Taylor, Supt., Frostburg, Md., will enlarge power plant.

Frederick.—The City has applied to the Public Service Commission for permission to install an electric-light plant

for illuminating the city and furnishing electricity for residential lighting.

## MASSACHUSETTS

Webster.—W. Stone, 12 High St. is in the market for a 100-kw. dynamo motor. A second hand one will do.

## MICHIGAN

Detroit.—It is reported that the Packard Motor Car Co. will add improvements to its power plant here, including the installation of new equipment.

## MINNESOTA

Preston.—It is reported that an auxiliary plant will be constructed here by the Root River Power & Light Company to cost about \$25,000.

Rochester.—A hydroelectric power plant will be constructed near Zumbro Falls, for which \$360,000 bond issue has been made. City clerk, A. T. Wright.

Winona.—The Wisconsin Railway, Light & Power Co. will erect a new and modern steam reserve station here, equipped with the latest machines. Estimated cost \$200,000. R. M. Howard, general manager.

## MISSISSIPPI

Lucedale.—Lucedale Light & Power Co. will install equipment and construct ½-mi. transmission system.

## MISSOURI

Memphis.—The city is contemplating the issuance of \$25,000 in bonds for the construction of municipal electric-light plant.

Oregon.—The St. Joseph Transmission Company will construct a 50-mile transmission system; develop 100 horsepower.

St. Joseph.—Plans are being made for remodeling power plants and factory of the Western Tablet Co., 11th and Mitchell Sts. F. B. Daggert, Engr., 614 N. 5th Street.

## NEW MEXICO

Carlsbad.—The installation of new equipment in the local electric light plant and water-works, involving an expenditure of about \$10,000 is contemplated by the Public Utilities Co. A. J. Muzzy, Pres.

## NEW YORK

Albany.—Electric elevators are to be installed in the State House. Bids will be received by the trustees of public buildings, Executive Chamber, Capitol, Albany until March 9th, drawings and details may be had at the department of Agriculture, Room 1224, Woolworth Bldg., New York or Dept. of Agriculture, Capitol, Albany.

Buffalo.—It is reported that the International Railway will increase the company's system 9,000 kilowatts at a cost of \$175,000. One item is the equipment of five substations with additional machinery, including seven 1,000-kw. rotary converters. Power will be carried from Niagara Falls to these substations by 500,000-circular-mill cables.

Fulton.—It is announced that the Fulton Light, Heat & Power Company has completed plans for a transmission line from this city to Phoenix.

## NORTH CAROLINA

Hickory.—Community Club, Startown Farm Life School Dist. will install electric light plant, small generator and gas engine.

Kernersville.—The installation of a local municipal electric-light plant is being considered.

Shelby.—An ornamental street lighting system, to cost about \$3,000, is being planned by the City Council.

Warsaw.—It is reported that the town is prepared to grant a franchise for the installation and operation of an electric-lighting system.

Yadkin Narrows.—The Aluminum Company of America has decided to continue the development of its water power on the Yadkin River and expects to construct a power-house on the east side of the river and to put in three 18000-kw., 13,000-v. 36-cycle generators transmitting to Yadkin Narrows

for conversion to direct current. This will amount to an eight-pot development for aluminum plant; one pot probably ready in July and several in the fall.

## OHIO

Columbus.—The municipal electric light plant and distribution system will be extended and improved with new equipment, etc., for which bonds will be issued to the extent of \$265,000. Underground wiring in a large territory is also under advisement.

## OKLAHOMA

Ardmore.—The city is planning to establish a hydroelectric plant on the Washita River, 14 miles from here, and the construction of a transmission line to the city, at an estimated cost of \$375,000.

Langston.—Langston Colored College will rebuild burned power station.

Oklahoma City.—Huckins Hotel will erect building to contain power, heating, light, water, ice and laundry plants.

Texhoma.—The City Board will erect a larger building and install larger and better generating equipment.

Wister.—The Board of Trustees has authorized the issuance of \$7,000 for the installation of an electric lighting system.

## OREGON

Eugene.—Ornamental lamps will be installed on Willamette St. between 11th and 13th Avenues and the City Council has also under advisement the installation of ornamental lamps on 7th Ave. between Olive and High and on 8th Ave. East between Willimette and Pearl.

LaGrande.—It is reported The Morgan Lake Plant of the Eastern Oregon Light and Power Co. at this place which was recently destroyed by fire will be immediately rebuilt.

Portland.—A lighting system is to be installed at Holliday Park and a cluster lamp lighting system on First St., between Morrison and Yamhill Sts.

## PENNSYLVANIA

Christiana.—A new silk mill, to be operated entirely by electricity, is to be erected here at an estimated cost of \$50,000. For details address the Business Men's Association.

Hazleton.—The installation of an electric street lighting system is being arranged for by the city council.

Washington.—Plans are being constructed for the installation of an electric power plant to furnish electricity to the Casino, Bijour and Strand Theatres and possibly business houses in the block bounded by Chestnut, Main and Pine Sts., West, on a co-operative basis; the plant to be installed in the basement of the Strand Theatre.

Wilson.—The installation of an electric-lighting system is under advised by the commissioners.

## SOUTH CAROLINA

Camden.—City will install 25 meters and 25 kw. in transformers. E. D. McCutcheon, Supt., municipal water and light plant.

Fort Mill.—The installation of a municipal electric-light plant is being considered. E. C. Patterson, Mayor.

## SOUTH DAKOTA

Alcester.—10,000 has been voted for the securing of an electric light system.

Hurley.—An electric lighting plant will be established here, \$10,000 have recently been voted for that purpose.

## TENNESSEE

Chattanooga.—The Davis Hosiery Mills will extend their plant, including additional buildings and power plant to cost about \$150,000.

Memphis.—The Hoshall Machinery Co., Bank of Commerce and Trust Bldg. are in the market for two 75-kw. D.C. 250-volt generators connected to engines; two 100-kw. 125-volt D. C. generators connected to engines.

Nashville.—Plans are being prepared by the Cumberland Tel. & Teleg. Co. for the construction of a central exchange and office building (to cost \$200,000) to replace the building

damaged in a recent fire. A new switchboard and wiring system will be included in the work.

Ridgeville.—The Standard Processing Co. will install additional machinery (electrically driven) at a cost of \$15,000.

Ruskin.—The Ruskin-Cave College will rebuild power plant; steam power; may consider dam and electric power; school and village plant; prices on 40 hp. engine; 25 kw. generator, supplies, etc. Estimated cost about \$25,000.

## TEXAS

Archer City.—City contemplates the installation of an artificial light and power plant. Address the Mayor.

Bartlett.—The local substation of the Texas Power & Light Co., Dallas, recently destroyed by fire, will be rebuilt. Benjamin.—J. C. Copeland will instal electric-light plant.

Dublin.—A transmission line to Harbin is being considered by the Central Texas Power & Transmission Co.

Floydada.—Efforts are being made by the Chamber of Commerce to secure the construction of electric-light plant.

Gonzales.—J. F. Woods, Jr., care of Gonzales Electric Light Co. will build electric light plant.

Hereford.—Plans for a municipal electric-light plant is under consideration, initial installation to include two turbine-engine-driven units (directly connected having a rating of 250 hp. each.

Hereford.—The Hereford Light & Power Co. will install equipment, including 125 hp., return tubular boiler and 50 kw. steam-driven generating unit.

## VIRGINIA

Clarksville.—Bonds will be issued for the establishment

of an electric light plant.

Quantico—2000 acres on the Rappahannock River have been purchased by the Quantico Co., who contemplate the erection of a steel plant, including electric lighting system, cottages, bank bldg., etc. Eldredge Jordan, Real Estate Trust Bldg., Washington, D. C., is manager.

Radford.—Oren Dodds applied for franchise to construct electric-light plant.

Stuart.—The Clark Machinery Co. will establish a plant at a cost \$10,000 to \$15,000; transmission about 1¼ mi. develop about 100 to 125 horsepower.

Winchester.—\$6,000 have been appropriated by the City for the installation of a "white way." Address the Mayor.

## WASHINGTON

Albion.—Ornamental street lighting system will be installed to cover the entire business section of the city.

Everett.—City contemplates the installation of an electric plant.

## WEST VIRGINIA

Wheeling.—Plans are being prepared for a 2-story power house 100x100 ft. for Block Bros. Tobacco Co., at an estimated cost of \$80,000. G. Frederick, Ch. Engr.

Williamson.—Williamson Light & Ice Co., O. B. Welch, Gen. Mgr., will erect electric-light plant and ice and cold storage plant. (See Ice and Cold-Storage Plants.)

## WISCONSIN

Crivitz.—Residents of this community are planning to secure an electric light plant.

## Financial Notes

The Arkansas Valley Railway, Light and Power Company, Pueblo, Colorado, has retired \$50,000 first mortgage sinking fund bonds of the Pueblo Traction and Lighting Company.

\* \* \*

The City Council, of Peoria, Ill., has under construction the establishment of a municipal electric light plant. The council's committee reported that this would mean a saving to the city of about \$32,000 a year.

\* \* \*

The Columbus Railway, Power and Light Company, Columbus, Ohio, has declared its quarterly dividend of 1¾ percent on preferred, and 1¼ percent on common.

\* \* \*

The Cleveland Southwestern and Columbus Railway Company, of Cleveland, Ohio, has made application to the Ohio Public Utilities Commission to be permitted to purchase the property of the Crawford County Gas and Electric Company, at Crestline, Ohio.

The Standard Utilities Corporation has been chartered in the State of Delaware; headquarters given as New York City. Capital stock \$2,000,000. To erect light plants, generate electricity, etc. Incorporators are Anselm P. Anderson and Joseph F. Curtin, of New York.

\* \* \*

The Michigan Railway Company, of Jackson, Mich., has announced that it has leased the following electric railway lines: Grand Rapids, Holland and Chicago; Michigan United Railways; Michigan United Traction, and the Kalamazoo, Lake Shore and Chicago lines. The leases, which aggregate 546 miles of trolleys, will become effective January 1.

\* \* \*

It is rumored that the Reading Transit and Light Company, of Reading, Pa., will expend about \$300,000 during the year 1916 in enlarging and improving its power plant in West Reading.

\* \* \*

A net increase of \$175,622, over the same period in 1914, is shown in the earnings of the Georgia Railway and Power Company and its affiliated companies for the eleven months ending November 30.

\* \* \*

The Iowa Electric Company, of Cedar Rapids, Iowa, has filed an amendment to its articles of incorporation increasing its capital stock from \$400,000 to \$600,000.

\* \* \*

Net earnings of the Kaministiquia Power Company, of Ontario, Canada, showed an increase of over 11 per cent. over 1914, for the period ending October 31st.

\* \* \*

The Hooper, Kimble and William Power and Light Company, of Boston, Massachusetts, has purchased the power plants of Sac City, Wall Lake, Lake View, Carroll and Lytton, in the state of Iowa.

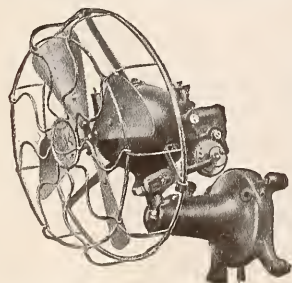
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# ELECTRICAL AGE

The National Monthly of Electric Practice

Technical Journal Company, Inc., New York

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Vol. 48

APRIL, 1916

No. 4

## Reinforced Concrete Poles

Some Of What Has Been Done—What Should Be Done.

High Steel Prices Forcing Their Use.

By **W. L. Cadwallader**

In the electrical industry of to-day the pole plays a very important part. Millions of dollars in capital are invested in the poles set along our streets and highways and additional millions are required in operating expenses to replace those weakened by age, and to repair damage caused by failure due to storms or too severe loads. Therefore any type of structure which can show a possible economy, either in first or in ultimate cost, will receive favorable attention.

There are three kinds of poles in general use—wood, metal and concrete. Of these wood poles are by far the most numerous, but are at best short lived, while those of concrete, although having a life which, if they are properly designed, should be indefinite, are, as a rule still rarities.

It is true that in some localities, in certain sections of Canada, for example, they are found in large quantities, but in comparison with the enormous number of wood poles used annually, the few occurrences of concrete poles are only a very small proportion.

The wood pole has been longest in the field, and in spite of its low strength and short life, is a fairly satisfactory structure. The concrete pole, it might be argued is of very recent origin, and too much cannot be expected of it yet. Nevertheless it has been sixty years since the first concrete pole on this continent was built, and the rapid development of reinforced concrete along other lines during the past ten or fifteen years should apparently lead to the expectation of rapidly increasing numbers of concrete poles. However, when greater strength or permanency is required that can be afforded by wood, steel is as yet more frequently used, in spite of its higher maintenance cost and shorter probable life.

There must, of course, be reasons why concrete poles have not yet become as popular as might be expected. The most important are cost, difficulty in handling owing to the weight, and a lack of certainty as to whether commercially made poles will stand up satisfactorily under long service. There is also the

erroneous idea that concrete poles are entirely lacking in elasticity.

In general neither steel nor concrete poles can be furnished and installed as cheaply as wood. In some instances concrete poles have been built at figures only slightly in excess of wood, but these cases are, as a rule, exceptional. Such poles are very light, and only of a strength approximating that of wood, and it has been possible to construct them under favorable conditions at a pole yard not very distant from the point of erection.

For the average transmission lines conditions are not always so favorable. Even if concrete poles with the same strength as wood are used, the weight will be greater, adding to the cost of handling and trucking, and (of freight) is shipped by rail.

The largest installation of concrete poles on this continent is in Toronto. Here up to 1912, 25,000 were in use. As the poles are short and sheltered by trees and buildings, and only a few wires are carried, the loads are small, so that as standards, 24-ft. poles with an ultimate strength equivalent to a 500-lb. pull at the top and 30-ft. poles with an 800-lb. pull at the top were adopted. The 24-ft. pole has a width at the top of five inches and at the base of eight inches with one  $\frac{3}{8}$ -in. rod in each corner. The 30-ft. pole is 9 ins. at the base with one  $\frac{1}{2}$ -in. rod in each corner. The cost at the yard including 10 per cent. for engineering and supervision has been given at \$5.00 for the 24-ft. poles and \$8.00 for the 30-ft. poles.

While these figures are exceptionally low and compare very favorably with the cost of wooden poles, it should be borne in mind that their strength is less. However, experience thus far has shown that in general these poles are sufficient for the service required on this line so that any additional expenditure for greater strength would not have been justified. In cases where extra heavy loads have caused the pole to show signs of failure guys or heavier poles have been installed.

Tests of three poles designed for street lighting in

suburban districts in Rochester, New York, show the following results. They were 30 ft. over all with a top  $6\frac{1}{2}$  in. sq. and a butt  $9\frac{3}{4}$  in. sq. The reinforcement consists of one  $\frac{3}{8}$ -in. rod in each corner. The poles were buried 5 ft. in the ground and the load applied 2 ft. from the top. With a pull of 500 lbs. the deflection at the top varied from 7 to 13 ins. and with a pull of 1,000 lbs. the deflection was from 19 to 29 ins. Failure occurred at loads between 1,000 and 1,100 lbs. while fine surface cracks began to appear at about 700 lbs. Some of the deflection was probably due to the earth settling.

On high tension transmission lines, wood poles are being replaced by steel because of the lack of durability and strength of wood and because with steel the spans can be increased with a saving in the number of insulators, foundations, etc. Therefore if concrete poles are to be used for this class of work, they should be stronger than those of wood. One pole capable of withstanding the loads of a 250 ft. span will be cheaper than two at 125 ft. spans. The most economical span which can be used will depend on the size, number and spacing of wires to be carried, and the location of the line. When the loads to be carried become too great, the size and weight of the poles cause transportation and erection to offer serious difficulties.

#### Some Heavy Construction

For carrying transmission lines or heavy telephone lines, poles must have greater strength than have those already described. The loading of  $\frac{1}{2}$  in. ice and 8 lbs. per sq. ft. wind pressure means a horizontal load of a little less than a pound per wire for each foot of span. Therefore a pole carrying two circuits and a ground wire should be of sufficient strength to carry, with a factor of safety, a horizontal load at the centre of gravity of the wires, of approximately 1,050 lbs. for 150-ft. spans and 2,100 lbs. for 300-ft. spans.



Fig. 2.—Pole No. 5 Under Test

Heavy telephone lines will require a strength greatly in excess of this. For example the P. R. R. Telegraph Line across the Hackensack Meadows not far from New York was designed by Mr. R. D. Coombs to carry 6 ten pin arms and 2 forty pair cables carried on steel messengers. On the basis of 100 ft. spans and a loading of  $\frac{1}{2}$ -in. ice and 8 lbs. wind the resultant load at the center of the wires is 5,100 lbs. exclusive of wind on the pole. On the basis of  $\frac{1}{4}$ -in. ice and 8 lbs. wind the load would be 3,000 lbs. As telephone and telegraph wires are rarely strung with enough sag to permit their standing up under the first of these loadings, it is customary either to reduce the loading or to reduce the factor of safety required by permitting high unit stresses.

The Meadows Pole line, whose method of construction is shown in the accompanying



Fig. 1.—Building Hackensack Meadows Line. Poles weighing 5,000 to 6,000 lbs.

illustration has been built some years and undoubtedly represents the heaviest concrete pole line constructed in this country.

In addition to the heavy load to be carried, the ground was very bad, being for almost the entire distance a peaty swamp, so that expensive foundations were necessary. The poles are 8 ins. square at the top with an increase in thickness of 1 in. for each 5 ft. of length. The lengths vary from 35 to 65 ft. and owing to the bad foundation they are imbedded in the ground from 10 ft. for a 35 ft. for a 65 ft. pole. In addition a timber grillage consisting of railroad ties is securely attached about 4 ft. below the ground.

The weight of these poles ranges from 5,300 lbs. for a 35 ft. pole to 17,300 lbs. for a 65 ft. pole. Ordinarily, handling these heavy sections would have been a difficult task, but in this case they were taken from the cars and set by a derrick car with a specially built 90 ft. boom.

A test was made on a preliminary pole, 55 ft. long and buried in the ground 13 ft. The reinforcement consisted of one 1 in. sq. rod in each corner running full length, three 1 in. rods in each face parallel to the wires and two in each face perpendicular to the wires, of varying lengths. The load was applied 2½ ft. from

the top. The test showed the following deflections at the point of application of the load.

Load in Pounds	Deflection
1000	7 ft.
2000	15 ft.
3000	26 ft.
4000	40 ft.
4360	47 ft.

It should be understood that a large part of these deflections was due to the shifting foundations. A 1/16 ft. crack appeared at 4360 lbs. and on continued application of the load the concrete failed in compression. As a result of the test certain changes were made in the design which greatly strengthened the pole with little or no extra expense.

As these poles have stood up under storms which brought down many others in the vicinity, the factor of safety adopted has apparently been sufficient.

### A Competitive Concrete Pole Test

In 1913, the New York Central Railroad conducted some tests on concrete poles at Harmon, New York. The specifications provided that the poles should be designed for three cross-arms, each carrying two cables 1½ ins. in diameter, supported on ¾-in. messeng-

#### DIMENSIONS OF POLES

	Pole No. 1	Pole No. 2	Pole No. 3 and No. 4	Pole No. 5 and No. 6
Width at top	7 in.	7 in.	7 in.	8 in.
Width at butt	15 in.	15 in.	17 in.	14 in.
Reinforcing	4 5-8 in. cor. rcds.	4 3-4 in. cor. rods.	4 5-8 in. cor. rods. 12 3-4 in. side rods.	4 1 in. cor. rods. 4 7-8 in. side rods. 2 1-2 in. side rods.
Total Area steel	1.56 sq. in.	2.25 sq. in.	8.3 sq. in.	7.6 sq. in.
Weight of Pole	4700 lbs.	4700 lbs.	5900 lbs.	3900 lbs.
Solid or Hollow	Solid	Solid	Solid	Hollow

#### RESULTS OF TESTS

Pole No. 1			Pole No. 2		
Load in Lbs.	Deflection	Remarks	Load in Lbs.	Deflection	Remarks
1000	2 in.	Several hair cracks	1000	2 in.	Several hair cracks Cracks 1-16 in. open Cracks 1-4 in. open Failure near ground
2000	6 in.		2000	6 in.	
3000	12 in.	Cracks near ground opening up	3000	11 in.	
3100	18 in.	Failure near ground	3500	15 in.	
3300	26 in.		3600	20 in.	
Pole No. 3			Pole No. 4		
Load in Lbs.	Deflection	Remarks	Load in Lbs.	Deflection	Remarks
1000	1 in.	Hair cracks near top Hair cracks near ground	1000	1 in.	Hair cracks 6 ft. from top Several cracks near top Cracks scattered along pole Failure about 6 ft. below top
2000	2 in.		2000	2 in.	
3000	4 in.	Cracks 1-4 in. open	3000	3 in.	
4000	6 in.		4000	5 in.	
5000	8 in.	Failure about 6 ft. below top.	5000	7 in.	
6000	11 in.		6000	9 in.	
7000	14 in.		7000	11 in.	
7500	18 in.		7500	13 in.	
Pole No. 5			Pole No. 6		
Load in Lbs.	Deflection	Remarks	Load in Lbs.	Deflection	Remarks
1000	1 in.	Hair cracks about 10 ft. below top About 10 hair cracks evenly distributed Width crack 1-32 in.	1000	1 in.	Hair cracks appeared Cracks closed up Cracks evenly distributed
2000	3 in.		2000	4 in.	
3000	5 in.		3000	6 in.	
4000	8 in.		4000	10 in.	
5000	10 in.		5000	12 in.	
6000	14 in.			0	
7000	17 in.		5000	13 in.	
7200	21 in.		6000	22 in.	

On increasing load pole deflected 36 in. before failure. Concrete failed in compression at two points 10 feet apart.

On increasing load pole deflected 44 in. before failure. Concrete failed in c mpression about 6 ft. above ground.

Fig. 3.—Results of Competitive Test—Load Applied 28 feet From Ground Line

ers, with a height of 22 feet from the lowest arm to the ground. A wind loading was assumed of 15 lbs. per sq. ft. on the poles and 10 lbs. per sq. ft. on the cables and messengers covered with 1/2-in. ice. On the basis of 125 ft. spans this was equivalent to a horizontal

difficulty was encountered in pulling over the broken shaft. The fact that Nos. 5 and 6, although of less and less area of steel were of practically the same strength as Nos. 3 and 4, was probably due to the concrete being denser and stronger.

It is apparent from the above and from many other tests that concrete poles can be designed for any reasonable strength requirement. If properly designed and made they will present an attractive appearance and will not deteriorate with age. In fact, if not under-reinforced, they should increase somewhat in strength, due to the increase in the compressive strength of concrete. This is a most valuable property as compared with the rapid deterioration of wooden poles.

**Concrete Pole Costs and Construction Economies**

There is not the least doubt that the time is now here when standardized, concrete poles can be built and erected at a cost, that compared to that of steel, of equal strength, will cause them to become very greatly used

The cost will vary greatly with the strength required, 35 ft. poles for distribution circuits have been built for from \$8 to \$12, but they have as a rule a somewhat lower strength than a first class wood pole.

The cost of a 30 ft. pole similar to numbers 5 and 6 described above should be about as follows:

Steel, 580 lbs., at 2 1/2.....	\$14.50
Cement, 2 bbl. at \$1.50.....	3.00
Sand, 1/2 yd., at \$0.80.....	.40
Stone, 3/4 yd., at \$1.20.....	.90
Bands .....	1.00
Labor .....	6.00
Form .....	.50
Engineering and superintend'ce	2.70

\$29.00

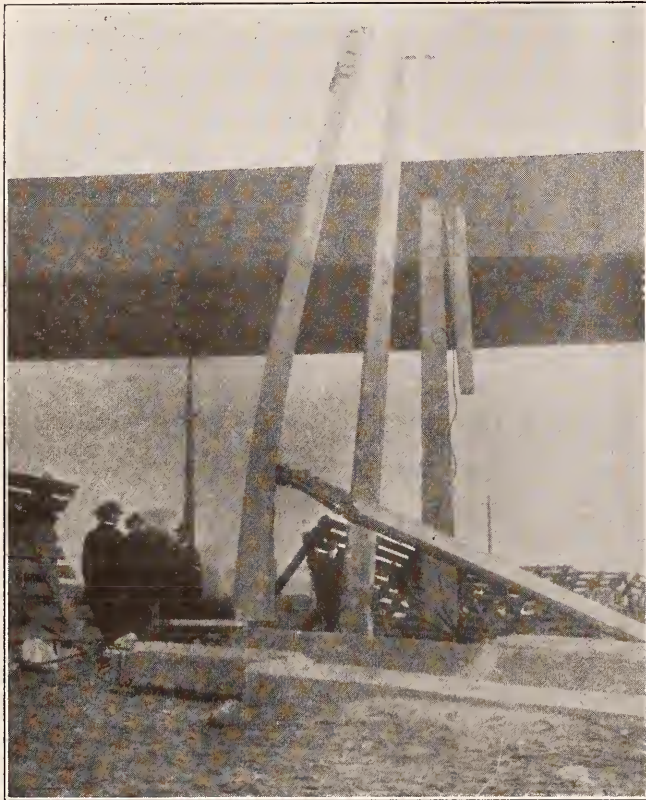


Fig. 4.—A Propped Test Under 6,000 lbs. Pull

load of 400 lbs. per cable or a resultant load of 2700 lbs. applied 24 ft. above the foundation.

Three manufacturers submitted poles for tests, and owing probably to different interpretations of the specifications, these varied considerably in dimensions and strength. One pole of each group was tested in torsion, and two in direct bending. All were at least six months old when tested. They were set in concrete foundations, with the load applied 24 ft. and the scale from which the deflection was read 26 ft. above the top of foundation.

The general characteristics of the poles and the results of the test are as follows:

Poles No. 5 and No. 6 were designed and built by a well-known New York concern. They were hollow, the walls being 4 ins. thick. The reinforcing consisted of 1 in. corner rods, with two 7/8 rods in each face parallel to the wires, and perpendicular to the load, and two 1/2 in. rods in the other two faces. The rods were twisted squares held in place by wrought iron bands about 20 ins. apart, to which they were securely wired. The concrete was a 1-2-4 mixture.

Poles 1 and 2 were not strong enough to meet the requirements of the specification. The others carried twice the design load with only hair cracks which closed up on removing the load, and from 2 1/2 to 2 3/4 times the load before failure. All showed considerable elasticity and numbers 5 and 6, which failed in compression, were held up by the unbroken rods, so that



Fig. 5.—Square Heavy Concrete Pole Line

This is exclusive of arms, braces and steps, whose cost will be the same for either wood or steel. The cheapest means of taking care of the steps is to mould hard wood blocks in the concrete, into which the step can later be screwed. A better method is to use screw anchors.

A latticed steel pole of equal strength and height should cost, if purchased in quantities at normal prices, about \$35.

#### Hollow Concrete Poles

The advantage of hollow over solid poles is mainly in weight. Poles of small diameter are generally solid, since in order to effect any material economy, the walls would have to be made so thin as to seriously reduce the strength. In larger poles there may be an advantage in making them hollow.



Fig. 6.—A Model European Hollow Concrete Pole Line

For example the 65 ft. pole used on the Pennsylvania Railroad, mentioned above, weight 17300 lbs. If this had been made hollow with walls 4 ins. thick there would have been a reduction of one yard of concrete and 3900 lbs. weight. The saving in material would have been partly offset by the cost of the core and the increased difficulty in placing the concrete; but the reduction in weight might be worth while in a reduced cost of handling and freight rates, if shipped by rail.

The hollow pole also offers an opportunity, which is sometimes made use of, for bringing wires down the inside.

The walls of hollow poles should not be made too thin. Some tests of this type have shown them to fail at loads considerably below their theoretical strength owing to the walls not being heavy enough to resist the shearing stresses.

The poles which have been described represent what may be termed the standard construction in this country. Other special designs are in use, chiefly abroad, but they have not been adopted here. As a rule the form work is more elaborate, more care is necessary to ensure absence of voids in the concrete, and the strength in proportion to the amount of material is not so great.

While the writer does not believe that in all cases the use of concrete poles is economical, there are many conditions for which they are well fitted. Along city or suburban streets, where the loads are not too great, they can be used to advantage. While the first cost will be somewhat greater than that of wood poles, the cost at the end of say twenty-five years, after the expense of renewals to the wood line has been added, should not prove very different. Also the more ornamental appearance of the concrete pole may be of considerable importance.

For transmission lines outside of towns, the use of concrete poles will probably be justified in only a few instances. If long spans are used the poles become long and heavy, making hauling and setting expensive. It is not possible where considerable strength is required to widen the pole and reduce the amount of metal as can be done with steel poles, because this involves increased amounts of concrete and still greater weight. Also the pole has little strength at the top to resist torsional stresses caused by a broken cable.

For telegraph and telephone lines concrete poles can be used where maintenance and the low strength of wood poles is a matter of serious importance. With the present sizes of wire, it is not possible to lengthen the spans materially, so that little economy can be effected by having fewer poles per mile. The poles must be strong enough to carry whatever loads can reasonably be expected to occur. The failure of a certain number of wood poles during severe storms is looked upon as a necessary evil, but this cannot be permitted to occur with concrete, whose chief advantage is its permanence.

In conclusion, too much emphasis cannot be placed on the necessity for careful design and supervision of the construction of concrete poles. The strength adopted must be sufficient to carry safely the probable loads. The details of design should only be handled by a man thoroughly familiar with the principles of reinforced concrete and experienced in pole work. In manufacturing, careful inspection is required to ensure the production of a dense concrete with a high compressive strength, and without voids which will reduce the strength and mar the general appearance. Plastering the surface should not be necessary, although rubbing the faces with a concrete brick shortly after the forms are removed will improve their looks.

If these precautions are adopted a concrete pole can be made which will give entirely satisfactory service, and which will have a most valuable property not possessed by wood—permanence.

# Uses and Starting of Synchronous Motors

By Harold Mann

The effect of power factor upon the capacity and operating of alternating-current machines and systems has long been known, but it is only within quite recent date—the last few years—that the manner in which low power factors actually increase the initial investment in apparatus for a given energy output has been recognized in a practical form. Since recognition has come effort is now being made to reduce the deleterious influence of low power factors by either using apparatus that results in higher power factors or by compensating in some way, phase control, for them, until the low power factor is neutralized or more or less prevented by other apparatus effecting a high or a leading instead of a lagging power factor.

This article is not concerned with the correction of power factor, nor yet, strictly speaking, with the various methods and apparatus for obtaining high power factors collectively or individually, but to explain how the use of synchronous motors in place of induction motors for many fields of application may be taken advantage of without affecting the starting characteristics of the load served.

The synchronous motor is now being used quite extensively in place of the induction motor. It is used to-day where three or four years ago its use would not have been dreamed of because of its high cost, the complications its use would impose, and the much greater likelihood of operating troubles developing even where skilled labor were available. The synchronous motor has, however, passed through a time of development in the last few years and may now be said to be as rugged and almost as reliable and satisfactory in every way as the induction motor, in consequence of which it is now coming into increasing use where before motors of the induction type only would have been considered.

Against the use of the synchronous motor as compared with the induction motor has been brought forward its higher first cost, while the theory has been advanced that greater skill is required to operate it, trouble is more likely to develop due either to the machine itself or to conditions over which it has no control such as sudden changes in frequency, of voltage or of current, any one of which might result in the synchronous falling out of step whereas the induction motor would merely grunt and slow down until normal operating conditions returned when it would come up to normal speed again provided the load it was carrying was not far in excess of full-load rating. It is true that the synchronous motor occupies more space than does the induction motor of the same rating; its first cost is higher on account of an exciter and field rheostat being an integral part of the synchronous motor installation; and there is need of a little more care in handling is also true, but with the use of squirrel cage windings in the pole pieces, etc., the synchronous motor is now reliable and comparatively stable. The result is that the synchronous motor may be used to good advantage in many places where the induction motor is now used, provided there is attention close at hand, and frequent starting and stopping are not needed.

Many power contracts for the supply of electrical energy contain clauses that stipulate that the power factor shall not fall below a certain specified value, and should this value be exceeded a forfeiture clause imposes additional charges according to the extent that the power factor falls below the limit specified. On the other hand, often the higher the power factor the more advantageous are the rates for the consumer. In such cases it is to the advantage of the consumer to not only keep his power factors within the specified limit, but to keep them as high as possible. Not only does it mean lower rates for electrical energy, but it also means that his apparatus may be of smaller capacity, and therefore of lower first cost, for a given output than would

otherwise be the case. (There is another way of looking at the matter. A load is increasing and soon will it be necessary to install additional copper and electrical machinery: instead use a synchronous motor and maintain a higher power factor than would be possible with induction motors and there will, no doubt, be found to spare capacity in copper as well as in apparatus).

It can be seen that the advantages are all in favor of the high power factor, to both central station company as well as to the consumer. Under these circumstances power factor control may be taken advantage of in its strictest sense in the large plant but yet the labor and complications and the investment they represent not be justified in the small plant. In this case it is clearly a case where the power factor should be maintained at some definite value or between some value such as 90 per cent. and left there. This it is possible to do by use of the synchronous motor without any specially skilled labor.

In using a synchronous motor in place of the induction motor the aim of the customer is to raise his power factor, and thereby obtain increased capacity of his apparatus while at the same time obtaining more favorable rates. In doing this he must not change the characteristic of his load, that is to say the mechanical load served by the motor. In other words the synchronous motor must be capable of doing what the induction motor did, and in the same way, except that it takes current of high power factor from the line instead of current of low power factor. Thus while the power requirements remain the same the method of applying them that have to be different.

The chief factor that must be considered in changing from an induction motor drive to one employing a synchronous motor is that of starting, and it is the various forms of starting, according to the requirements of the various classes of machines driven, that will be dealt with here.

Different kinds of service have different speed-torque characteristics. The induction motor is available in two types, namely, the squirrel cage type and the variable resistance type, the one for comparatively light starting torque, the other for severe starting torque. On the other hand the synchronous motor has only one starting and speed-torque characteristic, although it may be modified somewhat by design. As the synchronous motor is to replace the induction motor means must be found, therefore, for obtaining the requisite speed-torque characteristics. This is done by using different methods of starting. In some classes of work the synchronous motor has the necessary characteristics, in which case the procedure is simple and straightforward, in others it has not, but may be made to have a characteristic having very close semblance to that of the motor it replaces by using the proper starting methods.

With any machine, whether direct-current or alternating-current motor of the induction, synchronous or repulsion types one requirement is the same, namely, that the motor be capable of being started from rest and bringing the load up to speed with the least possible disturbance to the line. In alternating current motors it is not current alone that causes voltage fluctuations but power factor also, hence the power factor should be maintained as high as possible, at the same time attempting to keep the current down to as low a value as feasible. The torque of a synchronous motor has a definite value at the moment of starting, which increases somewhat as the speed comes up to a certain point, and then decreases as synchronism is approached when the torque has a relatively low value. If the voltage be increased the starting torque is increased likewise, and as the square of the impressed voltage. But the kilovolt-amperes taken by the motor also increase as the square of the voltage, hence it is necessary to place a limit upon the permissible voltage that may be applied to the motor because of the heavy starting

current down to as low a value as possible the starting torque suffers, of course, since it also varies as the square of the voltage impressed upon the motor.

Different classes of apparatus have different starting torque characteristics. For example, the starting torque may be very high due to excessive static resistance due to friction of bearings but once the machine is turning over little additional torque is required to bring the machine up to full speed. On the other hand, the starting torque requirements may be low because the friction of journals, etc., is small but as the speed increases the torque that must be exerted may increase in value. This latter requirement is a difficult one to meet satisfactorily by means of the synchronous motor, and is the most severe condition that a synchronous motor is called upon to meet. To overcome these difficulties different methods of starting have been developed, in this way modifying the speed-torque characteristics of the synchronous motor. These starting methods may be divided into two classes, namely, that where high starting torque is required but decreasing torque as the speed increases, and that where the starting torque is small as compared with that at about synchronism.

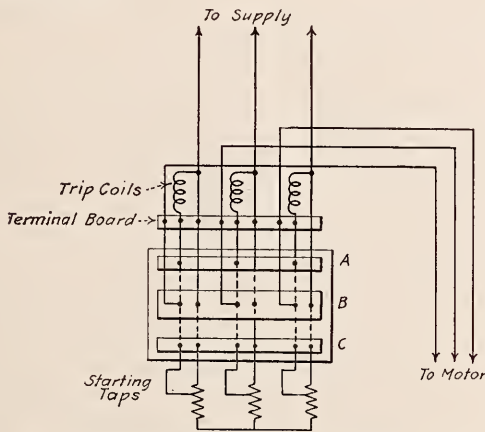


Fig. 1.—Connections for Self-Contained Starter

In this figure, A is the running position, C the starting position and B is an oil-immersed circuit breaker integral with the compensator. Note trip coils in the running side of leads.

The usual method of starting a synchronous motor—the most common example being that of the self-starting rotary converter probably—consists of cutting the stator or primary winding of the motor in on about one-third voltage with the field winding open circuited. When the motor has reached constant speed the field (which has its field rheostat set to correspond to about normal no-load voltage on the motor) is closed. The machine is then immediately thrown from the thirty per cent. voltage tap to full line voltage. The motor is then ready for service, and voltage and power factor adjustment. To care for varying static friction values and other unknown factors the compensators usually have taps brought out at about 30, 37.5 and 45 per cent. of full voltage. Only one of these should, of course, be used, and the one chosen should be that enabling the desired torque with the least current rush. Too low a voltage should not be used otherwise difficulty may be experienced in “pulling in” the motor when the field is excited. Trouble in this respect will not occur so long as the motor reaches a speed within about 5 per cent. of synchronism.

In those cases where a high pull in torque is required and yet the starting current and torque do not necessitate a high voltage starting tap two or even three taps may be brought out from the compensator. The motor is started on the low voltage tap and is then thrown from tap to tap until it is connected to full line voltage. In this way the starting current is prevented from being excessive while the necessary “pull in” torque is obtained. On comparatively small capacity machines of voltages not higher than about 2400 volts the use of two or more starting taps has

little effect on the cost of the compensator or starting installation. However, at higher voltages and for motors above about 500 kv-a. the compensator requires separate oil circuit breakers with the compensator. The connections for a self contained compensator and one using separate circuit breakers are given in Figs. 1 and 2.

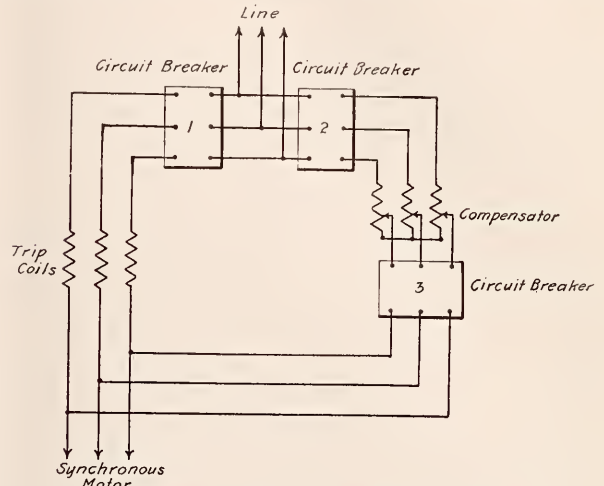


Fig. 2.—Starter With Separate Circuit Breaker

With this arrangement circuit breakers 1 and 2 are interlocked so that 1 cannot be closed so long as 2 or 3 is closed. Breakers 2 and 3 are operated by the same lever. Note that overload trip coils are placed in the running and not in the starting leads.

Instead of using a compensator or auto transformer for obtaining the voltage steps money may often be saved, and where other conditions permit, by building the transformer that supplies the motor with the necessary voltage taps in the secondary. The taps usually chosen for this purpose are about 45, 50 and 66 2/3 per cent. Where the demand of current must be low reactance coils are inserted in the starting circuit as shown in Fig. 3. The method of starting is to all intents and purposes the same as before and by placing the reactances as shown in the sketch they require no further thought.

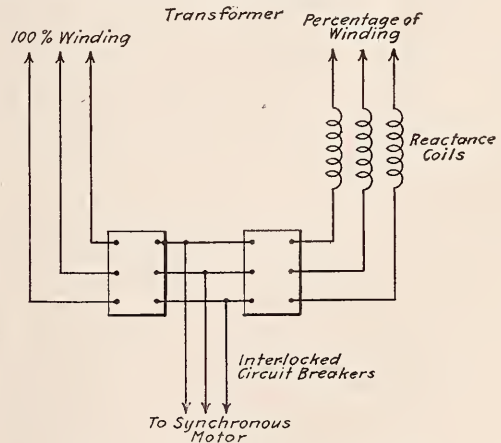


Fig. 3.—Starter With Reactance Coils

In reviewing these various methods of starting it is seen that they are not really a very serious deterrent against the use of the synchronous motor. It is in the interests of the central station company to have high power factors, and it is not unreasonable, therefore, to expect that they will make it worth the customers' while to maintain high instead of low power factors by giving the customer with high power factor a more favorable energy rate than the customer with a low power factor. This is being done already to a limited extent, and it will come into favor more and more as time goes on

# Present Status of Electric Power Generation, Transmission and Distribution

By Percy H. Thomas, Consulting Electrical Engineer\*

## Prime Movers

Very great advances have been made in prime movers during the last few years and in most plants apparatus not of the modern types, even if still in entirely serviceable condition, can be discarded to advantage on account of the high efficiency and low cost of the newer machines.

### Steam

For steam units the high speed steam turbine is practically universally used, the speeds usually running at least as high as 1,500 to 1,800 r.p.m. even on large units. These turbines should be operated on high pressure and with good vacuum, using either jet or surface condensers, with water jet type air pumps. Vacua as high as 28½ ins. or even 29 ins. may be obtained on full load with fairly cool condensing water, e.g. 70 deg. F. The steam pressure is usually at least 200 lbs. with 100 deg. F. or more of superheat. Full load efficiencies may run as good as one kw. for 13 lbs. of steam per hour (including auxiliaries) under the most favorable conditions in the largest units, although 15-17 lbs. of steam is more usual. It is desirable to have one or two large units in each station to carry the great bulk of the load, while the peaks, and, if necessary, the light night load may be carried on smaller units.

Steam turbines may be obtained of a capacity as high as 50,000 kv-a. and have been built for as high as 35,000 kv-a. One of the turbine builders in the U. S. A. has built a 30,000 kv-a. turbogenerator in two parts, (the high pressure element discharging into a low pressure element) provided with separate shafts and running at different speeds (1500 r.p.m. and 750 r. p. m.) Each part may thus be operated at the most favorable speed. While some gain in economy is secured and smaller masses are to be handled, there is a certain loss of simplicity and larger floor space requirement over the single turbine and more experience is required to determine the future of such double turbines.

Boilers when supplied with proper draft and adequate stokers may be operated at loads double the best practice of ten years ago, and without any loss of economy. As much as 5 to 7½ lbs. of water per hour per square foot of tube surface may be safely evaporated in a modern boiler and even this may be nearly double for overload conditions, though with some loss of economy.

The net result of the great advances recently made in the art of generating electricity by steam may be seen from the example of the Manhattan Elevated Railway's 74th St. Power House, built in 1901, and then containing 8-5,000 kw. generators driven by reciprocating engines. This was a model station. These 8-5,000 kw. generators are now being replaced by 8-30,000 kv-a. turbo-generators, operated from the original boilers, which, however, are provided with new forced draft mechanical stokers. The new equipment is all contained in the original building, including the new condensers and switch gear.

### Hydraulic Turbines

Modern designs of hydraulic turbines may be obtained for any head from a few feet to 3000 feet or more. The Pelton wheel is used, as heretofore, for high heads, but the turbine type wheels are built up to a few hundred feet. At the present time efficiencies as high as 90% to 92½% are obtained at full load, an improvement of at least 10% within a few years. Some interesting examples of modern turbines may be mentioned to show the very great development of hydraulic power.

Power Station	Head in feet	Capacity of unit in h. p.	Speed r.p.m.
Miss. River Power Co. ....	32	10,000	57.7
Alabama Power Co. ....	68	17,500	100.
St. Lawrence River .....	30	10,800	55.6
Lawrence Co. ....	76	20,000	120.
Turner Falls Co. ....	54	9,700	97.3
Government station at Nore, Norway .....		19,000	
Pacific Gas & Elec. Co., Electra Power House .....	1450	10,000	400
Great Western Power Co. ....	430	18,000	400
Bombay Transmission .....	1727	11,000	
Shawinigan Falls .....	145	18,500	225
Tallah Falls, Ga. ....	600	17,000	514
Nippashi River, Japan .....	350	10,000	375
Washington Water Power Co. (largest ever built) .....	168	22,500	200

Considering the design of water turbines, more and more attention has been given recently to the shaping of the approach passages and the discharge or draft tubes to avoid eddy losses and utilize the full velocity head of the discharge—concrete forebays and draft tubes are often used in large units.

Managers of power plants are tending more and more toward the view that for the usual power services requiring steady and reliable power, hydraulic turbines as prime movers should be considered as auxiliaries or at best as a source of large blocks of kilowatt-hours at very low cost, while enough relay steam or other power must be available to fill in the gaps of low water or other disturbances of supply.

### Gas and Oil Engines

For many years the high full-load economy of gas and oil engines caused repeated attempts to rely on such prime movers as power system relays and to use them for local and private plants in place of electric power from a general supply system. These efforts have however, had little success and are not likely to succeed generally in the near future. As relays, the gas or oil engines cannot be made in large enough units to be desirable. A very few thousand horse power represents the limit in gas engines and perhaps 1000 h.p. per cylinder the limit in the Diesel engine, which is at present the most generally available form of oil engine. They are further inherently large in size and clumsy and run at slow speed. Their admitted higher efficiency is not sufficient to overcome these other disadvantages for the purposes of larger power plants.

For private plants gas and oil engines are sometimes used, the former especially where natural gas is available. The high heat value and low price of this fuel is sufficient in the case of such plants to overcome the defects of large installation cost, small overload capacity, low efficiency on light loads and bad regulation, inherent in the gas engine.

Where no natural gas is available it is possible to install a gas producer and manufacture gas and considerable success has attended many such installations. However, in cases where electric power may be obtained at a reasonable rate from a service plant, perhaps in the neighborhood of 1c. a kw.h., or less, the simplicity of operation and small initial investment cost of the service plant power will outweigh the apparent gain in economy that can often be shown on paper in the use of a gas producer outfit.

In case of Diesel engines the initial cost is very high and

\* Continued from March issue.



the weight of the engine excessive, although the full-load economy is high under favorable conditions.

### Governing

The problem of governing large power networks requires a word of comment. It is impracticable and undesirable that all the generating units in a large system should take part in the regulating function and usually some one generator is selected for this duty. The governors of all the other generating units are then made insensitive or are blocked so that most of the variations of the total load are taken on the governing unit. Usually a steam unit is chosen for regulating purposes, partly because the governor of a steam turbine is naturally more sensitive and quicker acting and partly for reasons of economy so that any momentary diminutions of load will result in a saving of the relatively expensive coal. It is usually found a favorable condition for the gates of water turbines to be set to use a definite quantity of water and thus deliver a fixed amount of power.

### Induction Generators

It sometimes happens that a small water-power is available supplementary to a general system, which power, would not, however, warrant continuously maintaining an operating force. In such cases an induction generator (that is, an induction motor driven as a generator) may often be used to advantage. The characteristic of this machine is that when its field is excited by being connected to an electric circuit it will deliver to the line in the form of current whatever power may be supplied to it. It need not be synchronized and cannot fall out of step. If the voltage on the circuit drops, as in the case of a short-circuit, the induction generator will give greatly reduced power to the circuit which is favorable for overcoming the short-circuit.

On account of this quality of dropping its output on a fall of voltage and on account of the lagging magnetizing current taken from the line, these induction generators have been proposed for use in very large, extra high-voltage power systems in which the control of short circuits is difficult and in which there is an excess of line charging current. Up to the present time there are very few, if any systems, in which at full load there is an excess of charging energy, on account of the large lagging component of the usual industrial load. The characteristics tending most markedly to an excess of charging energy are high line voltage and long transmission.

In the case of the Big Creek Line of the Pacific Light & Power Company with its 150,000 volt, 250 mile transmission, the charging current of a single line is not sufficient to neutralize the lagging component of the load, but with two lines in operation and approximately the same load there would be an excess of leading current.

Reference has been made above to the wide variation of operating level utilized in some reservoirs to increase storage capacity. This plan would naturally waste the difference in head between the actual water level existing at any particular time and the low level when a canal is used, since the water for the canal must be taken from the low level.

It has been recently proposed, however, to save some of this head wasted when the storage reservoir is nearly full, by operating an additional turbine by the difference in level between the actual reservoir level and the canal level, through which turbine the water would pass on its way from the reservoir to the canal and using the power to drive an induction generator connected to the main power circuits. The only governor then required would be overspeed control on the water wheel.

### Transmission and Distribution

In any large power plant, the functions of transmission and distribution merge into each other, for the principal consumers will ordinarily be separated by many miles and furthermore, there will ordinarily be several sources of power located at dif-

ferent points. The transmission and distribution systems then resolve themselves into a network of high-tension lines to which are connected power users and power generators at convenient points.

These networks are ordinarily of slow growth, starting with a single line and distribution plant. In the U. S. A., Canada and Mexico, however, they have grown to great size and many are supplemented by numerous local distributing networks of lesser voltage. Typical systems are:

(1) Montana Power Company serves largely railroad and mining service.

Extent: 225 miles in east and west direction  
250 miles in north and south direction  
(the latter will soon be increased to 400 miles)

Voltages: 15,000; 50,000; 70,000 and 103,000 volts

Maximum Rating of Generators: 75,580 kw.

Maximum Rating of Substation 99,543 kw.

Maximum Load during 1914 61,000 kw.

Total Generated Energy 402,000,000 kw-hours

Total Delivered Energy 365,000,000 kw-hours

Annual Load Factor: 75%

Monthly Load Factor: 86%

Total Length High-Tension Lines: 1465 miles

(2) Southern Power Company. This company supplies most of North Carolina and especially the cotton mill district. It also supplies power to an electric railroad over 100 miles long.

Extent: 240 miles in a northeast and southwest direction  
65 miles in a southeast and northwest direction

Rated Generator Capacity: 124,000 kw

Rated High Voltage Transformer Capacity: 160,000 kw.

103 Substations containing transformers having  
a total rated capacity of 241,000.

High-Tension Voltages: 50,000 and 100,000

In the same part of the country as the Southern Power Company are six other power companies operating at 100,000 volts or thereabouts. These seven systems are all interconnected, giving a very extensive network including a continuous 100,000-volt line 1,000 miles long between Nashville, Tenn. and Henderson, N. C. The interconnection of these companies is for the purpose of mutual co-operation to exchange peak or emergency power. It is interesting to note the remarkably complete manner in which the water power of this region are made available throughout four States.

(3) Pacific Gas & Electric Company. Serves over one-half of the people of California including San Francisco, Oakland, Sacramento and all the central parts of the State.

Extent: nearly 38,000 square miles

Operates: in 30 out of 58 counties of the State and  
supplies energy to 177 cities and towns. Serves  
378,705 consumers.

Length: 100,444 volt line 109 miles

60,000 " " 1299 "

24,000 " " 91 "

17,000 " " 102 "

Total Transmission & Distribution Lines: 5090 miles

Rated Generator Capacity (hydraulic): 121,000 hp.

(steam): 109,000 hp.

Energy purchased from adjoining companies in 1914: 181,700,000 kw-hrs.

There are numerous other large networks. Examples are; Mexican Light, Heat & Power Company in the neighborhood of Mexico City, the systems in and around Montreal, Canada; those around Los Angeles, California, and Salt Lake City, Utah, all of which have interesting features.

As other interesting examples of the adaptability of electric power transmission it may be worth while to call attention to the large plant of the Lehigh Navigation Electric Company, which generates power from the famous culm (fine refuse coal at mines) piles of Eastern Pennsylvania and distributes it to cement mills and other consumers. Also the Chile Exploration Company, which generates electric energy from fuel oil on the

east coast of Chile and transmits it nearly a hundred miles to the huge copper reduction plant of the company at Chuquicamata at an elevation of nearly 10,000 ft.

The first consideration in these high-tension networks is that of voltage. When the distances are large, high voltage is necessary to produce an economical transmission or to secure a good regulation. This makes it desirable in developing even a relatively small plant to adopt a voltage high enough to suit the possible future extension of the plant. On the other hand, too high a line voltage requires very expensive apparatus for delivering power to local users.

Where the power is supplied largely at one end of a network with power users at the other, the transmission losses are very important, but there are systems in which there are power houses pretty well located over the system with a somewhat similar distribution to that of the power users. In such a system the only transmission of power for any considerable distance is the residue or balancing power, flowing to even up the load to the various supply stations. In such a system the transmission losses and the line voltage drop are of less importance, therefore, a lower line voltage is appropriate.

But the relation of line voltage to operation is a particularly important one in large systems, for the problem of cutting off the power in case of a break or short-circuit becomes in general more difficult with high voltage since the superior regu-

lating quality of the high voltage line causes a much larger flow of energy at the break than would otherwise occur and again a serious breakdown in the high voltage system will cause a much greater, wider spread disturbance to other parts of the system than would be the case with a lower line voltage. Some of the above networks (e.g., Pacific Gas and Electric Company) are built up in considerable measure of older plants operating at 60,000 volts (a common standard voltage) and have this great operating advantage, that a breakdown at one point produces a relatively small disturbance at distant points on account of the great drop produced by short circuit currents in the long relatively low voltage lines. It is very doubtful, however, whether it would be a wise plan to designedly use a relatively low voltage for the purpose of localizing of disturbances. This result may better be accomplished by artificially introduced current limiting devices strategically located and controlled by automatic apparatus. The practice in overhead lines has not yet developed to such a point, however, except in isolated instances (e.g., New York, New Haven & Hartford Railroad Company which uses a reactance, short-circuited by a circuit breaker between the generators and line). This practice of using artificial reactance inserted in the system is, however, common in power stations where large generators are to be paralleled on the same busbars and underground feeders are used.

*(To be concluded)*

## News Notes

### Automatic Telephone Exchange to Norway

An American firm has just been awarded the largest European contract for telephone apparatus and material ever let outside of Europe. It involves a 35,000-subscriber automatic exchange for Christiania, Norway, costing about \$1,250,000.

### Electric Vehicles in Jamaica

Jamaica, with its fine roads and abundant water power, is turning to electric automobiles. Gasoline sells there at about 48 cents a gallon. If proper attention is paid to the fact that the island is mountainous and grades are steep, and that cars should be powered accordingly, a good export business in electric vehicles can be built up.

### Magnetism and Heat

At a lecture given in Paris not long ago, in order to show the way iron loses its magnetism at a certain temperature an aluminum tube with a sheet iron plate on the end was hung pendulum-wise beside an iron magnet. In front of the magnet was a bunsen burner with the flame arranged so that when the magnet attached the iron plate on the pendulum and pulled it over on one side, the plate was in the flame.

As soon as the iron was red-hot it would lose its magnetism and swing out of the flame. On cooling down again it would become magnetic and swing over into the flame only to be demagnetized again. This action would keep up as long as the flame was maintained.

### Correct Wind and Sleet Conditions on Transmission Lines

The allowance for wind and sleet conditions on transmission lines has been recently investigated by engineers who have operated lines in the severest climates. About the worst conditions to be guarded against according to the latest indications are  $\frac{3}{8}$  of an inch of sleet on a wire combined with a wind pressure of 11 lbs. per square foot of effective area. This calls for a factor of two.

### Sealing Fuses

A system of sealing electric fuse plugs to prevent tampering with current by unauthorized persons, has been placed on the market. The fuse is of porcelain with a slotted head and a wire runs through the slots from one side to the other. When the ends of the fuse wire are sealed with a bit of lead, any effort to substitute another fuse will be readily detected by the inspector.

### Engineers for Preparedness

The following is a copy of a resolution unanimously adopted by the 3,000 engineers representative of the National engineering organizations, who have been attending the course of lectures on military engineering in New York during the past three months:

The engineers assembled in public meeting on March 20, 1916, under the auspices of the Engineers Committee on Military Lectures, believe that it is unworthy a great nation like the United States and that it is dangerous to the peace, safety and liberty of its people, to remain in our present position of inadequate military, naval and industrial preparedness.

We believe that between pacifism and militarism there is a just, safe and proper ground, greatly in advance of our present position—a ground which involves large additions to both the navy and army, a large increase in our schools for training officers and a co-ordination and mobilization of the physical and industrial resources of the nation.

We believe that this nation should never make war except to enforce peace; that when strongly supported by armed resources its influence in maintaining its own liberties and rights, and the liberties and rights of the weak and oppressed throughout the Americas, will be greatly strengthened.

We believe that Congress should give due weight to the opinion of experts and should then appropriate sufficient money to put the nation in a position of defense against attack on either the Atlantic or the Pacific Coast.

We demand that our representatives in Congress act in accordance with this expression.

# All Around The World

## Electrical Flashes From Beyond Our Horizon

### "Cold Light" Projectors

One of the so-called scientific writers for a Parisian daily paper is out with an impressive announcement of the use of "cold light" for projectors used for spying Zeppelins at night. Evidently the war has not as yet exterminated all the genius of France.

### Marking Up Prices in Switzerland

Though not, as yet, a combatant in the European war, Switzerland, like all the other neutrals, has been powerfully affected in every way.

The increasing cost of all raw material and the scarcity of labor, due to the presence of so many men in the army, which is kept on practically a war footing, has forced the Swiss electrical manufacturers to increase their prices on nearly all their output in practically the same proportion as the recent rise in Germany.

### Germany Abandons Plan for Electrical Monopoly

According to the latest advices from Germany the Imperial Government has decided to abandon the plan which had been made for converting electric service in the Empire into a government monopoly.

It is stated that the plan was given up partly because the Saxon Kingdom is about to establish a royal monopoly of this sort and partly because Bavaria is about to build a very large central station without the monopoly feature.

### Indian Demand for Electrical Material

For a few years preceding the outbreak of the war the Indian markets were flooded with cheap German wiring material and devices such as wire, switches, porcelain parts, fuses, lamps, heaters, etc.

The stock left on hand is now all wiped out and there is a strong demand for this class of merchandise, which certainly ought to appeal to American manufacturers, as, in this case, all correspondence can be in English, thus removing the language difficulty which seems so great to many of them.

### Zinc Conductors

Although the Germans are said to have found great quantities of copper in Turkey and Servia, they are nevertheless trying to substitute zinc and iron for copper conductors in many places. The committee on conductors in the Electro-technical Union has published information on the electrical and physical properties of both zinc and iron and has indicated places where they can be successfully substituted for copper. As the relative conductivities of aluminum, zinc and iron, referred to copper as 100, are 58.4, 28.5 and 12.5 respectively, it follows that the practical usefulness of the last two metals as substitutes of copper for electrical purposes is necessarily rather limited.

### Price Increase on German Electric Machinery

The larger manufacturers of electrical machinery and apparatus in Germany have made another increase of 10 per cent. in their prices. The cause, as given, is the advance in the cost of raw material. The increase applies to practically all the output of the big electrical companies and makes a total increase in price of 40 per cent. since the war opened. Further increases are reserved in the case of articles for purely peace purposes.

### German Electric Kitchen

The largest electric kitchen in the world is in use at Siemensstadt near Berlin. It serves 3,000 people in four groups of one half hour each between the hours of 12 noon and 2 P. M. It is supplied by 6600-volt, 3-phase current reduced to 220-volt, 3-wire, and it is said that the daily consumption of power for each person served is only about half a kilowatt-hour. This is considered as averaging about half a cent per capita per day, making one of the cheapest as well as the most efficient and sanitary cooking outfits in the world.

### Electrical Power From Peat

A peat-burning, high-tension electric generating plant has been in successful operation for many years in Northern Germany. It consists of three 6000-volt, three-phase steam tender-generator of 1250 kw. capacity each. The peat is cut out of its bed by electric power and hauled to the plant in the same manner. The consumption is about 75 tons of briquetted peat a day. The output is used to supply light and power to half a dozen cities, transmission being at 20,000 volts.

### Russian Demand for Electric Goods

According to reports from commercial representatives returning from Russia, the opportunities now existing for the sale of electrical goods are practically unlimited. The stocks are depleted and people are looking to Americans to supply the market. American consuls and consular agents are overwhelmed with inquiries as to where electrical goods can be purchased.

Among the articles most in demand are copper and iron wire, telegraph and telephone apparatus, small motors, X-ray apparatus, batteries, and in fact all manner of electrical supplies. It is said that nearly all of the 150,000 German merchants and manufacturers, formerly residents in Russia, who supplied most of the trade, are interned in Siberia for the duration of the war. Particularly, are the Russians anxious for manufacturing plants to be established in their country, and they are offering to put up three-fifths of the necessary capital if Americans will supply the other two-fifths and the necessary knowledge.

The demand is such that exporters can get practically their own prices, and absolutely satisfactory banking reference will be put up with each order.

### Electricity in China

China shows a vigorous and increasing demand for electricity in all its branches. The Shanghai Municipal Electricity Works supplied over 30,000,000 units during 1914 as compared with 21,000,000 units in the previous year; 1,500 radiators have been installed in Chinese houses, and small motors are very popular. The installation of electric lighting and power in the numerous large cities in central and southern China is under full way now, and the British firms that have realized the possibilities of the market, and those who have been sufficiently enterprising to meet the local conditions are being amply repaid for their trouble, while their work has given the greatest possible satisfaction to the Chinese companies on whose behalf the contracts have been undertaken. British installations have recently been completed for the great cities of Soochow, Changchow and Yangchow, in the province of Kiangsu, and for Ningpo in the province of Chekiang, while a very large number of smaller plants and dynamos have been supplied for lighting small towns, missions and factories. The business formerly was largely in the names of German firms, mainly because they were willing to take entire contracts and to finance them.

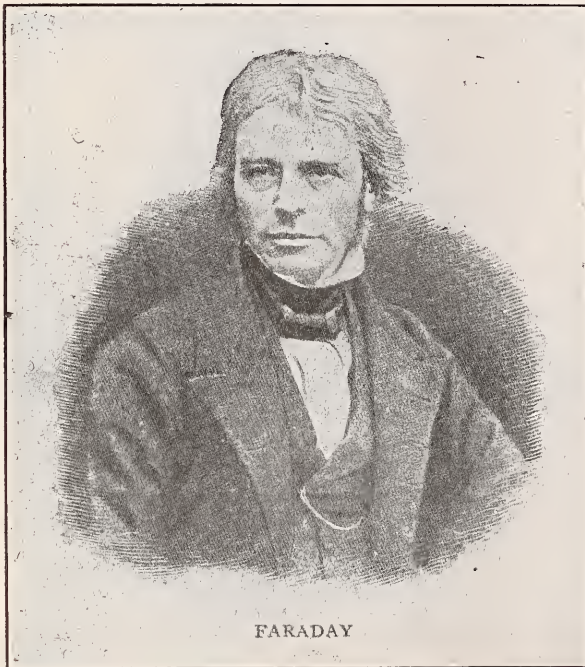
# Electrical Fathers

Michael Faraday

The man whose work, more than that of any other single man, has contributed to the modern growth of electrical science is the Englishman, Michael Faraday, who many have called "the world's greatest experimental scientist."

Newington, then on the outskirts of London, was the scene of Faraday's birth, September 22nd, 1791. Like many another great man he came from a very humble family, his father being a journeyman blacksmith, whose poor health and impaired earning power kept his family in constant want. Nevertheless his parents were excellent people, and the lad was carefully taught not only reading and arithmetic, but the more important matters of loyalty and high principles in conduct.

At the age of thirteen years Faraday was apprenticed to a bookbinder who was interested in the family. Here he had access to many books, and with his fine mind and untiring industry proceeded to educate himself by solid reading. He soon took to reading the scientific works of the times and the bent of his genius is shown by the fact that he once began to attempt to verify by his own experiments the statements that he had read. He got such chemicals as he could afford and made an electrical machine that would work, using a glass bottle as the cylinder for it.



FARADAY

It was in the year 1813, when Faraday was twenty-two, that the opportunity to take up his life work came. A customer at the book shop had taken him to hear four lectures by Sir Humphrey Davy, then at the height of his fame. Encouraged by this friend, Faraday wrote full notes of these lectures, re-wrote them in his best style and sent them to Sir Humphrey. This led to an acquaintance which resulted in Faraday's appointment to be an assistant in the Royal Institution of which Davy was then director. The salary was 25 shillings, or about \$6.25 a week, but the opportunity for a man like Faraday was just what was wanted. The connection with the Institute lasted all his life.

In the latter part of the same year Faraday started on a tour of France, Italy and Switzerland with his benefactor, which lasted for eighteen months. On it he met both Ampere and Volta.

Coming home he settled down to work on chemical matter and soon created a reputation for himself. Before long he was known as one of the skillful analysts of the institute

and in one year he earned over \$2,500 in fees outside of his still modest salary. When he found that this work was interfering with his scientific investigations he refused any more of it, and devoting himself to experiments lived happily on his limited income.

In 1820, as noted in a former article in this series, Oersted's discovery of the relation between electricity and magnetism, as illustrated by the effect of a current-carrying conductor on a magnetic needle, made a tremendous sensation in scientific circles. Faraday, with many others, held that the turning of the needle indicated that there was something revolving around a current-carrying conductor, which dragged the needle into its position. He worked vigorously along the idea and a year later succeeded in producing the first continuous rotation of a wire around a magnet, and then that of a magnet around a wire.

It is said that when he saw electric wires for the first time revolving between the poles of a magnet, he rubbed his hands as he danced about the table with great glee, exclaiming: "There they go! There they go! We have succeeded at last."

But the crowning work of Faraday was the discovery of electro-magnetic induction, which later not only developed into the power-driven dynamo, thus cheapening the cost of electricity to a point where it could become an economic factor, but also lies at the base of all the enormous transformation and transmission development that has spread electrical energy practically all over the civilized world.

Seven years, from 1824 to 1831, he toiled indefatigably in trying to produce an electric current by means of a moving magnetic field.

Suddenly, within a few weeks, in the fall of 1831, he not only succeeded, but accurately deduced and stated the laws governing induction so completely, that to this day no one has ever found any serious error in his work.

The apparatus used by Faraday in this epoch-making experiment consisted of an iron ring wound with two coils of bare wire—one 72 ft. long, the other about 60, the turns being separated by twine and the layers by calico. The longer coil was connected to a battery and a loop of the shorter one passed over a compass needle. Making and breaking the battery, or primary circuit, caused the needle to kick. This was essentially the first transformer.

Less than two months later he made the first dynamo by revolving a disc between the poles of a magnet. With one end of a wire held against the edge of the disc and the other against its shaft, a continuous current flowed in the wire.

It has been truly said that his rapid working out of the law of induced currents and his ingenious theory to explain the facts of induction were scarcely less important than the discovery of the fact itself.

These great achievements were fully appreciated by the scientific men of the day and honors from foreign countries, as well as from his own Royal Institution, came thick upon him. He was, before this time, happily married, and in 1833 was appointed a full professor of chemistry at the Institute for life without the obligation to deliver lectures.

His long period of strenuous work broke down his mind to a certain extent at last. Memory failed and the final five years of his life were spent waiting cheerfully and uncomplainingly for what he called "the great change."

He passed away painlessly, August 25, 1867, and left behind him not only a great name in science, but the event better memory of having (in the words of one of his friends) "passed his entire life in a sustained effort to do good."

In the Congress, in 1881, that named the electric units, it was but natural that Faraday's work in determining the specific inductive electrostatic capacity of many of the more common dielectrics should be remembered by naming the unit of electrostatic capacity the "farad" in his honor.

# EDITORIAL

## Economy in Concrete Pole Construction

There are times in the sequence of all affairs when a few years or even months make greater changes in men's thoughts and resultant methods than otherwise occur in centuries.

Do many of us realize that right now, speaking in an engineering sense, we are living through one of those times? The rising cost of metals and commodities due to their enormous absorption in the war are forcing new considerations and new economies in nearly every industry.

With steel more than double in price and zinc increased fourfold, the cost of all galvanized structures has reached a point hitherto unknown and all metal construction in fact, is on a new basis.

There is no doubt that many construction plans to-day are contemplating the use of concrete, reinforced and unreinforced, where a year ago it would hardly have been given a hearing in competition with metal.

This is specially true of the various forms of poles used in electrical construction. Leaving aside the tax on all electrical business involved in the heavy depreciation charges on the millions invested in wood poles, there is a combined maintenance and depreciation charge on nearly all outdoor metal structures that is almost as great proportionally.

Replacements, therefore, as well as new constructions, are very likely to have concrete considered more carefully than has been the custom in the past.

So far as poles are concerned, in an article in this issue we are attempting to give an idea of what has been done here in this line. In this as in many other practical details we are considerably behind current practice in Europe.

Round, tapering, hollow reinforced poles, at the outbreak of the war, were obtainable there at a price that was rapidly putting steel out of the running. Of course, the situation was materially helped by the greater cheapness of labor; and labor costs are a very important factor in making and erecting concrete poles.

When reinforcing steel is rightly embedded in a concrete of suitable density its preservation is perfect and its durability may be said to be indefinite. Where the same attention to the proportions of parts and economy of construction is given as in using other materials, reinforced concrete poles can not only be built to compete with steel of equal strength in economy, but can also be constructed to compete with wood, if the strength of the wood after eight or ten years of weathering is taken into account. From fence post up to pole sizes of the largest and heaviest types now in use, the cost and quality of carefully designed and proportioned concrete poles will more and more tend to displace the perishable wood and steel types, still too much in use.

## School Training For Electrical Workers

The increasing demands for higher quality of work and workmen in electrical contracting is being shown in the rising requirements of the various state and municipal bodies that have put electrical licenses in force within the last few years.

At first regarded none too favorably by the greater number of electrical contractors, a brief experience with their working has caused a change of heart. Many men who were strongly opposed to such licenses are now strongly in favor of them.

The inevitable result of the operation of these licensing rules is to stimulate the demand for high class electrical workers. Those who should be most interested in meeting this demand will do well to lend their hearty support to the prevocational schools in various cities.

Elsewhere in this issue we give an account of the work as it is being carried on at Louisville, where it bids fair to fill the need of trained workers.

Supporting this kind of teaching is more a matter of cents than sentiment for the uninterested or untrained worker is a costly element in the industry afflicted with his inactivities.

With the chance for selection thus placed before boys in the public schools there is bound to be an intelligent selection of vocations which will greatly improve the better class of man before ever he comes to the notice of the contractor. The youngster in the prevocational school has seen what he wants and gone after it at the expense of someone else than the contractor. In this way the waste factor in contractor labor will in time be materially reduced.

A consideration of the value of the difference between efficient and inefficient workmen, in a line where the cost of labor is as important a proportion of the total cost of the work as it is in electrical wiring, will show the importance of this factor.

The net cost of finding out and getting rid of a careless, unskillful or indifferent wireman often amounts to many times his wages, which are not infrequently paid out for hindering rather than helping the contract.

In an occupation where conscientiousness and reliability are so important, where skill and swiftness in the work are so profitable and where the personal relations between employer and employe should be so close, as is the case with electrical wiring, the increase in the number of trained men who have not made their choice of employment under the exigencies of the moment's need but rather have started out from a deliberate choice to make skilled employees out of themselves in a certain industry, cannot but fail to be a matter of vital interest to all electrical contractors.

The success of this method has long since been proven in other countries.

### An Export Detail

There is no question of the hour more vital to the continued prosperity of these United States than that of getting and holding our share of the world's international trade.

The consular reports, the narratives of special agents, intelligent travelers, commissions from foreign countries, all who have given any attention to the matter, unite in telling us that the chance of centuries is now before us. They give ample evidence that the demand for American finished products exists in practically all countries in an intensity not even yet fully grasped by the business world. Never in history has there been such a hungry, wide-spread desire among so many nations for the products of one nation.

It has long been the fatal stumbling block of the American manufacturers, that too little attention has been paid to certain details, trifling in a way, and yet of vital importance in getting the foreign business in the first place and of retaining it when it is once gotten. We have all heard the stories of foreign catalogs and correspondence sent out in the wrong language. We know of the classic cases of land packing for ocean shipment and marine packing for land shipment; of utterly useless package weights for animal transport, of costly ignorance of foreign customs regulations and credit requirements, and a whole long list of other failings all springing from a lack of careful study and attention to detail.

Perhaps the chiefest sin of all these has been in the failure of any considerable body of our manufacturers to realize that out of the forty-five leading nations of the world, at least twenty-five have the metric system obligatory. This means that practically all the measurement of raw materials, goods, machinery and all classes of manufactured products in these countries are made on this system. The five hundred millions of these countries talk and think of all measurements in terms of the meter and the kilogram. Machine-shop tools and all scales and measuring devices are adjusted to its dimensions. The unwillingness or inability of America to supply machinery to fit the requirements of this well-nigh universal system has been a real handicap to the country's export trade. Repair parts of electrical and other machines, wires for winding, instruments, any number of different classes of articles with an inch and pound division will not fit on machines made on metric dimensions.

Many instances have been cited where the losses due to the time and effort required to make the changes necessary for the adjusting of the connecting element in such cases, have amounted to many times the cost of the parts themselves.

A 400 horsepower synchronous motor of German make was burned out in a South American mine. In coming to re-wind the armature only American wire was available and the slots proved to be of such a size that the required number of conductors of the nearest required size could not be forced into the slot and proper insulation maintained. The enforced use of smaller wire resulted in unsatisfactory performance. This difficulty was never wholly remedied until wire drawn to a metrical gauge was secured.

A Belgian locomotive broke down in China. The

railroad company's machine shop had American machinery, and there was a lot of time and money lost before repair parts were made to fit.

The flange on the receiving end of a Swiss turbine refused to mate up with American pipe and a reducer had to be made in the field to connect them.

The list of troubles of this kind might be extended indefinitely. It is time and past time that this state of things should end. Forty years ago Congress made the weights and measures of the metric system legal in this country. In these forty years many earnest efforts have been made to spread its use. They have been fought at every turn and, speaking comparatively, practically no progress has been made. Although a large number of manufacturers who have long been interested in the export field use the system, in some cases in both foreign and domestic work, the great mass of those who are looking hopefully toward the new conditions obtaining abroad are entirely unprepared to turn out articles for the Russian, Chinese and Latin-American trade in the system of measures in use in those countries.

Although Great Britain has been as slow as ourselves in adopting the metric measure for domestic use, the exporters there long ago learned their lesson, and it is firmly established in the British export trade. Exporters here, who know the conditions, have for years been trying to get the American manufacturers to turn down the unscientific measurements that handicap this country and use the scientific system, not merely for its value in exporting, but for its own convenience and time saving. As the domestic trade has hitherto so largely overbalanced its foreign interests, these efforts have not succeeded as they should.

#### FOR A PRACTICAL ORGANIZED EFFORT

Is not now a good time to look into this matter and by a concerted effort make a move for the gradual substitution of centimeter for inch and kilogram for pounds? Cannot this country do what has been done so long ago in France, Germany, Italy and nearly everywhere else in the world? We do not see that there will ever come a more opportune time.

This change has undoubtedly got to be made if the country is to get its full share of the world's business, and it will come as soon as all scales and measures are made in duplicate so that either system be used. Thus all "yard sticks" will be made a meter long and marked in inches on one side and centimeters on the other. Volume measures should have liter capacity with the quart mark inside. All scale beams and weights will, similarly, be double reading.

When this practice is once universally established the metric system will easily glide into common use on the merits of its superior convenience and mental economy.

Why cannot all the big societies and manufacturing and trade associations of the United States get the help of federal, state and city governments, and with the co-operation of the great mass of intelligent people in the country, put the metric system in the way of common acceptance and thus materially benefit the domestic business of the country as well as its conquering progress in the world's markets!

# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## Testing Relays With Cycle Recorder

By H. A. Cozzens, Jr.

This is the day of the central station. The recent developments in large size units, motor driven auxiliaries and the general tendency towards more efficient operation preclude serious competition from the small isolated plant in localities where large central stations operate. As a result of these improvements the business of the central station has been on the increase. Another tendency has been the acquiring of many small stations by a combine or corporation with the consequent abandonment of the small units. This tendency has given rise to what is termed system operation or load dispatching. With small stations, each one was operated more or less independently, but now the load is distributed by system operators so as to gain the highest efficiency of generation and transmission.

System operation has presented many problems and probably one of the chief factors in solving the problems has been the introduction of the relay to wide usage. The primary use of the relay has been to cut out cable so as to protect the apparatus. The recent growth of the central station industry has added an additional factor to operation than mere protection, and this is continuity of service. The average power user dreads a shut down and the power solicitor finds it a difficult task to dispose of central station power in districts where these interruptions are frequent. To reduce these to a minimum in the larger systems the practice is now to appoint a body to plan

generator feeds directly to the bus, from which the current flows to a tie or selector-bus, to which about five feeders are tied. The most likely location of the trouble would be in the feeders and as a consequence the relays of these feeders are set to trip at 200 per cent. overload in three-quarters of a second. Then the tie bus relay would trip at 250 per cent. overload in one and one-quarter seconds. These figures are arbitrary and are determined by local conditions. In this manner any trouble is instantly localized and the danger of spreading is reduced. This idea is carried out for operation all over the system particularly between a chain of substations and two generating stations. The primary object is to keep current at all substations in case of trouble and to locate and segregate the trouble as rapidly as possible.

It is readily apparent what a significant part of the relay plays in operation and it is the purpose of the following matter to present the scheme for testing and setting relays. It is assumed that the average reader is acquainted with the various types and uses of relays.

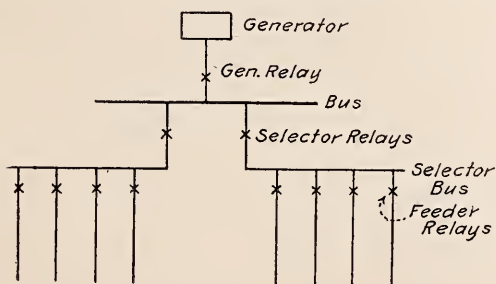


Fig. 1.—Relay Installation Diagram

the uses and settings of relays as well as other problems affecting disturbances so as to segregate the trouble to a few feeders. Not so long ago, a serious arc or surge would trip out cable after cable sometimes covering a wide area. With everything dead it took time to restore conditions to the normal and this interruption cost a sum of money to the large power user.

The method of eliminating this trouble is shown in Figure 1, an illustration of a simple feeder layout with relays. The

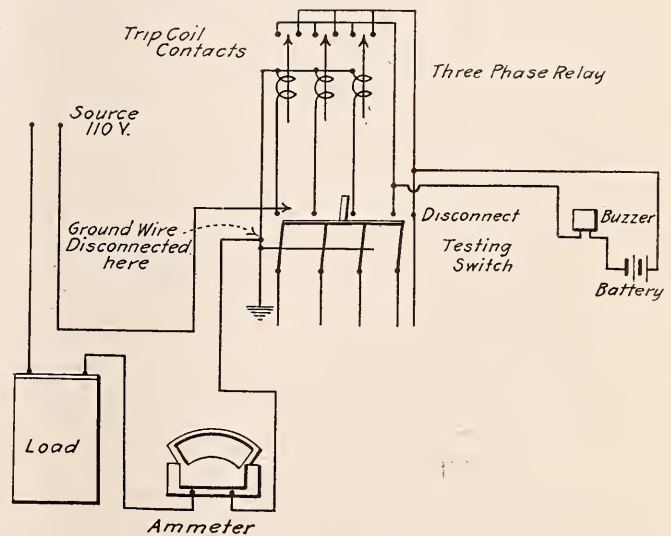


Fig. 2.—Relay Test With Stop Watch

The first testing of relays was done chiefly by the operator and his helper, and at times when the load was light and they could be spared. The manner of testing is shown in Fig. 2. The load which usually consisted of a lamp bank was mounted in a box set upon four casters to facilitate moving about the switchboard. The ammeter and the switches were placed on the

top so as to be accessible. The operator would secure the proper load on the ammeter and then would attach the test leads to the relay, one phase at a time as shown. The helper would stand in front of the relay with a stop watch which he would start when the operator closed the switch putting the load on the relay. When the plunger struck the contacts he would stop the watch and record the time, resetting the relay if necessary. This method involved a high personal element in securing the time which could not always be depended upon. In the second place it took both men from in front of the switch board which resulted in confusion in case of the unexpected happening. The test switch used in this scheme presented a few disadvantages. It is of the ordinary type to short circuit the instrument transformers but when used in relay testing, the ground wire from the coils had to be disconnected from the switch unless the circuit used to provide the testing current was grounded.

The next move was to attach a buzzer and battery to the trip circuit, as shown in the right of the sketch, eliminating one man, as the operator could start the watch upon closing the switch and stop it upon hearing the buzzer. This was an improvement but it still permitted the inaccuracy in recording the time.

Recently a comparatively new instrument has been introduced for the calibration of relays called a cyclic recorder. This device records the number of cycles intervening between the instant the load is applied to the relay and the closing of the contacts. The advantage gained in using such an instrument in relay testing is obvious, in that it makes the recording feature automatic and free from personal error. In calibrating relays with the cyclic recorder it has become the practice to refer to the setting in cycles as opposed to seconds. As for instance

fits into the lid of the case while the load box, recorder and ammeter are retained in pockets in the body of the case. Three pairs of leads are used, one to the source, another to the relay coil while another it attached to the contacts. These leads are equipped with test clips, making them easy to snap on to the jaws of the test switch. Provision is made for keeping them in the suitcase when not in use.

Referring to the illustration, switch No. 1 controls the current from the source while switch No. 2 controls the recorder. To test the relay, the operator first opens No. 2 and then closes No. 1, after joining the two clips which go to the coil together and then adjusts the load. This is done rather than to adjust the load with the relay in circuit as overloads easily overheat the relay. The No. 1 switch is then opened and the leads fastened on to the test switch jaws and closing No. 2 switch prepares the recorder, the dial of which has been set to zero, for service. To make the actual test the operator has but to close No. 1 switch which puts the overload on the relay and starts the recorder which operates until the contacts close after which it ceases to record, then the operator opens No. 1 switch and records the reading on the cycle recorder adjusting the relay if necessary.

The use of No. 2 switch is merely to keep the recorder out of service while load adjustments are made since the instrument is more or less delicate.

The relay in the illustration is of the single phase type and has a separate switch so that no leads have to be disconnected to make the test.

The salient advantages in using the cyclic recorder in the calibration of relays are rapidity testing, accurately and freedom from personal error.

\* \* \*

### The Operation of Resistance-Reactance Single-Phase Motors on Machine Tools

The resistance-reactance single-phase motors are similar in construction to the poly-phase motor. They are somewhat larger than a poly-phase motor of same output on account of the necessity of a centrifugal clutch, to secure good starting torque. The rotor is of the high-resistance squirrel-cage type for the same reason. The stator is usually connected three phase delta. In starting the rotor revolves free of the shaft until about three-fourths full speed when the clutch automatically locks the rotor to the shaft and takes up the load. The necessary phase displacement is caused by an external resistance-reactance type starting box in the larger sizes but in the small sizes the control mechanism is self-contained and the motor is connected directly across the line. These motors are built in 0.10 to 15 horsepower.

Motors of this class are satisfactory only when a moderate starting torque is required, and must not be used even under these conditions if there is liable to be violent fluctuations in load or voltage after starting. The reason for this is that the action of the clutch is not a positive one and that as the speed drops the centrifugal force becoming less decreases the friction between the clutch surfaces, allowing the rotor to drop or let the shaft slip.

There was a case recently in which the motor would fall out when an attempt was made to use it as a drive for a tool grinding milling cutters. As the motor was quite old the machinist bought a similar one a trifle larger. The result was the same. On investigation it was found that the grinder pulled the speed down until the clutch fell out. The machinist complained that in another shop he had the same rig working with a smaller motor and it gave satisfactory results. Investigation proved that the other rig was equipped with a different type of motor. The rotor of the machine was then fastened permanently to the shaft after which the motor would take its load after attaining speed. The characteristics were ill-suited for the work, however.

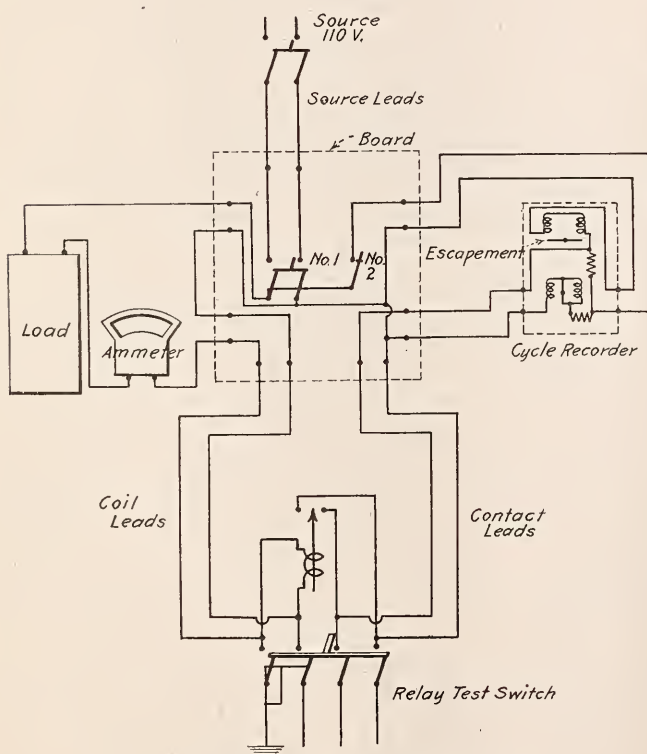


Fig. 3.—Testing Relay With Cycle Recorder

with a frequency of sixty cycles, a setting of seventy-five cycles would mean one minute and a quarter.

The use of this instrument is shown in Figure 3. The apparatus shown in the illustration can be mounted in a suitcase, making it readily movable from station to station and easily put in service. The board upon which is mounted the binding posts



It is advisable to consult the motor manufacturer regarding the motor best suited to the particular load, or see someone who you feel sure knows.

The resistance-reactor single-phase motor with a high resistance rotor have a very small torque and overload capacity. For this reason they are not suited to grinding operations or where the load fluctuates violently.

The chief field for this motor is in constant load work as, for instance, blowers, fans, pumps, and compressors.



## Bearing Currents

BY KENNEDY G. ROCKWORTH

Those working round large electrical machines are often surprised to find that they receive a slight electric shock from the shaft of one machine but fail to do so from another apparently similar and incidental machine, and working under exactly the same conditions.

It has long been known that under certain conditions a voltage may be induced in the shafts of electrical machines, although these voltages are quite small. In fact, it is their smallness that is the reason that these voltages not having been investigated to a larger extent than they have. The induced voltages rarely exceed a few volts, but the currents are often quite heavy because the large cross section offered by the bearings, pedestals and bedplates of the machine introduce a very low resistance path for the flow of current. Usually the currents that flow are not of sufficient amount to warrant any special methods of preventing the flow, although occasionally they do cause trouble, in which case preventative means must be resorted to.

The currents that flow through the shaft, bearings, etc., of machines are not understood, nor does their extent permit of ready calculation because there are so many unknown factors and ones that are variable entering into the problem. These currents may be found in both direct-current and alternating-current machinery. In the direct-current machines an electromotive force is induced only while the machine is rotating, that is while a field of flux is being cut; but, on the other hand, in alternating-current machines a voltage may be induced whether the machine be rotating or whether it be stationary, since the field of flux may be stationary but alternating. In actual tests it is often found that the current flowing with the alternating-current machine stationary is greater than that existing when the machine revolves, for the reason that at standstill the resistance offered to the current flow is a minimum whereas while rotating the film of oil in the bearings increases the resistance very materially.

On finding that currents are flowing through a machine it is natural that one wonders why it is, and if reference books are consulted nothing is found about this subject. The reason that there are very few authoritative statements covering this matter is because the knowledge on the matter is very meagre, and somewhat uncertain.

One thing is certain, however, and that is that the flow of currents along and through the shafts of dynamo-electric machines results from the dissymmetry of the magnetic circuit in the machine. It is for this reason that one machine will have heavy currents while another apparently similar machine has no currents flowing. The dissymmetry may in either the armature magnetic circuit or the field magnetic circuit or in both. The chief cause of dissymmetry are the mechanical joints, one or more of which enter into all machines almost. Other causes are great difference of permeability and length of flux path. It will be obvious that it is practically impossible to calculate the various values of permeability of the path of the flux, reluctance of the joints, resistance of the oil film, of the casting constituting the cross section for the current flow, etc., hence the values of current cannot be predetermined with any degree of accuracy, even if the electromotive force is obtainable from calculation

or actual test. The only way to determine the current circulating through the shaft is to measure it.

The larger the machines, physically and in capacity, the more likely are bearing currents to occur, because there will be a greater number of joints, etc., tending to make different reluctances, etc. Whater-wheel type generators are particularly prone to have currents flowing through their shafts; as are also large induction motors where the very small air gap of these latter machines will assist to augment the unsymmetrical magnetic circuit.

When the currents flowing through the shafts of dynamo-electric machines assume such proportions that they are of a serious nature two things may be done. One is to offer two paths for the flow of current; the other is to prevent current flow. The first of these is accomplished by short circuiting the shaft upon itself by connecting the ends of the shaft together through a cable of ample current carrying capacity. Sometimes this cable is insulated from the machine frame and at other times not according to individual opinion. The probability is that it is better to insulate this cable since by so doing there will be less tendency for current to flow through the frame, bearings, etc., although the frame is in shunt to the cable at all times in any case, and the current will divide through the two paths inversely as their respective resistances. The second method, which consists of interposing an insulating joint in the circuit and in this way preventing the flow of current, is the most usually done and will generally be found to be the more satisfactory way of eliminating the trouble. Once an insulating joint is placed in the circuit, if it be done in a proper way, it may be forgotten whereas the brushes required where a cable connects the two ends of the shaft together are always in need of attention at regular intervals, even though it be quite a small amount.

The energy loss due to the passage of current through the shafts, bearing and frames of dynamo-electric machines is one of those losses that must be put down as "stray loss," and is a comparatively small loss in any case. It is not because of this energy loss that it is desired to eliminate these currents, but because of the possible damage that they may do, if unchecked, to bearings by pitting, roughening, and burning until cutting and heating takes place. According to tests made it seems to be indicated that about one ampere per square inch of contact surface is the limiting value that may be allowed to exist without the likelihood of harmful effects occurring. Taking this figure as the limiting one it can be seen that even on large machines—which are really the only ones that give trouble in this respect—the current may be very heavy indeed before any appreciable damage to the bearings might be expected.

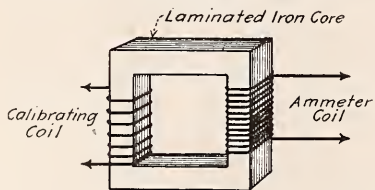
Having come to the conclusion that currents are actually flowing through a machine the next thing is to determine whether or not this conclusion is correct, and if so what proportions these currents assume. It has already been explained that it is impossible to calculate these currents from measuring the induced voltage in the shaft because of the unknown and varying reluctances, permeabilities and resistances. Some means must, therefore, be found to measure the current direct.

One way to do this is to connect a heavy copper cable of ample cross section to both ends of the machine shaft. This cable must have low resistance, otherwise the current flowing through the cable, since the two are in parallel. The cable is connected to each end of the shaft through flexible copper brushes (carbon brushes cannot be used because of their comparatively high resistance). An ammeter is connected in the cable. This ammeter should be one that is designed for use on alternating currents, of course, and should have ample capacity lest the current be sufficiently heavy to damage it. If no indication is obtained then a smaller capacity meter may be used later. In making this test it must be remembered that the cable and ammeter are in parallel at all times with the shaft, pedestals and frame hence the current indicated by the meter

may be half or less than the total current flowing. There is no way of telling just what the total current is without interposing an insulating joint somewhere in the machine circuit. If this is done usually it will be found best to do it under one of the pedestals.

One method of measuring the current, and a reasonably accurate one, consists of utilizing the shaft of the machine as one turn of a current transformer. Round the shaft is built up a ferric core upon which is wound a number of turns of small wire. In this circuit is connected an ammeter. The shaft constitutes the primary and the other turns the secondary of the current transformer. Before it is possible to use this transformer with any degree of accuracy it is necessary to calibrate it. This is done by winding a few turns on the core in place of the machine shaft. In this circuit connect an ammeter and then connect the winding through a rheostat to the alternating current supply of the same frequency as that of the machine it is desired to test. Vary the rheostat and therewith the current in the transformer primary at the same time recording on paper both primary and secondary currents. Do this over a sufficient range such as it is expected will occur on test. Correct for the ratio of turns (since the shaft constitutes one turn whereas in calibrating a number of turns are used) and plot the values of the secondary current against those of the primary. Having calibrated the current transformer in this way it now remains to build up this core round the shaft of the machine. When this has been done and all is in readiness start the machine and bring it up to normal frequency and normal voltage. Read the ammeter and record the current values as they are indicated on the meter. Convert these current values to actual amperes and the required determinations are obtained. This method while appearing somewhat tedious is really less costly to do than the previous method at the same time being reasonably accurate. It is usually more easily carried out, also, since flexible copper brushes, heavy cable, and the means for fastening the brushes to some form of rigid base are not always obtainable.

In closing it might be said that currents in the shafts of dynamo-electric machines do not often cause any serious trouble except in the very largest machines such as those of the water-wheel type. When trouble does develop before going into expensive tests it is well to make sure the oil is not the cause of the trouble, or a defective filtering system.



Sketch of Built-Up Current Transformer

The sketch shows a core built up for the test here described. The inner opening in the core must, of course, be large enough to permit the shaft of the machine to be tested being passed through it. If much of this kind of work is to be done it will be found most economical of time and money to build up the core in the same way that a split-ring current transformer is made, so that the core may be opened and slipped on the shaft and clamped closed, in this way saving the time and annoyance of having to build the core round the shaft.

### Current of Lightning Discharge

A portion of a tubular copper lightning rod that had been struck was recently inspected by experts connected with the Weather Bureau.

The tube, which was the terminal portion of the lightning rod, was completely crushed except at the tip. It was fused in places and the brazing solder at the joint had volatilized. It is thought that the tube was squeezed by the magnetic

field of the discharge while hot, and from the fusing and crushing effect it appears that the current must have been approximately 90,000 amperes.

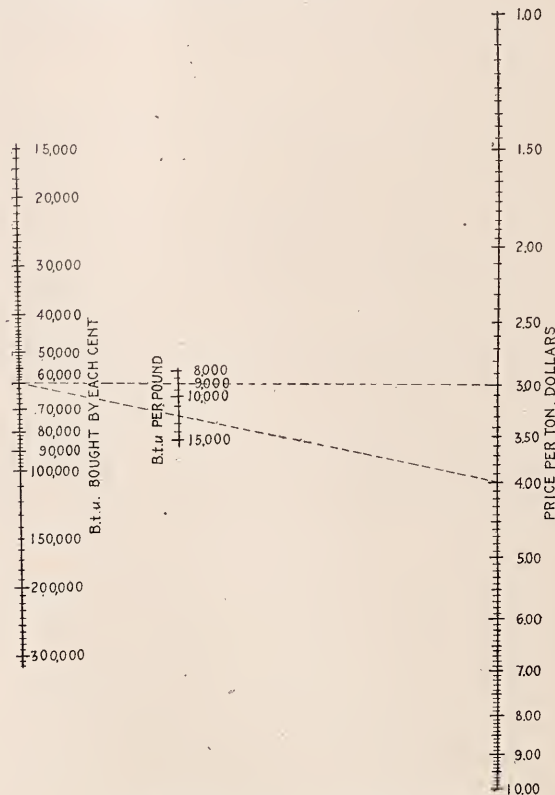


### A Chart That Shows Why Coal Should Be Bought on a Heat Unit Basis

This chart will be found useful by all purchasers of coal who buy on a large scale. It shows, with considerable accuracy, the reasons why coal can often be profitably bought on a B.t.u. basis.

All you have to do is: Lay a straight edge across the chart and you immediately know how many B.t.u.'s you are getting per cent, which is the important factor, always.

For example, if you pay \$3.00 per ton for coal which contains 9,000 B.t.u. per pound, the dotted line across the chart shows that you are getting 60,000 B.t.u. per cent.



Cost and Heat Unit Coal Buying Chart

Again, if you pay \$4.00 per ton for coal which contains 12,000 B.t.u. per pound, the lower dotted line shows that you are again getting 60,000 B.t.u., per cent.

The \$4.00 coal, therefore, is just as "cheap" as the \$3.00 coal as far as cost of B.t.u.'s is concerned. In fact, the \$4.00 coal is very likely the coal to buy in preference to any other because of the fact that it doubtless contains less ash and other troublesome elements. If the \$4.00 coal should contain 13,000 B.t.u. per pound there would be no question at all as to which to buy.

Keep your eye on the left hand column. The cost per ton is not as important as the cost of the B.t.u.'s.

It will be noted that the range of the chart is great—from \$1.00 to \$10.00 per ton, and from 8,000 to 16,000 B.t.u. per pound of coal.

W. F. S.



### Boosting Producer Gas Plant Efficiency

In a recent lecture before the Royal Institute of Great Britain it was stated by an authority that by a new process for large producer gas plants, which involves the reducing of the temperature of the exhaust gases from 600 deg. C. to 200 deg. C., by passing them through an exhaust steam boiler, the efficiency of such a plant could be increased 25 per cent.

## The Care and Installation of Electric Apparatus

This article should supply the need of the small central station and isolated plant for a handy list of data on troubles and their remedies. It is arranged in laboratory style, which will be found convenient for reference and also familiarizes the user with the standard for test reports. . . . .

By H. E. WEIGHTMAN

### PART I—MACHINERY

The following gives a list of machines, switchboard and storage battery troubles upon which complaints usually arise and the instructions given herewith have been compiled as a guide for installers and caretakers of small electrical equipment. Apparatus should always be installed in accordance with the following and all defective conditions as herein mentioned should be remedied at once.

#### Machine Defects—Mechanical—Vibration

All machines such as dynamos, charging motor generator sets, motors, and all auxiliary apparatus after being mounted, should be absolutely free from vibration and pounding.

This vibration and pounding is usually due to an incorrect alignment of machines, an imperfectly balanced armature or rotor, unsteady on their foundations, or poor end play.

Instructions for the correct alignment of belt driven and direct connected machines are given in many of the handbooks and are also described in the Issues of many of the trade papers. If the instructions given the maker are not enough to cover a case it is best to bring the question up to him as his men are always collecting data on the machines and know more than probably anyone outside the field of this apparatus would. They know its peculiar characteristics.

An imperfectly balanced armature or rotor, which is now very seldom found after a machine has left the factory, can be tested for high or low points by removing the armature from the frame and setting the same on level knife edge supports, then revolving and allowing it to assume its position of rest. If there are high or low points, the high point will assume the lower position. This trouble can, in low and medium speed apparatus, be remedied by leading the low portion of the armature. The lead should be distributed as much as possible. Where the speed of the armature is high as in some turbine units the factory is the only place that the trouble can be overcome. Fortunately, the high speed units are always given a more rigid balancing test. Unbalancing may in some remote cases give trouble at only some critical speed between a standstill and full speed. In that case the factory must be consulted as to the danger element and the trouble remedied by them if possible.

If trouble is due to an unsteady floor foundation, the floor construction may have to be reinforced by auxiliary beams. In no case should the matter be allowed to lag because the building is in danger as well as the electrical apparatus. In case of steel girder foundations they may be strengthened by filling with cement or by steel shims. The girder may be bent out of true and this will in some cases give an unsteady foundation, the remedy of which is obvious.

When trouble is due to improper leveling of sub-bases this may be remedied by the use of fiber, or sheet iron shims at the points where needed. Cement grouting should never be depended on entirely as a leveling means on foundations. Always use enough shims to take the load and fill in the balance with the grout.

Machines may be leveled by placing a straight edge on the shaft or in direct connected units, on the coupling halves.

#### Bearings

All bearings on all machines should be free from leaks and not overheat under normal or a guaranteed overload.

These leaks are due to overflows, loose end plates and cracked bearings, absence of oil rings, oil rings out of place or journal boxes being improperly located in housing.

Leaks due to loose end plates can be remedied by the use of shellac and red lead in making up the joint. When the bearing is only slightly cracked this can be remedied by filling in with lignite. If the crack extends around the casting and is too large to be filled satisfactory, a new bearing should be ordered.

Overheating of bearings is due to lack of lubrication, presence of dirt, grit or other matter in the bearings, rough journals, journals too tight for shaft, bearings out of line, and pressure of shaft collars against bearings or armature out of the true polar center, which is indicated by the variable air-gap.

If trouble is due to a lack of lubrication, supply a sufficient quantity of good clean oil and observe that it feeds properly. This oil should be a first class quality dynamo oil. Great care should be taken not to flood the bearings as this will force windings or may in time rot the leads causing troublesome grounds and even short circuits.

When dirt, grit or other matter has collected in bearings this can be removed by thoroughly flushing with kerosene—gasoline should never be used. What was said regarding flooding the bearings with oil applies with equal force to the use of kerosene.

Rough journals or bearings should be smoothed down and polished removing all cuts, scratches and burrs which may be found upon their surface.

When bearings are too tight loosen up the bolts in the cap, evenly and a little at a time, until the trouble disappears.

If the shaft is high or low, pack up or turn down the bearing base sufficiently to allow proper setting.

When trouble is due to end thrust, a careful examination of the foundation should be made to see that the same is level. The armature should move free with end motion, which can be obtained by having a level foundation with the armature in its magnetic center.

When an armature is out of center in the polar space, it may be that the bearing has become worn allowing the armature shaft to move out of center. This can be remedied by recentering the armature, that is, setting same so that there is equal distance between armature and pole pieces on all sides and at both ends of the armature and then adjusting the bearings for this new position. This can be accomplished by the same process as when bearings are out of line as previously stated.

#### Oil Gauges

All oil gauges which have been supplied on machines should be free from leaks. These leaks are in most cases due to poor fitting at the place where the gauge stud enters the bearing housing, due to loose fitting of drain plugs or cocks at the bottom of the oil gauge, or poor gaskets for the glass sights.

The leaks can be remedied by tightening up all loose parts and applying red lead at leaky points. When gaskets are in poor condition new ones is the only solution that is effective.

All defective oil gauges and oil gauge glasses on machines should be replaced by the maker by others in good condition.

All oil gauges on machines should be mounted on the same side of the unit, that is, not on the left side of the motor and the right side of the generator. The same applies to cases where there are several units, the gauges should be placed uniformly on one side.

All gauges on one type of machines should be of the same style and of uniform size.

#### Brushes

All brushes should be of the type approved by the maker of the machine for the service conditions encountered.

All copper plating on carbon brushes should be cut back so as not to come in contact with the commutator. All brushes should be free from cracks and charring.

Avoid all patented brushes that are offered as a "cure all," as there is no merit in them unless designed so as to fit your case. Again, let me say, consult the maker or an expert.

All brushes should fit their rings or commutators. For methods see any standard handbook or reliable trade paper.

### Brush Holders

All brush holders should be mounted firmly on their studs so that there can be no chance of side motion.

All Baylis and similar holders should be mounted so that the lower edge of the contact plate is within one-sixteenth of an inch from the contact surface of the commutator.

The tension on all contact fingers should be uniform.

### Commutator

The commutators of all machines should be kept clean and smooth. Being clean and smooth counts more than the color that is so often emphasized in popular journals.

See General Electric Review for May 1913 on commutators and similar articles in the index of the leading trade machines.

Noises on a machine may be due to:

- (a) Armature striking or rubbing on pole pieces,
- (b) Collars or shoulders on shafting striking against bearing,
- (c) Excessive globules of paint being put on surface of armature so that they strike the pole pieces,
- (d) Loose screws, bolts or connections,
- (e) Singing or hissing of brushes,
- (f) Chattering of brush holders,
- (g) On belt driven machines it may be the flapping, pounding or slipping of belts
- (h) Humming of armature teeth as the pass the poles due to flux changes and to windage.

If the noise is due to the armature striking against the poles, a careful examination of the armature may reveal that some of the surface conductors are projecting out of their proper place. This is usually so only in cases where the coils are held only by binding wires. Such a condition means that the coils will have to be pressed into place and the band wires wound tighter. Where excess paint has been put on the armature it should be scraped off enough to allow the armature to clear. The air-gap should be tested by strip gauges or other reliable methods to be sure that it is the right amount.

When noise is due to collars or shoulders on shafting striking against the bearing, parts of the bearing may also be loose, all such parts should be tightened. This trouble may also be due to improper alignment of a unit.

When noise is due to loose bolts, screws and connections, these should all be tightened. The running of a machine may cause these to become loose and they should be given frequent attention. It may be necessary to provide check nuts or lock washers in some cases.

Singing or hissing of brushes are due to sticky or dirty commutator or unevenness of brushes, especially where the brushes are new and not worked to a seat. Trouble rarely occurs with copper brushes on account of poor seating.

Chattering of brushes due to their being loose or that the holder is loose is easily detected and remedied. When a brush wears below a certain point chattering may result, with accompanied sparking due to the holder hitting the commutator. The holders will also chatter after the commutator has been turned down below a certain working diameter.

Flapping and pounding of belts is due generally to a loose, poorly surface belt, or a poor joint. A proper tension should be used, avoiding too tight a belt. Good treatment for belt and a first class *square* splice should be had. All splices should be long and properly glued. The smaller the pulley the longer the splice.

### Leads and Connections

All leads frayed at ends where they enter lugs or thimbles should be bound with lockstitch and shellaced or painted with an approved insulating compound.

All local leads, such as the armature leads should be of the proper length and well formed.

All field leads should be clamped to the machine frame where necessary. These clamps should be made of thin brass or other nonmagnetic material and nothing but steel screws should be used to fasten the clamps to the frame. If this is done the clamps will never loosen up.

All armature leads from brushes holders to terminal blocks should be of such a length that they do not interfere with working around the commutator. They should not be so long that they rest on the sub-base of the machine.

All leads running to and from machines should be installed in an approved manner and painted with compound.

In making connections to terminal blocks all leads should be furnished with thimble type lugs.

No leads should be run in conduit where the insulation has been cut or marred.

### Missing Parts

All missing parts such as brushes, oil rings, brass caps for oil wells, thimbles for terminal blocks, brush holder accessories, oil gauges, etc., should be listed and the shipping cases searched for traces of them. If not found the maker should be required to supply the parts short.

### Numbering Machines

Most companies of the larger size number each machine and auxiliary in the plant. This is for inventory purposes and to identify the machine on repair and work orders. This practice can well be copied in all plants, to the smallest isolated station. A good practice is to print 1 inch numbers on each side of a machine or in one particular spot on each transformer or similar apparatus. White enamel is the best color to use.

### Finish of Machines and Parts

Machines should be given final finish only after all mechanical and electrical defects have been cleared. If at any time the finish is marred in repairing the machine, it should be refinished as an attendant will take better care of a good looking machine.

All cracks and patches on machines if they have been previously finished should be filled in and varnished.

All oil spots, paint spots, etc., should be removed and scratches refinished.

Wherever red lead has been used to remedy leaks around end plates on bearings or oil gauge studs, it should be painted.

After all electrical and mechanical defects have been cleared on machines installed they should be refinished if deemed necessary.

To refinish machines which have been previously finished in the factory, it will be only necessary to apply a coat of varnish. A standard varnish consists of one part ivory black mixed with two parts coach varnish.

In some cases, machines are shipped from the factory without this coat of varnish. These machines should be then varnished as completed.

All places on machines where enamelling has been broken off should be refinished. This also applies to the sub-bases as well as the machine proper. To patch up this abrasion it is first necessary to thoroughly clean it out with benzine to remove the oil which may have collected. It should then be filled with *Black Iron* filler and left to stand for at least twenty-four hours, in order that it may become perfectly dry. It should be then sand-papered with number 0 sand-paper. After sand-papering a coat of white lead shaded with ivory drop black or lamp black, should be applied. When this becomes dry it should be sand-papered with number 00 grade of paper, and given a coat of flat ivory black and allowed to dry for three hours, after which the coat of varnish mentioned above should be applied.

When abrasions are only slight, they can be filled with a putty made of dry white lead and varnish, smoothed with sandpaper, and covered with a coat of flat ivory black and varnished.

All scratches, paint spots, etc. can be remedied by first sanding with fine sand-paper and giving a coat of coach varnish.

All places where red-lead has been used to stop oil leaks should be painted over.

All brass and copper parts such as terminals, commutators, slip rings, brush holders and accessories, bolt heads, screw heads, etc. should be given a high polish. All parts not wearing or contact surfaces should then be lacquered.

A good paste is the best form of polish to use for polishing finished parts.

(To be continued)

# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

## Making Small Reactance Coils

By F. E. Austin

The request for information regarding "choke" or reactance coils published in the January issue of ELECTRICAL AGE is probably based on the desire of the querist to avoid using a resistance for regulating an alternating current where a reactance can be made that will better serve the purpose at a fraction of the cost.

For it is pretty generally known that where it is necessary to operate some alternating current device at a voltage lower than that commercially available, to properly and economically reduce the voltage or current, the so-called "choke" or reactance coil, connected in series with the device is much cheaper than a resistance, inasmuch as most of the energy absorbed is returned to the circuit while with a resistance all the energy absorbed is lost. The use of this device is based on the fact that if an alternating current passes through a coil of insulated wire wound in the form of a helix or solenoid, a counter electromotive force is set up within the coil that greatly reduces the amount of current that would result, were the wire laid out straight and the same alternating current pressure applied to its terminals, as when coiled up.

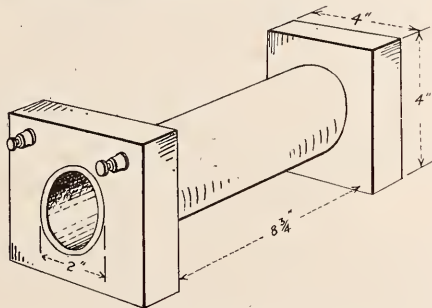


Fig. 1.—Spool for Small Reactance Coil

If a solenoid or coil is so arranged as to allow a soft iron core to be inserted through its central opening, the current reducing effect on the reduced counter electromotive force is greatly increased.

Two important characteristics of a choke coil that is provided with a movable iron core are the uniformity of the variation and the great range in the variation, of the choking effect.

The cost of regulation by using a choke coil is many times less than the same amount of regulation or reduction if ordinary resistance is employed.

Although a specific size of coil for a certain reactance was requested in the query the coil described in the following specification will enable anyone, as will be shown later, to get a variable reactance that will not only take care of the querist's case, but of many others, and will be effective for use in different work of either an experimental or permanently operating nature.

Five and one-half pounds of No. 16, double cotton covered copper magnet wire are wound on a spool or form, in eleven layers as shown in Fig. 1. The length of the spool is  $8\frac{3}{4}$  inches inside the square ends, the ends are  $4 \times 4$  inches, the central tube which may be made of hard fibre or of card board is 2 inches in diameter, making the diameter of the central hole through the coil, 2 inches. The thickness of the central tube may be  $\frac{1}{8}$  inch or even  $\frac{3}{16}$  inch. The ends may be of  $\frac{3}{4}$  inch pine or oak as desired. The holes in the wooden ends may be bored out by use of an expansion bit. There should be about 133 turns of wire in each layer (closely wound) and 8 layers; making about 1,064 turns in the completed coil. The ohmic resistance of the coil is about 2.7 ohms.

With a pressure of 35 volts, 60 cycles, applied to the terminals of the coil, the current will be 5 amperes. With a direct-current pressure of 35 volts applied to the terminals of the same coil

35  
a current of — = 12.9 amperes will result. The choking ability  
27

of the coil on alternating-current circuits is therefore 7.9 amperes at 35 volts, 60 cycles.

Considering the matter from a different standpoint, the coil will account for 35 volts either on alternating-current or direct-current circuits, when taking 5 amperes alternating-current or 12.9 amperes direct-current. While accounting for 35 volts alternating-current,  $2.7 \times 5^2 = 67.5$  watts are required, and while accounting for 35 volts direct-current,  $2.7 \times 12.9^2 = 451.5$  watts are required. The choking effect of the coil when accounting for 35 volts alternating current, effects a saving of 384 watts, as compared with an uncoiled wire of 2.7 ohms resistance; a saving of nearly 4 cents per hour, at a charge rate of 10 cents per kilowatt hour.

A core 16 inches long and  $1\frac{1}{4}$  inches in diameter, made up of  $4\frac{1}{2}$  pounds of iron wires about No. 16 B. & S. gauge, inserted into the central hole of the coil, will greatly reduce the current. If 110 volts at 60 cycles is applied to the terminals of the coil, without the core inserted, the current in the coil is  $16\frac{1}{2}$  amperes; while with the same applied pressure and the iron core inserted, the current is reduced to 1 ampere. By simply moving the iron core gradually out from the coil the current may be varied from 1 to  $16\frac{1}{2}$  amperes. The No. 16 copper wire of which the coil is made would carry  $16\frac{1}{2}$  amperes only a short time without overheating the wire. If a coil is made of a wire large enough to safely carry  $16\frac{1}{2}$  amperes continuously, and with the same number of turns (1,064) then such a coil could regulate from 1 to  $16\frac{1}{2}$  amperes with the same iron core.

In using a choke coil on alternating-current circuits, always complete the circuit with the iron core inserted; never switch the current on unless the iron core is inserted to full extent, which means minimum current. The choke coil might be

wound in two sections as shown in Fig. 2, which really constitutes two coils, thus allowing greater variation in choking effect.

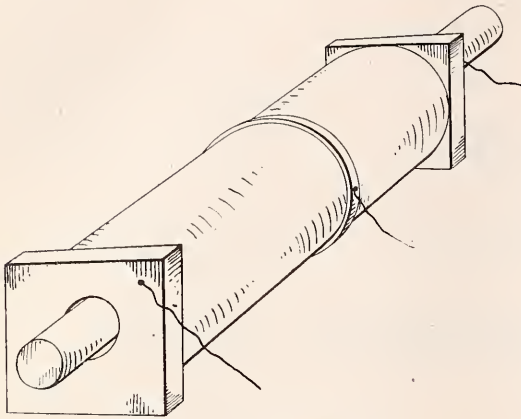


Fig. 2.—Two-winding Coil

One constructed by the writer, having the same dimensions as the coil described above, wound with 800 turns of No. 14, double cotton covered copper in each of two sections as illustrated in Fig. 2, and with iron core as described, can be used to regulate an arc light with one section from 110 volts, 60 cycles, or with both sections from 220 volts, 60 cycles.

\* \* \*

### Design of Small Reactance Coil

In the January issue of the ELECTRICAL AGE a method was asked for designing a reactance coil having an impedance of about 8 ohms at 60 cycles and capable of carrying indefinitely 3½ amperes without overheating.

In attacking this problem, the first question to be ascertained is whether it is intended to use a coil having an iron core, or one with merely air in the magnetic circuit.

This being settled, the first step in the design is to find how much self induction a coil must have to a reactance of 8 ohms at 60 cycles.

Reactance = self inductance × frequency × 2π  
hence calling self-inductance *L*, we have

$$L = \frac{\text{Reactance}}{2\pi f} = \frac{8}{2 \times 3.14 \times 60}$$

$$= \frac{47.1}{1} = .021 \text{ henry}$$

Knowing *L*, for size of coil with air core, we have the equation

$$L = \frac{3.2 A N^2}{10^8 l}$$

Where *A* is area of coil in square inches, *l* is length of coil in inches and *N* the number of turns.

For number of turns, then

$$N^2 = \frac{L \times l \times 10^8}{3.2 A}$$

Let us take the length of the coil as 2.5 inches, and a cross-sectional area of 5 square inches, corresponding to a diameter of a little over 2.5 inches.

Solving for number of turns.

$$N^2 = \frac{.021 \times 2.5 \times 10^8}{3.2 \times 5} = \frac{21 \times 10^6}{64}$$

$$= 328,125$$

hence *N* = 574 turns.

We must next be sure that we can put 574 turns of the necessary wire in the space assured. If the resistance losses in

the coil are to be kept low in comparison with the reactance, a fair sized wire must be used. Assume a No. 16 B. & S. wire covered with asbestos insulation 10 mils in thickness to insure fireproof construction, we have

Total diameter of insulated wire would then be

$$51 + 2 \times 10 = 71 \text{ mils}$$

This would give about 14 turns per linear inch of coil, and,

say, 35 turns per layer. Therefore the coil should be  $\frac{574}{35}$ , or approximately 17 layers deep, or at 14 layers to the inch, nearly 1.25 inches deep.

The resistance of this size of copper wire is about 4 ohms per 1,000 feet. The amount of wire required, taking mean diameter of winding as 3.7 inches be approximately

$$\frac{3.7 \times 3.14 \times 574}{12} \text{ or } 555 \text{ feet.}$$

Taking resistance at 4 ohms per 1,000 feet would give 2.2 ohms; Losses in coil at 3½ ampere would be 268 watts.

The weight of the copper wire and insulation would be a little less than 5 lbs.

The total impedance of this coil would be  $\sqrt{(2.2)^2 + 8^2}$ , or about 8.3 ohms.

If it is desired to use an iron core the size and weight of the copper wire used in making the coil can be much reduced.

An iron core consisting of a bundle of pure iron wires will increase the self-induction about 15 fold and if it is desired to use such a core the coil could be made less than half the size and weight. A design of 1 inch in diameter and 150 turns would work out closely enough, as by adjusting the air gap in the magnetic circuit the choking effect can be varied to suit. W. K.

\* \* \*

### Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

#### Economy of Three-Phase Transmission

Please explain fully how it can be that electric power at the same voltage and proportion of loss can be transmitted three-phase with only three-fourths of the amount of copper that direct-current transmission would require. How and why is the copper more economically used in the former case? A. W.

#### Changing Frequencies

Is there any simple, practical way of changing a 60-cycle alternating-current to 20-cycle alternating-current either by rotary or oscillatory method, other than by using the ordinary frequency changer? If so, please advise how it is to be done, giving sketch. C. H. C.

#### Grounding Open Delta Transformers

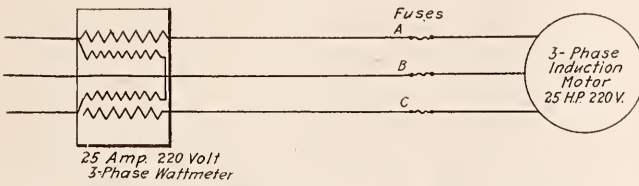
We are operating a 6,600 to 120-240-volt, 3-phase, "open delta" system with the common 240-volt wire grounded to a system of water-mains at all available points, for a mixed light and power service. It has given every satisfaction so far, but most text books and writers state that in a bank of open delta transformers the ground should be on the middle point of one of the transformers.

Of course with the latter arrangement the maximum voltage to ground is only about 210 volts as against 240 with the ground on the common wire, but is there any other reason for recommending the ground on the "neutral" wire?

If there is, we would like to know what it is. If there isn't, we are well content to let the ground where it is, as we get more benefit from its conductivity. Please advise us fully about this. E. M.

**Effect of Blown Fuse on Meter Readings**

Will a 25-ampere, 220-volt, 3-phase, induction wattmeter, connected as shown, record accurately the energy delivered to a 3-phase, 220-volt, 10-hp. induction motor, under the conditions



existing when one of the fuses between the meter and the motor is burned out, regardless of whether it is fuse A, B or C that is burned out? If so, why? W. T.

**Determining Power Factor With Wattmeter**

Answering query of M. S. in the March issue, if the current to be measured is that of a load whose power factor does not vary with the voltage and a steady voltage is available the power factor can be measured with a wattmeter as follows:

A non-inductive resistance of known value is placed in series with the circuit. This resistance can be made up of wire or cable whose resistance can be calculated from a wire table in case no resistors of known value or available. First connect as

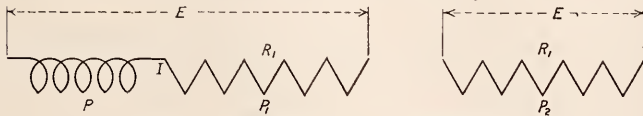


Fig. 1.—Methods of Connection

in Fig. 1 and measure the power absorbed by the resistance alone ( $P_1$ ) then that absorbed by the load alone ( $P$ ). Now connect the resistance as in Fig. 2 and measure the power it absorbs ( $P_2$ )

- $E$  = steady applied voltage.
- $P$  = power absorbed by load as read by wattmeter (in watts)
- $P_1$  = power absorbed by resistance as read by wattmeter
- $P_2$  = power absorbed by resistance when across  $E$  volts
- $R_1$  = resistance of resistor (in ohms)
- $I$  = current through resistor and load
- $R$  = resistance of load
- $X$  = reactance of load

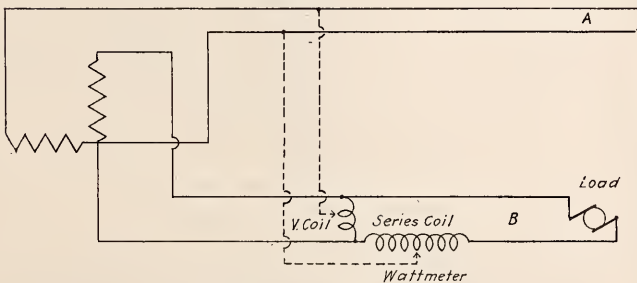


Fig. 2.—Two-phase Connections

Now

$$P_2 = \frac{E^2}{R_1} \text{ hence } E = \sqrt{P_2 R_1}$$

$$P_1 = I^2 R_1 \text{ and } P = I^2 R$$

$$\text{from which } \frac{P_1}{R_1} = \frac{P}{R} \text{ and } R = \frac{P R_1}{P_1}$$

$$\frac{E}{I} = \sqrt{X^2 + (R + R)^2} = \frac{\sqrt{P_2 R_1}}{\sqrt{P/R}}$$

$$\text{Solving, } X^2 = \frac{P_2 R_1 R}{P} - (R + R_1)^2$$

$$R^2 + X^2 = R^2 + \frac{P_2 R_1 R}{P} - (R + R_1)^2$$

$$\text{Power Factor} = P. F. = \sqrt{\frac{R}{R^2 + X^2}}$$

$$= \sqrt{\frac{R}{R^2 + \frac{P_2 R_1 R}{P} - (R + R_1)^2}}$$

$$= \frac{P}{P R_1}$$

In this formula the value of  $R = \frac{P R_1}{P_1}$  can be used.

$P$ ,  $P_1$ , and  $P_2$  are wattmeter readings,  $R$  is known so power factor can be calculated.

If a two-phase source of power is available and the voltages are balanced, steady and in proper relations the power factor can be obtained as follows, assuming a sine wave which is probably approximately correct.

Put the load on phase  $A$  with the wattmeter current coil connected in that phase. Connect the voltage coil to phase  $A$  and read the meter calling this reading  $P$ . Now connect the voltage coil to the other phase and read the meter for  $P_1$ .

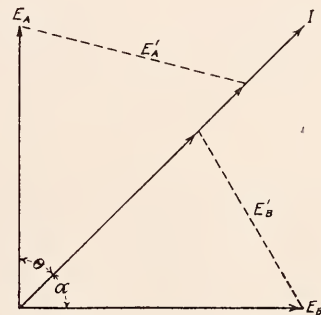


Fig. 3.—Reading Diagram

What the wattmeter really needs is  $I$  times the projection of  $E_a$  or  $E_b$  on  $I$

$$P = E^a I = E_a I \cos \theta$$

$$P_1 = E^b = E I \cos a$$

$$= E I \sin \theta \text{ (since } \theta + a = 90 \text{ deg.)}$$

Also if  $E_a = E_b$ , that is if the voltage of the 2 phases are equal, then

$$\frac{P_1}{P} = \tan \theta$$

$$\text{Power Factor} = \cos \theta = \frac{I}{\sqrt{I^2 + \tan^2 \theta}} = \frac{P}{\sqrt{P^2 + P_1^2}}$$

The accuracy of the result will be in doubt as unless meters are available, for we don't know how nearly correct our assumptions are as to voltage. R. H. W.

**Power-Factor From Watt-Meter Readings**

Answering the question in the March issue as to the best way of determining the power factor of a circuit by the use of a watt-meter; according to some late investigations the power factor of a three-phase circuit where any kind of a polyphase watt-meter is in use can be determined as follows:

Take readings of the time of one revolution of the disk of the meter when correctly connected in circuit; then reverse the

connection of one of the current coils and take readings of the new time for one revolution under this condition. Putting  $T$  and  $T_1$  for these readings respectively,

$$\frac{T}{T_1} \times \sqrt{3} = \tan \theta$$

That is, the ratio of these two time readings multiplied by the square root of 3, or 1.71, equals the tangent of the power factor angle. This known, the cosine of the angle, which is to say, the power factor, can be found from a table of tangents and cosines.

We do not know of any simple method for determining this quantity in the case of a single-phase circuit with the use of a watt-meter only, and if anyone does, we would be glad to hear from them. The methods usually given require quite a lot of calculation. S. U.



### Effect of Brush Shifting on Motor Speed

In the question and answer section of the March number there is an explanation which is not entirely correct. It is in regard to the reason why direct-current motors speed up when the brushes are shifted. Now as a matter of fact unless the motor in question is unusual it won't speed up unless the brushes are shifted in a certain direction (against direction of rotation). If the brushes are shifted with rotation the motor will run slower.

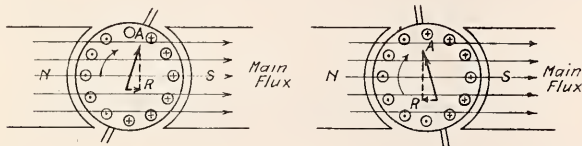


Fig. 2

Fig. 1

In Fig. 1 the brushes are given a back lead with respect to rotation. For simplicity the brushes are shown making contact directly on the conductors instead of on a commutator though this is merely a useful convention. The currents in the armature conductors are going in where marked (X) and coming out where marked. These armature currents flowing around the iron core of the armature will magnetize it in the direction of the axis of the turns producing the magnetism which is shown at "A." This action is entirely similar to the magnetic action of a current carrying coil on any piece of iron whether an armature or not. The armature flux can be considered as made up of two components, one in line with the main field flux, the other at right angles to it. This is another entirely justifiable convention and is only used for convenience. The first mentioned component of the armature flux being in the direction of the main field will strengthen it and cause the motor to slow down in order not to generate too high a counter electro-motive force with the increased field. If the brushes are shifted ahead as in Fig. 2, the axis of the armature flux will shift till the component "R" on the direction of the main field opposes it, weakens the field and speeds up the motor.

In Fig. 1 if the pole tips are not well saturated the cross component of the armature flux may distort the main field to such an extent that, due to the increased flux density at the leading pole tip, the total magnetic reluctance of the main field path is increased, thus cutting down the field more than the small component will increase it and the final effect will be that the motor will speed up. In this case the motor speeds up by shifting the brushes in either direction but speeds up much more with a forward lead than with a backward lead.

One very useful application of this principle is to accurately ascertain the correct neutral position for the brushes, especially on a commutating pole machine where correct brush position is important to good operation. Connect the machine as a motor, run it and measure its speed. Now reverse it and again measure

the speed. If the brushes are set correctly the speeds will be the same in both directions. If the forward speed is high then the brushes are too far retarded with respect to that direction of rotation.

The explanation given in the March number that the c.e.m.f. is cut down by the coils working against each other is true but it is an effect of secondary importance, for with ordinary machines there is a considerable space between poles where the field is weak, in other words, there is a fairly wide zone in which the coils generate very little voltage so that the brushes would have to be shifted through a considerable angle to make this effect show up. Even a small angular shift, however, gives a considerable armature flux component since modern machines are apt to have armatures whose ampere turns are fairly large with respect to the field. R. H. W.



### Solution of Charging Current Problems

Concerning the question as to charging current of a 100-mile three-phase transmission line that appeared in the December issue and had two answers published, one in January and one in March, the following is submitted as the correct solution:

The charging current of any wire, or any other device having electrostatic capacity, is represented by the formula

$$I = \frac{2\pi f C E}{10^6}$$

where  $I$  is the charging current in amperes,  $f$  is the frequency,  $E$  the impressed voltage and  $2\pi f C$  the "capacity susceptance" in terms of micromhos,  $C$  itself, being the capacity of the conductor in microfarads.

The value of the capacity to neutral for each of a given pair of conductors one mile in length, whose distance apart in air is  $D$  and whose diameters are  $d$  both being expressed in the same units, and  $D$  more than 10 times  $d$ , is

$$C = \frac{.0388}{2D \log \frac{D}{d}}$$

Substituting the value of  $D$  (72 inches) and  $d$  .289 inches, we have

$$C = \frac{.0388}{.289 \log 2 \times 72} = \frac{.0388}{.289 \log 498} = \frac{.0388}{2.697} = .0144 \text{ microfarads.}$$

Substituting the value of  $C$  in the above formula and using 25 cycles the susceptance of each conductor per mile is

$$6.28 \times 25 \times .0144 = 2.26 \text{ micromhos,}$$

and charging current per mile, per wire is

$$\frac{2.26 \times 46000}{10^6} = .1039 \text{ amperes}$$

46000 being the voltage to neutral.

Charging current per wire for 100 miles = 10.39 amperes.

All the foregoing holds true, whether for a single-phase, two-phase or three-phase system. The capacity to ground is not considered, being negligible.

For a balanced three-phase line with conductors arranged in

an equilateral triangle the charging current per wire is  $\frac{2}{\sqrt{3}}$  or 1.155 times the above value. Thus we get finally

$$\text{Charging current per wire} = 10.39 \times 1.153 = 12 \text{ amp.}$$

W. K.

The above is the correct solution. The formula published as used by E. J. F. in January in solving this problem would have given the same result as the above but for an error in the state-

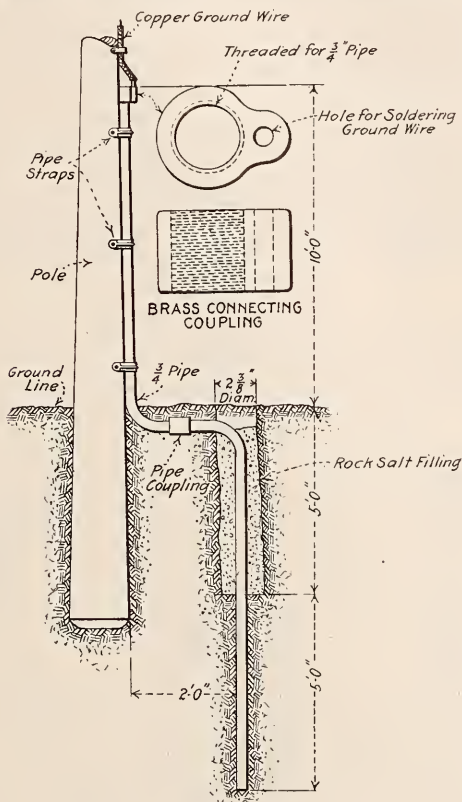


ment of the numerator of the logarithmic fraction in the capacity. This made the result too great. A similar error, combined with another in the statement of the general formula, led to the making of H. H. W.'s result in the March issue somewhat too small. Ed.

\* \* \*

### An Iron Pipe Ground with a Rock-Salt Filling

The construction of iron pipe grounds with a rock salt filling has been recommended by a good many engineers whose experience entitles their opinion to weight. Measurements have shown that the average resistance of ordinary ground connections of different forms and of various ages to be approximately 200 ohms. Obviously, an earth connection having such a high resistance cannot be very effective for secondary grounding. The connection of the kind illustrated in the figure has, it is claimed, the advantage of initial low resistance and of maintaining this low resistance permanently. The average resistance of 250 grounds of this type was 15.7 ohms each. The feature of this connection is a rock-salt filling which, when dissolved, permeates the soil thereby greatly increasing its electrical conductivity.



Construction of Rock Salt Ground

The directions for installing the salt-filled pipe ground are as follows:—First a 2-in. wrought iron pipe (outside diameter  $2\frac{3}{8}$  in.) is driven into the earth, at the point where the ground connection is to be made, a distance of 5 ft. It is then withdrawn. The cylindrical cavity thus formed is filled with rock salt as shown in the illustration. Now a 12-ft. length of  $\frac{3}{4}$ -in. galvanized iron pipe is driven through the 5-ft. salt stream and about 5 ft. further down in the earth. The top end of the pipe which is mutilated by its being driven into the earth is then cut off and threaded. Now another length of  $\frac{3}{4}$ -in. pipe about 10-ft. long is, with a coupling, connected to the length in the ground. A trench is then dug from the ground pipe to the pole and the extending length of pipe is formed into the trench and bent up the pole. It can be held thereto

with pipe straps. The top end of the ground pipe will then be approximately 10 ft. above the earth's surface as shown.

Obviously, the pipe driven into the earth must be located at least a couple of feet away from the pole to permit the turning of the pipe-cutting and threading tools above referred to.

To effect the connection with the ground wire a brass coupling of essentially the form shown in the picture is turned on the threaded end of the ground pipe. The copper ground wire coming down from the top of the pole is then soldered into the tinned hole provided for its reception in the coupling. It is claimed that an open coupling similar to that shown is preferable to a cap which encloses the end of the ground pipe, because an open coupling permits some rain and moisture to enter the pipe so that it can flow down therein and increase the conductivity of the adjacent soil. It is stated that when the first length of pipe is driven into the ground a considerable quantity of salt remains with it. This salt is slowly dissolved by the water which comes down inside of the pipe.

\* \* \*

### Protection of Ground Pipes from Corrosion

Corrosion may be due to electrolysis resulting from the flow of current from the metal to the earth; or it may be due to galvanic action resulting from either foreign substances in the soil or physical differences between adjacent points on the surface of the metal. Electrolytic corrosion, due principally to electric street railway, does not appear to be the cause of the present trouble, unless perhaps the ground rods are connected to a neutral or common wire carrying current, since no current can otherwise flow into the earth from the ground rods.

The trouble must therefore be due to self-corrosion. The action is galvanic, practically the same as occurs in the primary battery of zinc and carbon. The current flows from the zinc, through the electrolyte to the carbon. Analysis of the soils surrounding the ground rods may show that they contain carbon in some form or another. Coke, ashes, clinkers are often the cause of serious corrosion troubles. Tests have been carried out by a number of different parties on this matter and all agree that an iron rod embedded in a soil containing coke will give an electromotive force of about 0.6 volts, which is, of course, ample to cause rapid corrosion and integration of the iron.

Without knowing something of the soil, of the corrosion, the depth to which the rods are sunk and where they corrode, it is impossible to suggest a remedy that will be a real remedy. Paints that protect also insulate. In any case the paints usually used for the protection of underground pipes fail after a short time of service. Such a remedy, if feasible, would be temporary only. Were a first class paint available, one that had low electrical resistivity but high resistivity against corrosion there would be no guarantee that the coating would not be damaged in installing the rods. It would be out of the question to drive them in, the way rods are generally put into the ground.

The only apparent way out of the dilemma appears to be to determine the properties of the soil, examine very carefully the corroded rods, noting where and how they have corroded. Some idea as to the cause might then be possible. If the worst comes to the worst it may be necessary to replace iron rods by rods of brass. It might be worth while experimenting with galvanized pipes, taking care to galvanize them inside and out (by the hot-dip process).

To make an inexpensive and effective ground, drive an iron pipe one or two inches in diameter in the ground, not less than six feet, deeper if possible. Scoop out a basin at the surface of the earth and surrounding the ground rod, into which pour about three gallons of brine, more if it is thought that the rod does not go down to moist earth. Fill the basin partly with salt crystals and cover with earth. K. R.

# Questions and Answers

Will you kindly explain what is meant by "wattless" alternating current?  
J. S.

*Ans.*—There is no such thing as a "wattless" alternating current. It is incorrect to speak of one. What you mean is probably the wattless component of an alternating current which is out of phase with the electromotive force that causes it. The term "wattless" is meant to describe the displaced proportion of such current and was not a very fortunate choice.

\* \* \*

What is the rule for determining the proper size of wire to be used in winding the field coil and armature of a motor?  
H. B. L.

*Ans.*—The size allowance depends on the shape and area of the radiating surface of the coil and the arrangements for ventilation. Usually the allowance for a field coil is about 0.4 watt per square inch of outside surface. In armatures, the allowance for ordinarily high speed machines is about one watt per square inch of radiating surface of the armature. On a low speed machine the allowance must be increased.

\* \* \*

How do you change the number of turns for a 40-cycle, home-made, low voltage transformer given in the February issue to do for 60 cycles?  
H. H. P.

*Ans.*—To give the same voltage with 60 cycles that the design gave with 40 cycles will require the number of turns to be reduced in the ratio 60 to 40. Therefore it will only require two-thirds the number of turns with 60 cycles that were necessary for 40 cycles—if all the other conditions are the same. The transformers referred to gave 8 volts on open circuited secondary with 700 primary turns and 40 secondary turns. With 60 cycles to get the same secondary voltage there would only need to be two-third of 700, or 467 primary turns, and, similarly the secondary turns would only need be 27. This illustrates how high-frequency reduces the size and hence the cost of transformers, exactly as high speed reduces the size and cost of motors.

\* \* \*

They are talking of replacing arc lamps here with gas-filled tungstens. Will you tell me the exact candle-power of our arc light? The current is 6.6 amperes. They call them 1200 candle-power.

*Ans.*—The rating of arc lamps has always been rather misleading. An ordinary arc at the current you mention will absorb about 45 volts or approximately 300 watts. Although commonly called a "1200 candle-power lamp," the measured candle-power in the direction of the greatest intensity will be found to be about 600. Its real efficiency, therefore, would be ½ watt to the candle-power. Thus it can be compared with the metal filament lamp.

Y. A. S.

\* \* \*

(1) Is there any difference between a metric horsepower as used on the continent of Europe and the ordinary horsepower?  
(2) Give the value of watt in ft. lbs.  
B. A. R.

*Ans.*—(1) Yes. A small one. The metric horsepower is equal to 736 watts and the English (or American) horsepower is equal to very nearly 746 watts.

(2) 1 lb. lifted .737 foot (or nearly 9 inches) a second equals 1 watt.

Will you please advise me if a magneto is ever known to ring through being connected to the two ends of the conductors at one end of a coil of twisted lamp cord, where the insulation between the two cords is good?  
R. B. S.

*Ans.*—It is well known that a magneto will ring from the charging current of any circuit containing enough of electrostatic capacity to take sufficient current to ring the bell. With a sufficiently sensitive magneto and a large enough coil of twisted lamp cord, the magneto would undoubtedly ring.

\* \* \*

In changing a three-phase, three-wire primary circuit to a

two-phase, four-wire secondary is the Scott connection made on the primary or the secondary side?  
H. W. P.

*Ans.*—The "Scott connection" for changing from three-phase to two-phase, or vice versa, is always made on the three-phase side, whether it be primary or secondary. Hence in the given case it would be made on the primary.

\* \* \*

(1) In the February issue you state that about a ton of a certain coal would run a one-horsepower engine a whole year. Please explain how you figure this.

(2) Elsewhere in the same issue you gave an item that a certain plant has averaged 1.47 lbs. of coal per kilowatt-hour for six months. What is the over-all efficiency of this plant?  
S. L. E.

*Ans.*—(1) One horsepower-hour = 2547 B.t.u.

Hence: 1 horsepower-year = 8760 hp-hr. = 2547 × 8760 = 22,311,720 B.t.u.

The amount of energy in a short ton of coal running 11,155.86 B.t.u. would be:

2000 × 11,155.86 = 22,311,720 B.t.u.

or 1 horsepower-year as above.

Hence a single short ton of this coal, which has only a fair heating value, for soft coal, would yield a horsepower-year with a perfect plant having no losses. The last three figures in the February item were misprinted. The correct figures are 11,156 B.t.u.

(2) The coal at the plant under discussion was stated to run 13,606 B.t.u. per lb.; Now 1 kw-hr. = 3415 B.t.u.

Also, 1 kilowatt-hour made from 1.47 lbs. of coal is equivalent to 0.68 kilowatt-hour made per pound of coal, and the total kilowatt-hours in this coal is equivalent to

13,606

— = 3.98 kilowatt-hours per pound.

3,415

Therefore the over-all efficiency of the plant under discussion, from coal-pile to watt-hour meter is

0.68

— or 17.1 per cent. nearly.

3.98

Is concentric wiring a new idea? If not, why has it been so long in getting introduced?  
P. S.

*Ans.*—Concentric wiring is practically as old as the ordinary kind. Twenty years ago it was established in Great Britain and has been increasingly used there ever since. The backwardness of the American people (in some things) is the only reason we can assign. In cheapness of installation and reduced fire risk it is superior to ordinary wiring.

\* \* \*

Please give me a simple method for determining the number of lines of force passing at full load between the pole piece of a motor and the armature.  
S. M.

*Ans.*—It is easiest calculated from the relation between the voltage impressed on the motor and the resulting magnetic field. Count the number of conductors on the armature and multiply by the revolutions per second. Divide the voltages at the brushes by the product and by the result by 100,000,000 and you have approximately the number of lines of force. The result is not accurate on account of not having taken into consideration the volts drop in the armature and brushes. It will be too low.

To get it accurately the voltage at the brushes must be reduced by the amount of voltage lost in the machine which equals the resistance from brush to brush multiplied by the full current in the armature. The remainder, when this has been subtracted from the voltage at the brushes is the counter-electromotive forces of the motor. This quantity multiplied by 100,000,000 and divided by the product of the number of armature conductors and the revolutions per second will give the actual number of lines of force.

# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## Stimulating the Service Demand

In the early days, when the pioneers took up the fertile lands of the Middle West, all they had to do was to "tickle the prairies with a plow and they laughed a harvest." Today these same farms require an investment of millions in fertilizers—phosphates, nitrogenous stuffs and lime—to get the same crops that once were to be had for the asking.

Is it not the same way with the long-established cities that have had an electrical service for years? The present load, the result of a slow and steady growth, in many of these places has reached a standstill. Statistics show that the

necessary stimulant. Deferred payments and premiums are the main stock in trade in this work and both are used here. But, whereas, one offer confines itself exclusively to the lighting feature of the service, the others offers not only this, but also its heating and cooling possibilities as exemplified in the iron and fan.

Therein, we think the latter, particularly when the offer is made at this season of the year, makes a stronger appeal. For the greater the variety of the service rendered the wider will be its field.

### Electrically Lighted Houses

—Rent First  
—Sell First

We Will Pay Contractor for Wiring House for Electricity.



You can pay us in Monthly Installments with your lighting bills.



7 Rooms Wiring Complete for 12 Payments of \$3.50 per month  
Old House or New House



This offer for 90 Days from March 15th



Any Electric Contractor you select.

COMMERCIAL DEPARTMENT—Phone 4800

Cumberland County Power & Light Co.

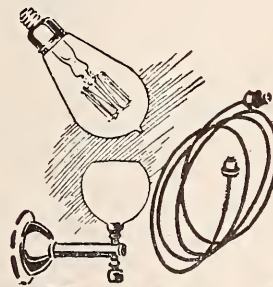
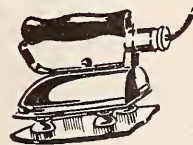
field is not nearly occupied, the larger proportion of houses, estimated at approximately 80 per cent., that remain unconnected not taking electric service under the conditions that have hitherto prevailed.

To draw out the latent demand of this section of the public is recognized as one of the most important problems now confronting the management of electric service companies. What is more natural than to take a leaf from the book of the farmers and make use of a "fertilizer" for this backward soil to induce it to "come across" with what it has to yield? The two advertisements shown herewith illustrate a couple of the most promising methods of applying the

### Electric Light Wiring

and all these for \$12

CHOICE OF ANY ROOM WIRED FOR ELECTRIC LIGHT.



these for \$12

\$1.00 DOWN, \$1.00 A MONTH

We'll put electric light in any room you say—give you a two outlet wall bracket—a 60 watt lamp—a six pound electric iron—an electric fan—cord and plug. Total cost \$12.00;

\$1.00 DOWN—\$1.00 A MONTH

This is the most generous offer we have ever made to non-users of electric light. If you are one of them we urge you to take advantage of it at once.

Kansas City Electric Light Company  
15th Street and Grand Avenue  
Telephone: Bell Grand 60 Home Main 60

Too much stress can hardly be laid on the difference between, not merely the electric light and its predecessors, but also on the equally great difference between the old stove-heated iron and the electric kind; broom and the vacuum cleaner; the wash-board and the washing machine; the primitive palm-leaf fan and its electric successor; the limited human muscle motor and the jack-of-all-trades domestic motor; and so on down all the long line of domestic electrical utilities.

A vigorous attack by means of forcefully put arguments along this line, backed up by judicious price concessions to

overcome the initial financial inertia of this class of householder, ought to go a good way toward the reduction of the abnormally large proportion of the community now living along the line of the electric service companies who have not yet seen their way clear to heed the call.

Of course, in putting out premium campaigns of this kind, the conservative manager will always avoid the not altogether uncommon error of offering more inducements than the possible revenues from the field concerned can ever justify. The scientific farmer always adjusts his expenditure on fertilizers to the capabilities of his soil.

\* \* \*

### Summer Resort Rates

The difficulties attending the operation of a lighting plant for a community occupied principally by summer residents, were brought out at a hearing recently at Boston, on a bill to investigate the operation of a Hull (Mass.) municipal plant. Prominent summer residents complained of the high rates prevailing, the maximum net lighting rate being 20 cents a kilowatt-hour.

Thomas H. Bittimer, town counsel, pointed out that the plant has to be maintained the year round for about three months' operation at anything near capacity. Earnings for March, 1915, were only \$1,065, while for August they were \$12,930. During the summer the town has about 25,000 inhabitants, and 25,000 more daily visit Nantasket Beach resorts, which are lighted by the town plant. The months of July and August are the peak-load time of the plant, the load falling off precipitously after Labor Day.

That the 20-cent rate is not an exorbitant one is evidenced by the fact that like resorts have an even higher rate than Hull. The summer lighting rate at Manchester-by-the-Sea, Mass., is 25 cents a kilowatt-hour.

The Hull municipal department has lately made a ten-year contract with the Weymouth Light & Power Co., by which a reduction in the cost of current, over the cost of generating it at the town's steam plant, will be brought about, resulting in an expected reduction of about 15% in both winter and summer rates. The former is now 15 cents.

\* \* \*

### Dealers' Problems

The Successful Store—How the Dealer Can Profit by Modern Merchandising Methods

By William F. Leggett

From the angle at which business is viewed today we know that neither the captain of industry of this generation, nor the merchant prince of yesterday were children of fortune, or freaks of accident—nor anything more wonderful than men who studiously observed conditions and moulded their business practice to extract the most profit out of them. They were the masters who eliminated the everlasting query from the profit and loss account and who first learned that a business structure which would outlive hurtful competition, could not be erected on uncertainty. They studied retail problems of their business, throwing aside every vestige of guesswork, and grasped the fundamental factors whether or not it led them outside the boundary of familiar routine.

Not every dealer in electrical supplies appreciates that his store registers an impression on the mind of each customer, nor does he fully realize how very sensitive customers are to those impressions. Untidy counters, broken containers, spineless salesmen, unkept windows—all these repel customers, and proclaim your store in a manner which requires no further publicity, except by the creditors' committee. In a similar way, the successful store becomes a momentum in itself, its growth being in direct proportion to an in-

telligent appeal for patronage, for trade will be just as responsive as you make it. Mark that well!!

When you are making the daily rounds, spend a little more time in the store, for here occur the intimate relations with your customers which decide either the success or failure of your efforts. However accommodating your sales force may be, however courteously your credit manager solicits settlement, they are not items of primary importance to your customers. Your shelves and show cases are the deciding factors, and if these are inflexible and unresponsive, you fail to extract the full extent of a customer's purchasing power, and limit their capacity to deal with you. The normal electrical store is serving the professional wireman and contractor, exclusively, and finds this business profitable, although competition is keen and profits small. In compensation it is claimed that each customer knows what he wants—purchases it, and leaves, requiring rather the attention of a porter or stock clerk; no one except the salesman. If your store is restricted to this class of trade, however profitable, you are not commanding the full extent of the public's purchasing power, for there has entered a buying factor with which you are unfamiliar, and whose patronage you should cultivate.

### Catching the Housewife's Eye—and Ear

Do not doubt that the housewife is keeping abreast of the times, and has become familiar with the slogan "Do It Electrically." She has informed herself of the many inexpensive devices which eliminate the drudgery from housework, and increase efficiency in her sphere. She is rapidly absorbing the advertising appeals made by manufacturers of electrical supplies, in the nationally circulated periodicals which reach the home, and some day or other, will surely seek information from you—or some other dealer—about the merits of an advertised article which she wishes to purchase. You should anticipate her demands by making your stock responsive to her call, and earn for yourself the name of being a necessity in your community. Remember that each time you are unable to satisfy a customer, dollars walk out of your door—more dollars than are involved in the immediate transaction, for you have created an unfavorable impression in the mind of your customer.

Every successful business is based upon service, and the dealer who profits most is the one who serves the best. Include in your stock the newly advertised articles of merit, and then watch the growth of your business. Do not restrict your stock flexibility to the articles which are called for from day to day, for you must remember that if each customer waited to buy until in actual need of material, sales would be few, and business vigil long and lonely, for the average buyer requires very little. Make it easy to buy, and follow this rule closely. Place in your stock those electrical devices which make house work pleasanter which give each day, an additional hour or two of leisure, and which renders the housewife more independent of the transitory servant. The average woman will not be unresponsive to arguments like these. You will not have to educate her to purchase, for each device has been thoroughly advertised in the various periodicals which reach the home, and their use explained, and at the same time there has been eradicated the impression that electricity is a luxury. In this way, and entirely without expense to you, there has been created a demand for electrical household helps, and a new field of profit is presented to those dealers who will improve the opportunity.

Progressiveness is not only looking, but moving, forward. Broaden your business horizon to include the house wife's every call for freedom from drudgery. Be one to serve, or some day a lively competitor will adopt the methods you now decline, and will replace you in the estimate of the public, as a successful retail dealer,

## Poster Competition for America's Electrical Week

The Society for Electrical Development, Inc.

By John A. Randolph,

To visualize the supremacy of electricity as a motive force in the world of industry and commerce, a pictorial design is sought by the Society for Electrical Development, 29 West 39th Street, New York. It is to be reproduced upon pasters, in press advertisements, on circulars, banners, letterheads, cards, in folders and booklets to be used in connection with "America's Electrical Week," the nation-wide trade movement to be held by the United Electrical interests from December 2nd to 9th. The aggregate circulation of the design will amount to hundreds of thousands.

In order to make the range of selection as broad as possible, the society has instituted a poster competition to open on April 1st and close June 1st, 1916.

In bringing any movement, undertaking or enterprise to the attention of the people by means of printed matter there is nothing more effective than illustrations. A well selected and clearly cut picture will always arrest the attention and drive home its underlying thought. The appeal of a picture is instant. The mind grasps its meaning without effort, often involuntarily. For this reason illustrations generally add fifty per cent. or more to the effectiveness of printed matter.

For a trade campaign of the nature of "America's Electrical Week" it is of paramount importance that a common design be used on all the publicity matter. It may consist of an emblem, a symbol, an ensign or of a symbolical picture but it should be the same on all literature sent out. The reason for this is repetition. A person confronted by the design day after day in the advertising pages and news columns of the press, on letterheads, on booklets, circulars and posters cannot fail to have the importance of the movement gradually impressed firmly upon his mind.

He may not take time to read the literature, but he cannot fail to see the design and grasp its meaning.

In the "Electrical Prosperity Week" celebration of last year probably no one element contributed more toward the remarkable success of that great campaign than the "Goddess Electra" emblem of the movement which, through its reproduction in the press of the country in addition to its appearance upon the special publicity matter issued by the Society for Electrical Development, was highly instrumental in bringing the movement to the attention of nearly every citizen of the United States. In many newspapers and magazines, the design occupied an entire page. Its appeal was strong, its underlying thought readily apparent.

In the coming poster competition, the society seeks a design equally as strong for the movement of next December which, in view of the prestige created by last year's celebration, promises to surpass the latter in popularity, magnitude and sales results.

### Selecting of the Theme

The selection of the pictorial theme is left entirely to the artist as the poster committee wishes in no wise to hamper the creative character of the poster. However, as the poster is to be used in a celebration of the part which electricity plays in social and industrial progress, the committee aims to bring forth the design which will portray, in the strongest and most forcible manner, the benefits of electric light, heat and power.

### Prizes

The prizes and designations are as follows:

A \$1,000 Grand Prize.

B \$300 Second Prize.

C \$300 Public Choice Prize.

D \$200 Art Students' Prize.

E \$200 School Prizes.

### Definitions of Classes

A—All artists, designers, instructors, and persons engaged in the profession of graphic arts are eligible for the Grand, Second and Public Choice Prizes, provided they comply with the conditions of the competition.

B—The Art Student's Prize is open to students regularly attending any school of design, art academy or institutions where poster art is a subject of instruction.

All designs entered for the Art Students' Prize will also be eligible for the Grand Prize, Second Prize and Public Choice Prize.

C—The School Prizes are divided into the following prizes: \$100 for the first prize; \$50 for the second prize; \$25 for the third prize; \$15 for the fourth prize and \$10 for the fifth prize. These are open to pupils of high schools, public schools, private schools, parochial schools, seminaries or academies, or to any pupil regularly attending any institution of learning which includes in its course the art of drawing or design in any of its branches.

All designs entered for the School Prize are eligible for the Grand Prize, Second Prize and Public Choice Prize.

Enclosed in the identification envelope which accompanies each design competing for prizes under class B or C must be a certificate signed by the principal of the school stating that the competitor was regularly attending the institution in question on the date upon which the competition opens.

Certain conditions, rules and requirements must be complied with by all competitors. A copy of these can be secured from the Society for Electrical Development.

### Judges

The judges who will determine the successful designs and award the prizes are as follows:

Mr. John Quincy Adams, Secretary, Municipal Art Commissions.

Dr. James P. Haney, Art Director of New York High Schools.

Mr. Arthur M. Wiener, President, International Art Service.

Mr. Herbert F. Houston, President, Associated Advertising Clubs of the World.

Mr. P. L. Thomson, Advertising Manager, Western Electric Company.

Mr. Henry L. Doherty, President, The Society for Electrical Development, Inc.

### Purchase of Design

The leading electric companies are continually purchasing attractive art designs to further their advertising campaigns, so that it is likely that many of the designs entered in the competition will be secured by members of the society as permanent designs for individual concerns.

The Poster Committee expressly aims to assist in the sale of these designs at the prices fixed by the artists in submitting their designs.

Each competitor therefore is required to set a fair market price upon his original, to the end that the society may enable to afford its best assistance to the artists in disposing, at the prices stated, of as many of the designs as possible.



### Long Lived Electric Vehicles

A well-known New York jewelry firm sold the last of their horses seven years ago as a result of several years experience previous to that date with electric delivery wagons bought in 1902. To-day seventeen out of the nineteen electrics are over ten years old, and although their 1-ton panel wagons weigh 1,600 lbs. more than the same capacity wagons built to-day by the same manufacturers, they are getting the required mileage out of the veterans at a satisfactory cost.

One ton of tungsten is said to make eighteen million incandescent lamp filaments.

## Where The Jobber Comes In

Account of an Effort to Short-Circuit Him and its Results

A Bit of Current Trade History

By J. W. Wooley

There has been a great deal of discussion and comment, favorable and otherwise, aroused amongst central station companies and telephone companies concerning the policy of certain electric manufacturing companies in marketing their entire product through the legitimate electrical jobber.

Up to about two years ago a well known manufacturer in the Middle West sold their product to both the jobber and the consumer—with plenty of accent on the latter. Many features developed which were unsatisfactory both to the consumer and to the company, and the latter felt that some remedy was imperative.

"It was out of the question," said the sales manager of the company, who was asked to make an explanation of their policy, "to attempt to raise prices to the consumer and to care for the crying need for 'service,' and as a result we had to devise a better method.

"To convince the consumer that we are familiar with both sides of this discussion, I want to say that we made a thorough and detailed study of the question. Amongst other things we found that the average amount of an order from an operating company was only a small fraction of the amount of an order from a jobber, but *that the cost of filling each order was the same.* While a little time could be saved in assembling the smaller amount of tools listed on an order from an operating company, the saving was lost in the increased ratio of cost of special packing cases, etc.

"A large percentage of these orders, came to us from operating companies that did not have a copy of our catalogue, and therefore did not have our catalogue numbers available. This necessitated further correspondence to ascertain just what the company required and therefore long delays in shipment.

"Orders for only 80 to 90 lbs. of tools came to us from companies 2000 miles distant from our factory. This meant an immense freight item in view of the fact that the weight of these small orders would not even come close to making up the weight allowed under the minimum freight charge. Investigation of several hundred orders showed that an average of 12 per cent. on the total cost of the tools could have been saved by the consumer had he been able to specify enough tools to make up the minimum required by the transportation companies.

"On these orders the matter of 'delivery' time was ascertained and it was found that the average time from date of shipment to delivery was nine days, an item of considerable expense to the operating company in 'delay.'

"We were, as a rule, so far away from the operating company that no accurate credit rating could be obtained. We, of course, used their standard rating books but we found them oft' times unable to do justice to either the operating company, or to us, in view of the fact that the ratings shown were frequently those made a year previous. Many times no rating was shown.

### Objections to Special Reports

"Special reports were out of the question for two reasons:

"1st.—The small amount involved would not warrant the expense and

"2nd.—The delay while securing this report.

As a result of our not being able to handle these 'credits' satisfactorily a considerable amount was charged off to profit and loss. A large percentage of this could undoubtedly have been recovered by suit but here again the small individual amount involved precluded the possibility of such action.

"After all was said and done, the one great underlying objection to selling or marketing tools direct was the lack of 'service.'

"A very large percentage of tool requirements are for emergency work and in any event owing to the relatively small amount of tools used in comparison to such other items as poles, pole-line hardware, and so forth less consideration is given this matter by the storekeeper than on items of which large amounts are required. As a result tool requirements are not specified until the supply is exhausted and 'service' is imperative.

"For these reasons the desired 'service' cannot be obtained from the average manufacturer.

"What about the 'economic' side of this problem?" was asked.

"Our experience in the last two years," said the sales manager, "has been that we can sell tools to the jobber, who will maintain a large and representative stock, and arrange a fair profit for him and still deliver the tools to the operating company at lower prices than we would have to charge if we sold them direct.

"By selling the jobber, our line is exploited by all his traveling salesmen at a small fraction of what it would cost us to do the same work. It is self evident that the selling cost whatever it is, must be paid for by the consumer.

"The jobber's salesman will call at least four times to the manufacturer's oncé. Being in close personal touch with the consumer the jobber's salesman has many friendships among the trade. He knows when to sell and when not to sell and for him to solicit an order for his jobbing house is in many cases equivalent to securing it. He has made a close and careful study of his particular territory, and it being local in scope, he is enabled to save time and money that the manufacturer could never hope to. He has not only one line to sell but probably hundreds of others and his selling cost is so prorated among these lines that as a result he is enabled to call on his trade oftener and sell more and at a far less expense than had he the one line to exploit.

"Now why can we arrange our prices to the jobber so that he can sell goods to the consumer cheaper than we can sell them to him direct, to say nothing of the saving on the short-er less than carload freight haul? Let us summarize:

"1st.—Our selling expense outside of advertising is practically nothing.

"2nd.—The jobber can and does pack tools for shipment along with many other items of which the manufacturer has never even heard. The packing and shipping charge is divided between several items and the item of tools is only a small proportion of the whole.

"3rd.—We have no credit losses.

"These three items about cover the economic side of this proposition. Call the jobber a necessary evil if you wish, but the fact still remains that we could not market our tools to the ultimate consumer were it not for this very same jobber who minimizes our selling costs and takes all our credit risks.

### A Case in Point

"When we make this statement we recall to mind the case of a prominent electrical manufacturing concern which was organized to manufacture a certain line of switches and electrical specialties—now sold extensively through the jobbers.

"At the outset this electrical concern felt they could, by eliminating the jobber, more advantageously market their goods to the user. They failed to see how the jobber who neither made the goods nor used them had a right to exist on the products of others.

"Just about the time that factory began to sell their product direct to the consumer they found to their great dismay that their marketing conclusion had been wrong. After interviewing various jobbers on the subject they learned the several facts which have since made this same concern a power in the electrical world.

"For instance, they found that the jobbers were in business to sell goods; that the jobbers made no goods whatever; did not know how to make goods; nor did they want to know; that they devoted their entire energies to the sale of merchandise. They found that the jobber had made a study of and had built up an organization based on many years of experience; that the concern which devoted its time to minimizing the troubles and expense of selling goods, had not time to cope with the problems incidental to their manufacture and that the factory which has succeeded in manufacturing an article successfully and economically has solved all the difficulties it should be troubled with and that it is more profitable to leave the marketing of that article to concerns which know how to market it better than the manufacturer ever will.

"The company referred to learned that by marketing their product through the jobber it would not cost them one penny for anything that did not sell and that it would cost them only a very small percentage of the price on what was sold.

"Had the company properly considered in the beginning what it was going to cost them to market their product direct—as they had contemplated—they would have known that they would need an army of salesmen which would cost them in salaries alone an amount that would be appalling, to say nothing of other incidental expenses, all of which would have to come out of the sales of their one line alone. And not only that, the expense would be on what they did not sell as well as on what they did sell.

"All of these things were learned by bitter experience and they have so revised their selling methods as to eliminate all of these troublesome items and turn the practical end of the marketing of their product over to highly trained and expert sales organizations maintained by the legitimate electrical jobber and in this way have been enabled to dispose of their product to the ultimate consumer at a far less price than had they continued their original method of selling direct.

"We do not know of a better illustration of the fact that the middleman or jobber is an economic necessity, especially in the electrical supply business.

"But putting aside all questions of an economic nature and getting down to the fundamental reason for the jobber's existence we come back to the one word 'service.' The jobber combs the country for standard electrical merchandise, buys it in the right market and maintains immense stocks in his warehouses for immediate shipment to his customers and can as a rule deliver material to them in an average time of two days. That's what counts in these 'high pressure' days.

\* \* \*

### An Advertisement That Drew

Specializing on the electric coffee percolator the advertisement shown herewith is reported as having produced good results in a famous Southern pleasure resort.

This is an example of focusing an advertisement on one feature of service, and when followed up each day or week by shifting to another feature often gives better results than the type of advertisement that attempts to present a large number of different service features at the same time. Experience alone will demonstrate which form of advertisement is best adapted to needs of a given community.

In this "ad" the scheme is a recital of the real (and imaginary) woes of breakfast getting under the old way; and then, when the picture has been made as dark as possible, the light of the electric method is switched on full blaze.

## How To Make Good Coffee--

### The Old Way

- 6:00 A. M.—Get up in a hurry.  
 6:10 A. M.—Run to the wood shed for an armful of wood.  
 6:15 A. M.—Skip out once more for a scuttle of coal.  
 6:20 A. M.—Place the kindling in the stove, then the wood, then the coal, and apply match to kindling. If it fails to burn, take everything out and carefully reset and relight.  
 6:30 A. M.—Wash your hands and dust your clothes.  
 6:35 A. M.—Fill the coffee pot with water and coffee in sufficient quantities and set on stove.  
 7:00 A. M.—The stove is getting hot and so are you. Don't worry.  
 7:30 A. M.—A cheerful (?) voice from the dining room calls: "Well, any time today for that coffee."

### The New Way

Set the *ELECTRIC PERCOLATOR*, already attached to the house wires, on the table. Then a "Twitch of the Switch" and Electricity does the rest.

This starts the day right. No dirt. No work. No worry. No screwed up face. No wrinkles. No burned hands. No harsh words. But plenty of good coffee and, just think, seven cups of coffee for 1½ cents worth of electricity.

Buy in Hot Springs

**Citizens Electric Company**

"Do It Electrically"

### Another Pull For "Safety First"

The central safety department of one of the large holding companies has been waging a novel campaign, directed particularly to children. The method used has been to issue a sticker that could be affixed to customers' bills. This sticker contains advice against inviting accidents, particularly applicable to children, such as playing with line wires and other pastimes to which juveniles are prone.

One company liked the idea so well that a requisition was made for 75,000 stickers, which rather upset the safety department calculations although the order was filled in time. A sample of the sticker as used by the Toledo Railways & Light Company is reproduced below:

#### HELP US TO PREVENT ACCIDENTS

Be Careful First  
 Let The Children Help Also

- Don't touch any wire in the street or hanging from a tree or pole.
- Don't touch or swing on a street lamp rope.
- Don't touch or attempt to fix street lamps; notify the electric company.
- Don't climb poles or street towers on which there are wires.
- Don't stand under a pole or a tower where linemen are working.
- Don't fasten clothes lines or any wires to electric light or telephone poles or towers.
- Don't have your hands wet or on any metal in the bathroom when you turn the lights on or off.
- Don't go near man holes or trenches in the street even though there are guard rails around them.
- Don't throw string or rope over wires.

THE TOLEDO RAILWAYS & LIGHT CO.

## Teaching Electrical Wiring in the Schools

How the Question of Getting Better Help is Being Solved in one Middle Western City. Spreading Throughout the Country.

By C. D. Crain, Jr.

Louisville, Ky., electrical contractors, as well as other members of the trade, are watching with much interest the innovation which has been introduced in connection with the prevocational school there, involving teaching electric wiring to boys attending the school. This is the first time in the history of the schools of that city that electrical work of this kind has been regarded as deserving a place in the educational system.

The prevocational school itself is something of a new idea. Louis A. Bacon, who is in charge of his work in Louisville, describes it as an "apprentice trade school;" that is, the boys are turned out ready to learn the trade by reason of the practical training in it that they have already received. An idea of the practical character of the work is suggested by the fact that printing, bookbinding, woodworking and other vocations in which there is a steady demand for skilled labor are being taught, the whole object being to enable the boy to find out what he can do best, and then give him some practical knowledge of the subject.

The prevocational school, as an institution, is comparatively young. Such schools are being conducted in a number of cities, including Boston, Pittsburgh, Milwaukee, Rochester and Louisville, and the idea is growing. The basis of the school is the fact that the great majority of boys and girls are forced to leave the ward schools before reaching the age of fourteen. The prevocational school would take the youngsters who cannot complete the regular school courses, give them an opportunity to learn something practical, and start them out to earn a living with an equipment molded to the needs of the individual boy or girl.

The things which determine the nature of the course to be taught include these:

The demand for remuneration of labor in the field.

The character of the work, whether comparatively simple or extremely technical.

The demand on the part of students for the instruction.

Woodworking is a "manual training" course nearly everywhere, but the fact that it was adopted for prevocational training in the Louisville school had nothing to do with the manual training feature. The latter is undertaken for general educational and cultural purposes, while the prevocational institution teaches nothing that is not immediately practical and useful. Electric wiring was considered on this basis, and was adopted for the reason that there is a big demand for trained mechanics in the electrical contracting field, and because boys with a good rudimentary knowledge of the business could easily get positions which would soon pay them unusually good wages, relatively speaking.

Showing the popularity of the work among the students, twenty-four out of the eighty enrolled are taking the course. The eighty include a number of girls, who are not eligible to instruction in wiring, so that the proportion of boys is much larger. The boys have taken hold of the course, according to Mr. Bacon, like the proverbial ducks to water, and are rapidly grasping the essential features.

Lighting and bell-wiring have been the subjects taught thus far, with special attention to insulation, connections and switches. Later on telephone wiring will be taught. Roy Bridgewater, a journeyman heretofore employed by a Louisville concern, is teaching the course, and is giving the benefits of his practical experience to the boys under him. Mr. Bridgewater is teaching the installations according to the methods prescribed by the National Code, and believes that

the apprentices he turns out will be able to put in a simple wiring installation that will pass the inspectors.

The employers in the different lines covered by the school are taking great interest in the work. The employing printers, for instance, furnished a good deal of equipment used in the school last year, and a number of them visited the institution and made talks on the practical phases of the work. The electrical contractors will be asked to supply similar co-operation in the near future, and there is every reason to believe that they will do everything in their power to assist the school to train electricians who will be a credit to the trade.

The prevocational school was started in Louisville last year, so that this is only the second year that it has been in operation. The electric wiring course was not put on until the current term, but the practical character of the work led to the inclusion of the subject by Mr. Bacon at the first opportunity. Last year a portion of a school building at Seventeenth and Madison streets was used, but the popularity of the prevocational courses was such that larger quarters were provided in the Board of Education's administration building at Eighth and Chestnut streets, where there is plenty of room to grow.

Some of the advantages of prevocational training to the children are described as follows:

"They have learned that accuracy is the first requirement for business.

"They have learned that a mistake means a financial loss to the shop.

"They have grasped the principle of team-work.

"They know that obedience, combined with initiative, spells business success.

"Since the apprentice system is obsolete, these principles are not ordinarily included by a child in a real shop. Real shops are not open in skilled work to an applicant under the age of sixteen. They are too busy turning out products to foster the development of the young workman.

"While business methods are being installed, the children are also unconsciously learning good English, correct spelling, punctuation and paragraphing.

"When the class began a reading lesson on Transportation, these words were written on the blackboard: Efficiency, Saving of Time, Improvement of Product, Prevention of Waste.

"For a few moments the class discussed what division of labor meant in their own shop; why such division meant for efficiency, the saving of time, the improvement of the product and the prevention of waste. Then the children read about the world's products. They went to the globe and saw how far many products were carried to their markets. Why did this pay? It took the class but little time to decide that it paid because the best product, the greatest time saver, the least waste, were the result of a division of labor where each section exported what it could raise best, and imported what someone else could most cheaply produce."

Combining primary studies of economics with practical training of the kind indicated certainly strengthens the boy who is almost ready to step out into the business world in the places where he is usually weakest. And the electrical contractor who has attempted to train boys for his work with indifferent success ought to be able to use a few graduates of prevocational courses, for they would not only have mastered the fundamentals of the business, but would have been prepared mentally to continue the work along the proper lines.

In fact, the hap-hazard, chance method of taking on the labor required in electrical contracting that has prevailed too largely in the past, has been a heavy burden on the contracting industry, and it is well for both contractor and employe that these steps are now being taken to end this needless element of risk.



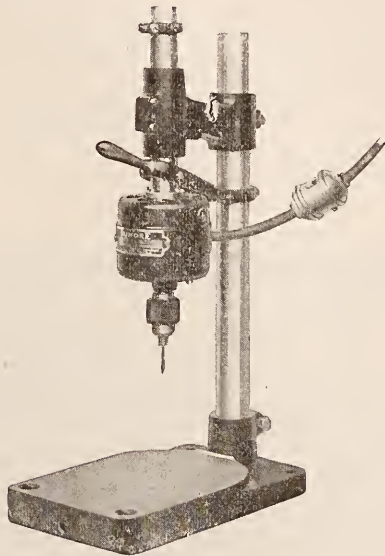
# New Products And How to Use Them

**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

The Names of Manufacturers not appearing in this Section will be gladly supplied on Request

## Motor-Driven Sensitive Drill

Manufacturers of small specialties—in fact, any manufacturers who are working up small parts—will be interested in a small, high-speed sensitive drill that has been brought out by a western electric specialty manufacturer. This bench drill is motor-driven, direct-connected, and is equipped with "S. K. F." ball bearings and a  $1\frac{3}{64}$  Jacobs chuck and has capacity in steel of from 0 to  $3/32$  brass, aluminum and wood 0 to  $1\frac{3}{64}$ .



*Motor-Driven Sensitive Drill*

The machine stands 18 in. high and has a 2 in. stroke. The motor and bracket can be readily raised or lowered on the main column. The motor overhangs sufficiently to enable the operator to drill in the center of a 6 in. circle. The drill is extremely accurate and small holes can be drilled with great rapidity. It will be found a handy and time-saving tool for all light and accurate drilling work.

❖ ❖ ❖

## Improved Storage Battery Cover

A recent improvement in storage batteries for electric pleasure and commercial vehicles, storage-battery mine locomotives and industrial trucks consists of an air-tight cell cover and filling-plug construction, which, the manufacturer declares, have many new and distinct advantages. The cover is made flush with the jar, leaving no space for the collection of moisture or dust or other impurities. The filling plug limits the amount of water than can be put into a cell to the exact amount needed to replace that lost by evaporation.

The result is said to be a clean, dry and attractive battery with the liability of short-circuiting, rotting of battery trays or corrosion of metal parts eliminated. The cover is fastened around the cell terminals by special sealing nuts which are threaded to the terminals, and the rubber washers used in connection with the sealing nuts make air-tight joints. The



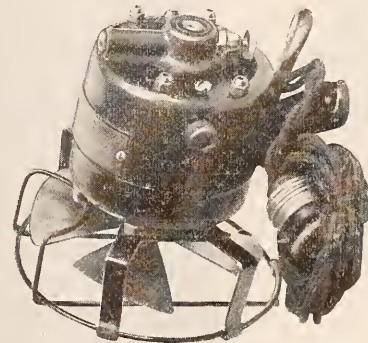
*Cross Section of Cover Showing Plug Removed*

cover and filling-plug of the type described above have already been employed in hundreds of thousands of automobile-starting batteries, where they have proved very successful. They are being used in connection with batteries that have been furnished to the United States government for modern submarines.

❖ ❖ ❖

## Travelers' Electric Fan

Travelers in these days of crowded hotels often have to put up in stuffy rooms where lack of ventilation may prevent a good night's sleep. As they need the benefits of rest as much as other folks, in order to meet this demand, a metropolitan specialty company has devised a compact, light-weight electric fan that can be readily packed in a grip and carried along on the journey. This fan is called the "Little Giant," on account of its power in comparison with its size and weight.



*"Little Giant" Travelers' Fan*

Complete with cord and plug it weighs 2.5 pounds. Its blades are 4.5 inches in diameter. It has a universal motor suitable for connection on any lighting circuit of from 110 to 130 volts. The fan is nicely finished and well built. It has speed adjustment, giving ready control of the breeze. Although designed especially for traveling use, it also serves admirably in small confined inclosures, or in providing just enough breeze for one person.

### Concentric Wiring Fittings

The new line of fittings for concentric wiring that the General Electric Company, Schnectady, N. Y., has been devising has been placed on the market. It has been gotten up along the lines indicated by the committee of the National Board of Fire Underwriters which has had the subject of concentric wiring under consideration for some time.

The line comprises cut-outs, junction boxes, snap switches, sub-bases, key and keyless receptacles, polarity caps, fused and fuseless rosettes, sockets, clamps, and tools, some of which are illustrated as shown.

These fittings have been developed for use on single circuits or 660-watt circuits in the wiring of existing buildings. Data compiled by the committee on wiring of the N. E. L. A. indicate, the manufacturer points out, that there are in almost every city numbers of small houses which the owners will not have wired because all of the standard forms of wiring are more or less expensive and, with the present methods of wiring, it is necessary to disturb the wall decorations, more or less, in order to obtain neat installations. The concentric wire is installed directly on the surface of the wall and can be covered with paint or paper.

The fittings are arranged so that the joints can be quickly and well made by expert wiremen and are designed so that the grounded sheath is continuous throughout the system. Because of the possibility of injuring the rubber insulation on the wire, the use of solder for jointing conductors is considered inadvisable. It is, of course, necessary that the outer sheath be carefully grounded at the service switch so that the whole system will be thoroughly grounded.

In the accompanying illustrations are shown various types of surface devices which will be most generally used in the smaller and more inexpensive houses. Flush switches and flush plug receptacles, however, are also being developed for use with concentric wire. The manufacturer also directs attention to the fact that concentric-wiring systems can be installed only with special permits from local insurance or municipal inspection bureaus.

The list prices range from 1 cent for supporting claims to \$1.10 for a combined three-wire, two circuit switch and plug cut-out. All these parts have a standard catalog number and are sold in standard packages of 100 each, with the exception of the clamps, which are sold in lots of 500 each.



Sample of Concentric Wire

The wire shown herewith has for its inner conductor a No. 14 B. & S. single-braided, rubber-insulated solid wire, National Electric Code standard. The wire is primarily an inner conductor surrounded by an insulating wall and jacketed over all with a closed tinned-sheet-copper sheath, folded longitudinally around the wire with a full lap giving uniform and double thicknesses.

The tinned sheath is soldered where it laps so that it forms a continuous water-tight and gas-tight jacket, having a conductivity and carrying capacity in excess of No. 12 B. & S. The finished wire measures 0.22 in. over all.



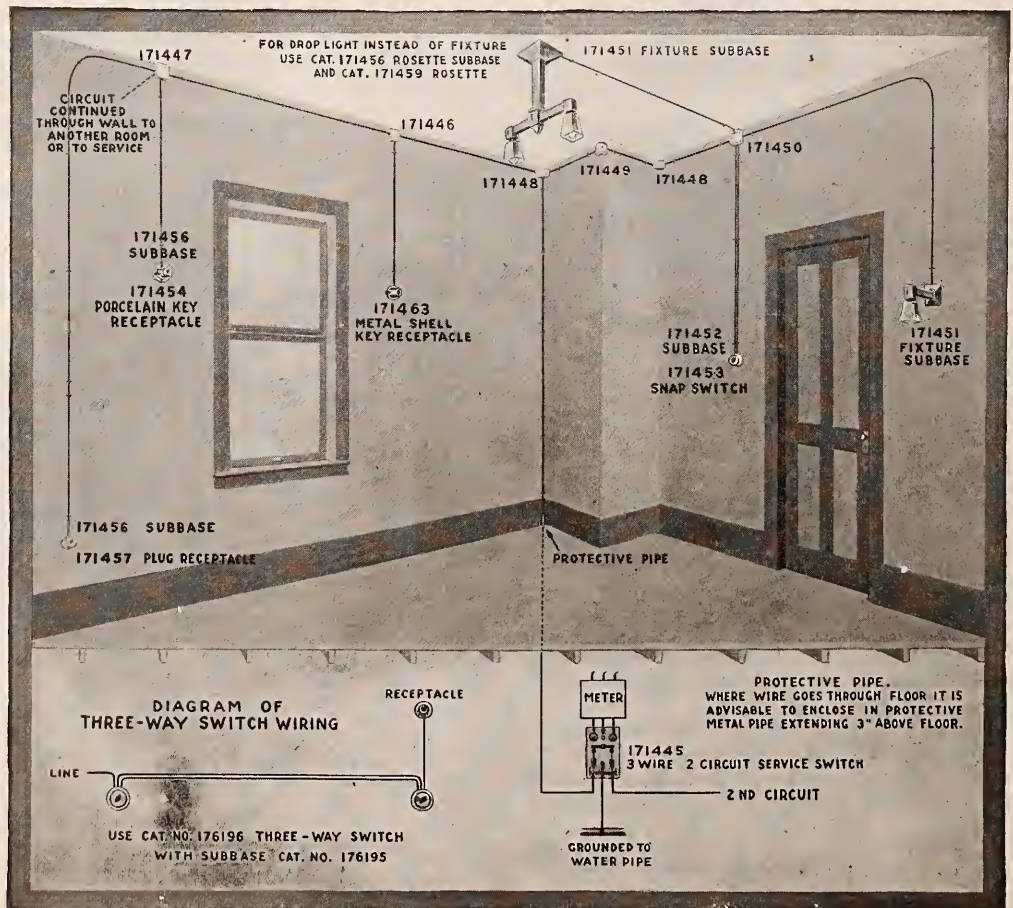
Three-way branch block



Four-way branch block



Junction box Inside Corner



Showing appearance of exposed concentric wiring



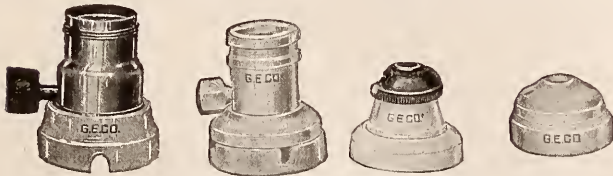
Combined Switch and Plug cut-out, three-wire, two-circuit; outside corner junction-box and junction-box for snap switch circuit.



Bases for Lighting Fixtures Receptacles and Rosettes



Bending Tool and Clamp



Receptacles and Rosettes



Pliers for Cutting and Stripping Concentric Wire

### Monogram Clock Control Apparatus

The extent and complication of up-to-date sign lighting control is well illustrated in the view of an apparatus for this purpose recently completed for a prominent sign company in Havana, Cuba, by a Chicago firm.

The switching apparatus consists of 76 individual switches, controlling a like number of circuits in four monograms, flashing on the time of day or night. The gearing in itself is very intricate inasmuch as there are numerous cams, one-tooth gears and Geneva movements, as it is necessary to revolve the lower cylinder once every minute, the middle cylinder once every hour and the top cylinder once every 12 hours; accurate timing gears are therefore essential and this mechanism is built so that it will not vary a fractional part of a second. One of the two switches on the right, next to the gear housing, controls the relay, which in turn is controlled by the master clock; the other switch controls the motor circuit, the latter starting and stopping once every 60 seconds, thus making the motor duty extremely severe.

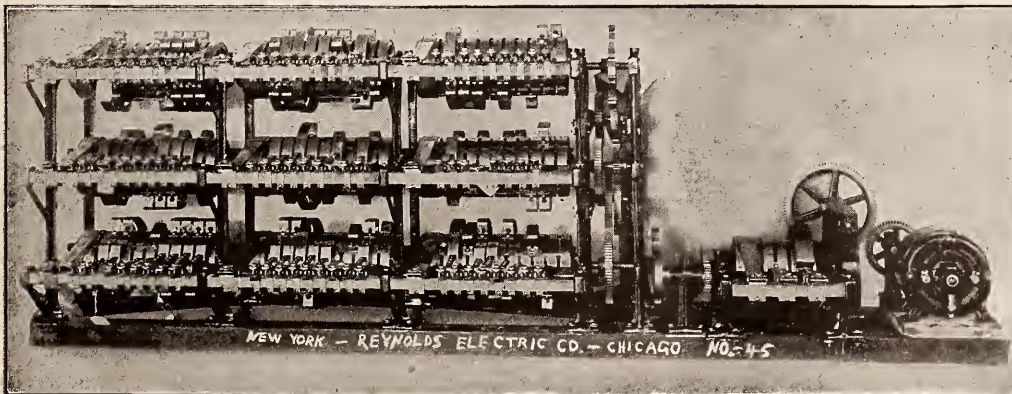
out or starting switch, and while the windings consist of both starting and running coils, in order to eliminate any possible switch trouble due to the frequency of starting and stopping, the stator was wound so that no internal starting switch was required on the winding circuit. The starting torque of the motor was not affected by this change and there was no "arc" or "flash" caused by the opening of the ordinary centrifugal acting switch.

\* \* \*

### Porcelain Socket with Iron Yoke

A substantial porcelain socket of the "Mogul" type with an iron yoke for attachment to pipe or rods for outside or similar work, has been recently brought out by a well-known New England manufacturer.

The yoke is tapped for 3/8-in., 1.5-in. or 0.75-in. pipe or rod as desired. The design of the yoke permits ample room for the conductors to be strung from the socket to the feed wires instead of drawing them through conduit or the supporting arm of the fixture. Conductors can be easily attached to



Clock Control Switch Mechanism



Porcelain Socket with Iron Yoke

The entire mechanism is built specially for this work and represents an unusual engineering feat.

Particular attention is drawn to the motor, which is also specially designed on account of the peculiarity of duty. It is of the 220-volt single phase induction type, 1/16 h.p. Contrary to precedent, the motor is constructed without a cut-

large-head binding screws and led through an opening in the top of the porcelain, thence diverging to either side of the iron bracket for attachment to the feeder.

Sockets of the type shown are also considered desirable for use in inclosed work, since the convenience in wiring and the ease of attachment reduce assembling and wiring costs.

## New Type of Emergency Connectors

Since electric power is so generally used in shops and in factories any means that permits maintaining power on an important motor is of value in keeping the shop in operation when breakdowns occur in the supply circuits or auxiliary apparatus. In taking a meter reading of the power input to a particular motor or other circuit it is also desirable to have available means for making the connection to the meter quickly and without disturbing the wiring.

These two objects were kept in mind in designing a line of power and meter connectors which has recently been placed on the market by the Electrical Engineering and Equipment Company, Wells Building, Milwaukee, Wisconsin. These connectors were invented by Lewis C. Roberson after many years of study of shop conditions and of the requirements for a connector suitable for emergency or temporary circuit connections. It can be used for connecting wires ranging from No. 14 to No. 6 and includes a fuse of the cartridge type carrying up to 30 amperes. Other connectors are made for heavier capacities, ranging up to 400 amperes.

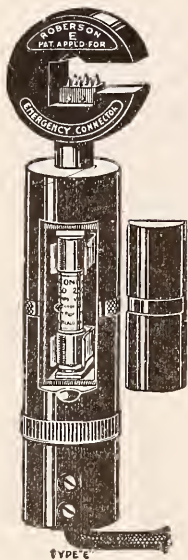


Fig. 1.—Jaw Type

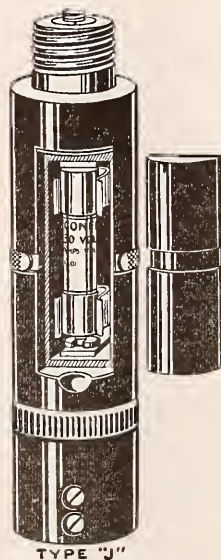


Fig. 2.—Plug Type

The construction of this type of connector is made clear in Fig. 1. It consists of an insulating handle with a separately controlled bushing at its bottom and an insulating head provided with a jaw-like opening. The insulated jumper wire or cable is placed into the lower part of the connector bushing at the bottom, the wire being held in place by the two set screws; it is not necessary to remove the insulation from the wire because on driving the set screws down tightly they will cut through the insulation and engage the conductor itself, at the same time firmly holding the wire in place. The current passes from these set screws through a movable stem that extends through the locknut between the bushing and the handle and connects with an L-shaped contact secured to the lower fuse clip. A standard cartridge-type Code fuse is placed between the fuse clips. From the upper one of these clips the current passes through contact and a metallic stem reaching through the upper part of the handle and through the jaws, connecting with the barbs or prongs which are arranged to engage the other cable or jumper; in this case, also, the connection is made without wasting time to skin the wire, the sharp prongs piercing through the insulation and making rigid electrical and mechanical connection with the wire.

Shown at the right in Fig. 1 is a small cover plate which is placed over the fuse opening in the handle. On turning the

knurled ring about the groove in this cover plate it is held in place and the fuse and its clips thoroughly protected. The body of the connector is made of insulating material and the head of the device is made of an insulating compound known as Thermoplax. Thus the entire connector is protected electrically and the fuse within it cannot injure the operator in case it should blow. The entire connection is very quickly made and serves as a means of restoring power to important circuits in which the wires may be broken through accident or otherwise.

Another type of connector is shown on Fig. 2, this is designed particularly to enable meter readings to be taken quickly and without disconnecting any wires or cables from the cutout. In order to make a meter connection the fuse is removed from the cutout clips and placed into the body of the connector between the standard cartridge fuse clips. A cover, in this case flat, is placed over this opening to protect the fuse. Thus a standard fuse is in series between top and bottom.

This type of connector can be used also in connection with the emergency connector, Fig. 1, by removing the fuse in the body of the latter and placing in its stead the meter attachment connector as shown in Fig. 2, the fuse being put into the fuse compartment of meter connector. This enables a meter reading to be taken on a temporary circuit very quickly. These meter connectors can be very quickly plugged in and readily removed without interruption to the circuit.

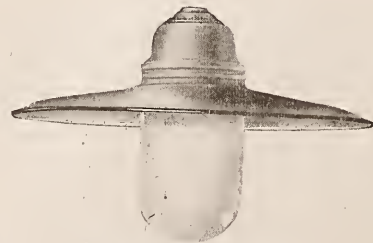
In a great many instances the value of these connectors has been proven for making quick connections of a temporary character or for restoring power to motor circuits after accidental troubles thereon. They are useful not only for power circuits but can be employed in lighting systems and for other temporary inside and outside work.

\* \* \*

## Vapor-Proof Lighting Fixture

The liability of metal to corrosion where exposed to strong vapors, gases, active liquids, steam and moisture, as is often the case in industrial lighting, has led a prominent eastern concern to perfect a non-corrosive vapor-proof lighting fixture, which is designed for use with nitrogen-filled lamps up to 100 watts.

Use is made of a strong heavily galvanized cast fitting, threaded for half inch conduits, which is securely riveted from below to a canopy or socket housing, ground formed in one

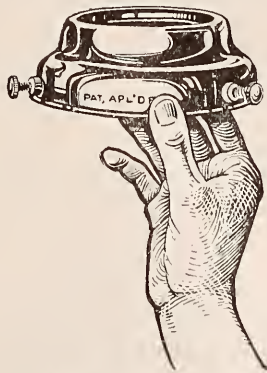


Vapor Proof Reflector

piece with a 15-inch porcelain enamel steel reflector. As asbestos washer is inserted between the two parts to make a tight joint and prevent abrasion in wind stresses. For use in extra dense and active fumes a solid aluminum casting is substituted for the galvanized fitting. A screw thread is cut on the canopy before enameling, and a vaporproof globe with threaded collar is screwed into the canopy with an asbestos gasket to seal the joints. A medium screw base porcelain socket, firmly secured inside the canopy and accessible for wiring completes the fixtures which is claimed to combine simplicity of parts with strong construction and to be absolutely vaporproof.

**Quick Snap Shade Holder**

A shade-holder designed to slip over the ring at the bottom of any standard socket is the "Ampico," illustrated below. These shade holders are substantially made and are



*Improved Shade-Holder*

claimed not to bend under the weight of any shade. It can be attached in an instant and holds firmly under all conditions. It is designed for use in all classes of work where shades are used.

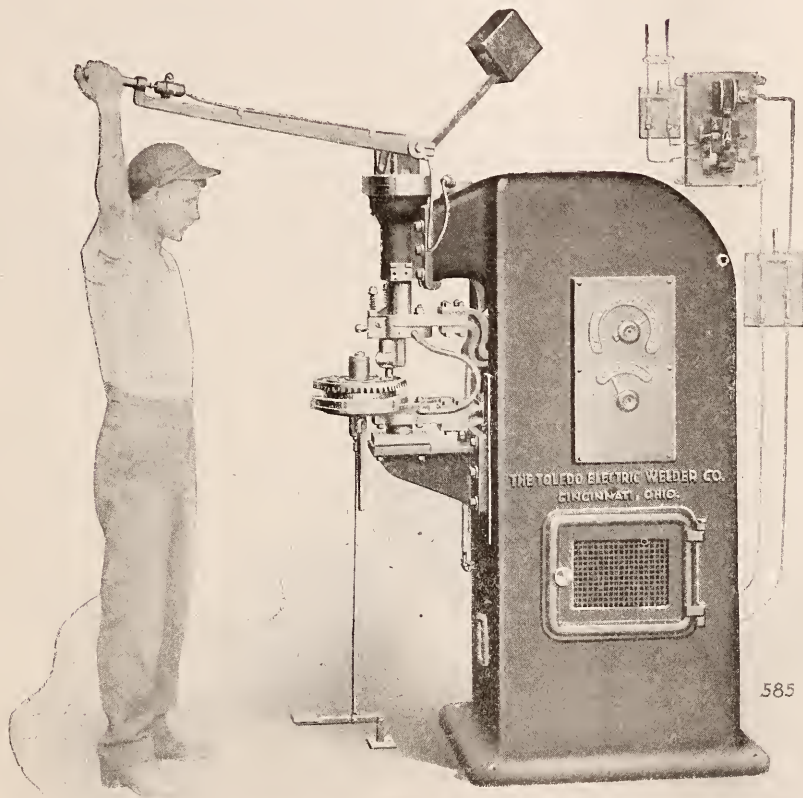


**Electric Riveting Machine**

One of the recent developments is the use of electric power for heating and upsetting rivets. The demand for a machine of this type has been created in lines of business using gears which are riveted together, and other material requiring riveting that is produced in large quantities.

In the electric process, rivets are inserted in the work cold and placed between the dies of welding machine—the dies are brought together—the current turned on, which heats the rivets throughout its entire length in the fraction of a second, and a further movement of the compression lever upsets the end of the rivet and causes the rivet to expand in the work, thereby making a tight and solid joint. No scale is formed because the heat developed is just exactly the proper amount, and the whole operation is over before oxidation can take place appreciably. By applying pressure from the dies upon the protruding end of the rivet, the stock is gradually folded over and pressed down, obviating the breaking up of the fibrous structure of the metal and insuring a head of maximum strength. The pressure being applied just as the heat is developed, also prevents the cooling of the rivets before the upsetting takes place, which of course is of obvious advantage.

In the illustration the upper die or electrode which bears upon the protruding end of the rivet, is caused to move upward and downward by the action of a toggle joint in the head of a welder which is operated by a movement of the hand lever. The leverage thereby secured is very great, resulting in sufficient force being exerted to properly upset the rivet with very little exertion upon the part of the operator. Current is turned on and off by a little master switch operated by a push button in the end of a lever, which controls the magnetic switch mounted upon the wall for handling the current taken by the welder. The work is in plain view of the operator at all times so that he very quickly learns to judge the proper heat required and the exact pressure necessary to secure the best results. The current is regulated by the dial switch shown on the right hand side of the machine, so that one machine can handle quite a range of stock as regards the size and length of the rivets used. These machines are provided with adjustments for taking up the wear of the dies, which are renewable, and provision is made



*Electric Riveting Machine and its Product*

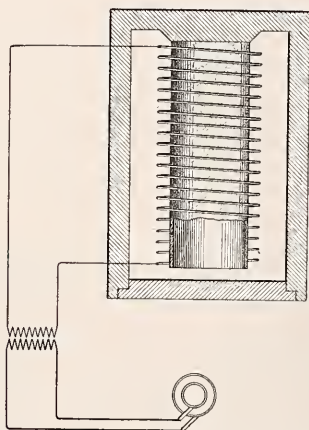
for varying the pressure applied.

The cost for current for upsetting  $\frac{1}{4}$  inch rivets, is two cents per 1000, and 5-16 inch rivets, four cents per 1000, based on current costing one cent per kilowatt hour. One man can do from three to five times as much work per day when heading rivets by this process, than can be done by the pneumatic method, or similar methods of riveting. The cheapest labor can be employed as no skill is required when operating one of these machines. It's the clean, quick and silent method of riveting.

## Recent Electric Patents of Interests

### METHOD OF TREATING METALS

In place of working or heating metals in the usual way to change the molecular structure or grain, Mr. Frederic L. Bishop, of Pittsburgh, Pa., in a patent issued to him on February 15th, 1916, describes a method of annealing, tempering, etc., by subjecting the metal to an alternating magnetic field. A coil carrying alternating currents is placed about the metal to be treated and produces both heating effect and magnetic effect therein. This combined action results in producing the desired

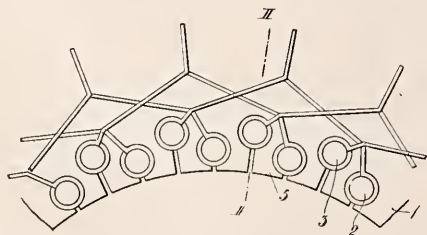


*Coil for Magnetic Annealing of Metals*

changes in the metal at a much lower temperature than when heat alone is employed. Also, the regulability of the heating by controlling the current permits the regulation of heating or cooling in any desired degree. It may be cooled gradually for annealing or the bar may be removed from the coil and quenched for hardening or tempering. In addition to the regulation of the amount of the current its effect may be changed by varying its frequency. Patent No. 1,171,832.

### STATOR FOR ALTERNATING-ELECTRIC-CURRENT MACHINES

For reasons well known to electrical engineers it is desirable, if possible, to have but one bar of bar winding in a slot. This is practicable, however, only in cases where the machines have a low tension, a high number of kilowatts, and a high number of revolutions. Mr. Jens Lassen La Cour, of Vesteras, Sweden,

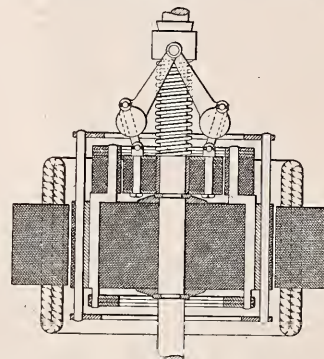


*Arrangement of Slots for Single-bar Windings*

has devised a form of winding wherein a single-bar-in-a-slot winding may be available under circumstances where it was hitherto impracticable and without producing undue magnetic density in the core teeth. This he does by having rows of bars at different distances from the air gap and staggering the bars of the rows as indicated in the cut. Patent No. 1,172,517.

### ALTERNATING-CURRENT MOTOR

Mr. Sven R. Bergman, of Lynn, Mass., in a patent issued March 7, 1916, shows a simple and effective means for varying the impedance of a secondary winding of an induction motor in response to speed conditions so as to regulate the motor accordingly. Mr. Bergman employs a centrifugal governor which

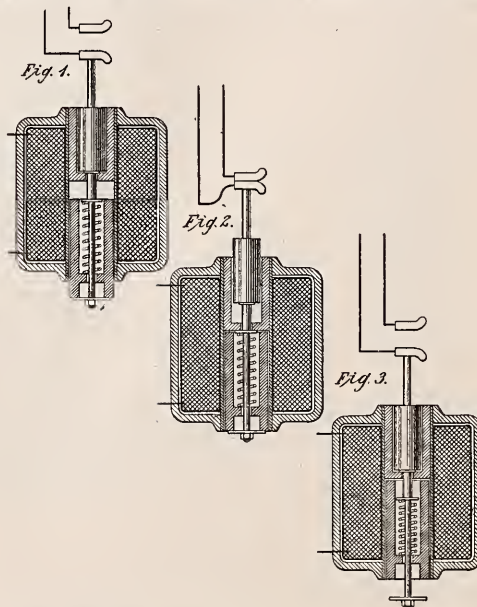


*Centrifugal Regulating of Alternating-Current Motor*

operates upon a magnetic mass affecting the magnetic circuit of a secondary winding and so varying its impedance. The device is quite clearly indicated in the cut. Patent No. 1,174,654.

### ELECTROMAGNET AND ELECTRICALLY-OPERATED SWITCH

In the control of resistance steps by electromagnets for regulating the starting and acceleration of motors it is desirable that the sections shall be cut out within certain predetermined limits of current. That is to say, a section should not be cut out when the current is too small nor should it be cut out when the current is excessive. Various devices, many of them quite complicated, have been devised to achieve this result. In a



*Overload and Underload Cut-Out Electro-Magnet*

patent to Mr. Ragnar Wikander, of Pittsburgh, Pa., issued March 14, 1916, is described a magnet structure which will not close the contacts which it controls when the current is either too large or too small. The structure of this device and the manner of its operation is clearly shown in the three accompanying cuts showing the device under different conditions of operation. Patent No. 1,175,323.

# TRADE LITERATURE

# Catalogs and Books

## A Review of the Latest Publications

**Domestic Electric Machines**, including washers, ironers and vacuum cleaners of the "Thos" make, are skilfully set forth in Catalog C of the Hurley Machine Company, Chicago and New York.

✦ ✦ ✦

**Electrical Lighting Decorations**, a specialty of the Elblight Company, New York, are described and illustrated in a folder recently issued by the company.

✦ ✦ ✦

**Electrical Window Display** and contractors' advertising in general are touched upon in "Display-Service-Bulletin" sent out by the Society for Electrical Development, Inc., New York.

✦ ✦ ✦

**Selling Mazda Lamps** is the title of a lamp-handbook gotten up for those who sell Mazda lamps, by the Westinghouse Lamp Company, New York. It is full of up-to-date information on Mazda lamps and is sent without charge to those who request it.

✦ ✦ ✦

**Self-contained Generating Plants** of the kind manufactured by the Universal Motor Company, Oshkosh, Wis., are described in the company's illustrated Bulletin No. 20.

✦ ✦ ✦

**Insulating Cable Joints** is the subject of an illustrated booklet entitled "Conducell, a Method of Insulating Cable Joints in Underground Transmission Systems," recently published by the Mica Insulator Company, New York.

✦ ✦ ✦

**Lightning Arrestors** and other protective apparatus are the subject of a catalog just sent out by the Electric Service Supplies Co., Philadelphia, Pa.

✦ ✦ ✦

**Electric Hoists** and similar apparatus as made by the Brown Hoisting Machinery Company, Cleveland, O., are told about in its Catalog D.

✦ ✦ ✦

**Electric Radiators** constructed on the Appel system are described in an illustrated folder sent out by the Lee Electric Radiator Company, Chicago, Ill.

✦ ✦ ✦

**Intermittent-Duty Controllers**, as made by the Allen-Bradley Company, Milwaukee, Wis., are told about in its illustrated Bulletin B-16.

✦ ✦ ✦

**Insulated Staples, Tube Flux** and compressed cleats, the product of the Blake Signal and Manufacturing Company, Boston, Mass., are set forth in recently issued circulars of that company.

✦ ✦ ✦

**Electrically Illuminated House Numbers** designed for attachment to an ordinary electric porch lamp are described in an illustrated circular sent out by Stanley & Patterson, New York.

✦ ✦ ✦

**Correspondence Courses in Electrical Engineering** as offered by the Joseph G. Branch School of Engineering, Chicago, Ill., are described along with eight other engineering courses, in the school's latest catalog.

**Electric House Pumps**, as made by the Columbus Pump Company, Columbus, O., are described in its Bulletin A-18.

✦ ✦ ✦

**Indestructible Miniature Transformers** made by the Thorardson Electric Mfg. Company, of Chicago, Ill., in sizes of from 40 to 120 watts, for low voltage electrical toy operation, are described in a well gotten-up folder recently distributed.

✦ ✦ ✦

**"Willey" Electrically Driven Tools**, a handsome well arranged booklet, illustrating the well-known line of drills, buffers and grinders, made by the James Clark, Jr., Electric Company, Louisville, Ky., is the title of the company's Catalog No. 26. There are more than 40 varieties in the company's standard output of these machines.

✦ ✦ ✦

**Cut Glass Illuminating Shades** an artistic product of the Jefferson Glass Company, Follansbee, W. Va., are depicted in a little blue folder lately sent out by the maker. They are mailed upon request.

✦ ✦ ✦

**Lighting Reflectors** designed on the "eye comfort" system, and their applications in many kinds of buildings, are the subject of a booklet recently sent out by the National X-Ray Reflector Company, Chicago, Ill.

✦ ✦ ✦

**Vapor Proof Lighting Fixtures** for use with its "Steelite" conduit are told about in an illustrated folder issued by the Inland Electric Company, Chicago, Ill.

✦ ✦ ✦

**Pole Line Hardware and Construction Specialties** are artistically listed and displayed in the new Hubbard catalogue, issued by Hubbard & Company, Pittsburgh, Pa., the largest manufacturers of this kind of material in the world. The complete line of high-class steel specialties for which the company is well and favorably known, is explained in legible type, on heavy soft-finish paper. The book is divided into 16 sections, in each of which material is grouped according to the purpose arms and fittings; high-tension arms and fittings; telephone and armse and fittings; high-tension arms and fittings; telephone and telegraph wiring; cable material, etc. It has 260 pages and 616 illustrations, carries a lot of useful engineering information and will be mailed on request to those interested.

✦ ✦ ✦

**"Some Installations of Westinghouse Switchboards"** is the title of a twenty-page folder just issued by the Westinghouse Electric & Mfg. Company. This folder illustrates the switchboards, control desks and switching equipments in some of the largest and most important of recent power developments and gives an excellent idea of some of the work being done by the Westinghouse Company in the switchboard line.

The company has also published a leaflet, No. 3823-A, on the latest type of rotary converters, and a Catalog Section I. P. 45 illustrates "modifications of the standard type of C. S. Motor." These modifications involve motors adapted for conduit wiring, idler pulley, back gearing and other changes from standard. Catalogue sections have also been issued on "Pole Line Hardware," "Type C. W. Slip Ring Induction Motors," a new pressed steel motor for constant and variable speed—continuous duty service now being brought out; and on "Switchboard Meters for Measuring Current, Pressure and Energy."

## General News

### Ohio State Electrical Show

The Ohio State Electrical Show will be held April 27, 28, 29, 1916, at Columbus, O. The best engineering companies of the country will be represented and their exhibits will give the public the opportunity of comparing advantages and disadvantage, developments and improvements of everything electrical. Lectures will be given on high-frequency work, modern inventions, X-Ray and other subjects which every one desires to know more about. This show which is given only once every two years is held under the auspices of the Ohio State University, Columbus, O.



### Long Lived Lamps

While refurbishing the City Opera House at Waterville, Me., several carbon-filament incandescent lamps were found still giving service. These lamps have been in use almost every evening for thirteen years.



### Detroit Nearly All Wired

Practically every detached residence, every apartment house and every cottage costing more than \$1,200 recently built in the territory served by the Detroit Edison Company is wired for electric light and is served by the company.



### Workmen's Compensation for Kentucky

The Kentucky Legislature has passed the workmen's compensation bill which has been before it since early in the session. It provides for insurance with the commercial companies or with mutual organizations and does not create a state fund, and it is virtually compulsory, since those employers who do not take advantage of its terms are deprived of the usual common-law defenses in cases of employees' claims.



### Rates for Street Lighting in Seattle Increased

The president of the Seattle City Council has, over the protest of the Mayor, fixed the rates for street lighting for 1916 at 4.5 cents per kilowatt-hour. The city, which is served from a municipal plant, formerly enjoyed a rate of 4 cents per kilowatt-hour for this service.



### Electrical Utilities Broke Records in 1915

Reports from those who make it their business to gather the statistics of the earnings and output of the electrical utilities show that the year just closed broke records in every direction, despite the fact that it opened under rather depressing circumstances.

Excluding all electric generating stations connected with electric or steam railways and all isolated plants, the combined earnings of the commercial light and power companies of the country in 1915 were \$360,000,000, an increase of \$24,000,000 over 1914, while their combined output was 18,400,000,000 kilowatt hours, a gain of 1,800,000,000.

Statistics covering 65% of the industry with the remaining 35% carefully estimated, show that the electric generating and distributing industry of the country is now in the best condition in its history. January, 1915, showed an average gain of only 4.1% in revenues over January, 1914, and for February, 1915, this gain dropped to 2%. From that time on there was a steady increase in the ratio of gain and for December, 1915, revenues showed an average increase of 11.8% over December, 1914, while output made an average increase of 23% as compared with but 1.4% for January, 1915, over January, 1914.

The gains in business by the companies would have been even larger, but for the inability of industrial concerns to obtain the required motors and of the companies to secure the additional generating equipment. So great has been the demand for electric power in the last few months that the manufacture of power apparatus have been hard put to fill the demand.

## Legal Notes

### Cannot Utilize Railway Poles for Carrying Light and Power Wires

In an opinion given to the Board of Supervisors of San Francisco, the city attorney stated that the San Francisco & Sierra Power Company had no legal right to furnish electric power to customers by using the poles of the United Railroads of San Francisco for carrying its wires. He said that the franchise for the erection and maintenance of the poles was granted only for the operation of a street railway system and there is no authorization to utilize them for any other purposes.



### Electric Rate Fixed by Municipality

The State Supreme Court, West Virginia, has handed down a decision holding that the Public Service Commission of the State has the power to change a public service rate fixed by a municipality by ordinances before the enactment of the law creating the Commission, where the authority to fix such rate was not expressly vested in the municipality by legislative action.



### Public Service Obligations go With Ownership

A recent decision of the Mississippi Supreme Court holds that in case a bankrupt public utility company is purchased by an individual the duties of the utility as well as the privileges are purchased and that such an individual can be compelled to operate the plant by the courts for the benefit of the public.



### Discrimination in Charges—Ground for Damages

A public service corporation in Iowa engaged in furnishing electric light and power to the inhabitants of a city, has no power to charge one patron one price, and a competitor a lower price for the same service under the same conditions, even though the higher price is not unreasonable or unlawful. Where such a company unlawfully discriminates in the rates charged, it is liable in damages to any person injured as the proximate result thereof; but, in the absence of a statute, a person not injured by such an unlawful act cannot recover. In an action against such a company for damages due to a less rate being charged for light and power furnished by the defendant to the plaintiff's competitor than was charged the plaintiff, it appears that the plaintiff was engaged in printing a weekly newspaper, and doing a job printing and electrotyping business, and that its competitor was engaged in running a newspaper and job printing plant in the same city under like conditions. It was held that the damages recoverable were such as were the direct and approximate result of the lower rate and therefore the difference in rates was not the true test of the measure of damages.



### Workmen's Compensation Act Relates Only to Employer and Employee

In an action for damages resulting from injuries to an electrician who was sent by his master to a factory to install some new wires and while at work there was injured through the alleged negligence of the owner of the factory, it was held that the Wisconsin Workman's Compensation Act applies only as between master and servant, and does not apply so as to prevent an action at law for injuries which an employe of one person has received at the hands of another, so that the electrician's remedies were not controlled by that act.



### Philadelphia Rate Case Compromised

The suit of the City of Philadelphia against the Philadelphia Electric Company to enforce lower rates for electric service has ended in a compromise whereby the electric company agreed to reduce its charges in such a manner as to decrease its gross income by \$1,000,000.



# Review of the Month

## A Complete Record of Important News Edited for Busy Readers

It is reported that the cost of generating energy by steam, in the case of the city of Seattle, Wash., was twice as costly as by water power during the year 1915. Seattle's municipal lighting plant paid \$56,160.16 for the generation of energy at the hydroelectric power plant at Cedar Falls, and \$112,466.26 at the Lake Union steam auxiliary plant in Seattle.

\* \* \*

The Boston Electrolytic Oxygen Company, recently incorporated with a capital stock of \$150,000, is manufacturing compressed oxygen and hydrogen gases at Everett, Mass. The process consists of electrolysis of distilled water which produces oxygen guaranteed 99.3 per cent. pure and hydrogen 99.9 per cent. pure.

\* \* \*

The Westerly (R. I.) Light & Power Company has applied to the State Legislature for an amendment of its charter, to increase its capital stock from \$700,000 to \$1,000,000.

H. D. McCutcheon & Co., of Pittsburgh, Pa., have received a contract from the Akron & Youngstown Electric Railway Company to construct an electric railway from between Akron and Youngstown, a distance of about 50 miles. Estimated cost \$3,000,000, exclusive of terminal facilities.

\* \* \*

The Hot Springs Light & Power Company, Thermopolis, Wyo., offers \$100,000 in bonds for sale, proceeds to be utilized for improvements to its hydroelectric power plant and for refunding purposes.

\* \* \*

The Elephant Butte Water Users' Association has under advisement the installation of a 400-hp. hydroelectric plant in the irrigaton canal near Leasburg diversion dam, about 15 miles north of Las Cruces.

\* \* \*

A power development at Big Bend in the Missouri River is planned by the Missouri River Power Company, recently incorporated with a capital stock of \$1,000,000.

\* \* \*

As a result of the installation of a municipal electric plant at Blair, Neb., the local plant of the Nebraska Gas & Electric Company will be discontinued.

\* \* \*

Daykin, Neb. has the construction of a municipal electric-light plant under advisement.

\* \* \*

Wm. A. Baehr and associates of Chicago, Ill., recently purchased the holdings of the Durant Ice and Light Company, Durant, Okla.

\* \* \*

Houston (Tex.) will construct a wharf, to be known as No. 4, at an estimated cost of \$400,000. It will be equipped with a 20-ton traveling crane, to be operated by electricity.

\* \* \*

The Denver Gas & Electric Light Company announces that during 1915 it sold 9,218 electrical appliances, which constituted a record.

The sales of all appliances showed good splendid increase, but the best example probably was that of irons, 4,851 being sold last year as against 3,124 in 1914, an approximate increase of 50 per cent.

The General Electric Co. has announced a bonus of 5 per cent. on the individual earnings for the current year of all employees in all of its plants who have been with it over five years.

This will mean a distribution of over \$3,000,000 to the older employes of the company, who are estimated to number 50,000 men. Payment will be made in two instalments.

\* \* \*

A steam power station of 60,000-kilowatts capacity is now under construction in Buffalo, N. Y., for the Buffalo General Electric Company. The installation will include three 20,000-kilowatt turbogenerators with five boilers of approximately 13,000 square feet of heating surface each, necessary steam and electric auxiliaries, coal-handling apparatus and trestle, and intakes and discharges for the condensing system. The Stone & Webster Company is doing the engineering.

\* \* \*

A notice has been filed by J. L. Fountain, Seattle, Wash., with the Snohomish County Commissioners at Everett appropriating 10,000 cu. ft. per second of water on the Sauk River for a hydro-electric development. It is reported that Mr. Fountain represents a British Columbia corporation which wishes to build a hydroelectric plant on the site.

\* \* \*

The I. P. Morris Company has just secured the contract for one 19,500-hp. vertical-shaft, single-runner turbine to operate under a head of 68 ft. at a speed of 100 r.p.m. for the Lock No. 12 development of the Alabama Power Company on the Coosa River. The unit is to have a rating of 2,000 hp. greater than the existing I. P. Morris units in the same station, the head and speed for each of the five machines being the same.

The Crocker-Wheeler Company, Ampere, N. J., has awarded a contract to the American Concrete-Steel Co., Newark, N. J., for the erection of a three-story, reinforced concrete addition, about 80 x 100 ft., to cost about \$60,000.

The Empire District Electric Company, Joplin, Mo., is making an extension to the turbine room to accommodate 30,000 kilowatts, of which 10,000 is to be in operation in May.

J. B. McCrary & Co., Atlanta, Ga., have received contract to erect electric-light plant and water works at Nashville, N. C. Approximate cost \$45,000.

\* \* \*

The Johnson Construction Company, of Pittsburgh, has been granted a franchise for the construction of an electric-lighting system at Gratz, Pa.

The Northwestern Power & Manufacturing Company, recently incorporated at Wilmington, Del., with a capital stock of \$750,000, for the purpose of acquiring real estate, power sites and water rights, for the generation of electrical energy.

The Peoples' Incandescent Light Company, of Meadville, Pa., and seven other companies have consolidated and are now operating under the name of the Northwestern Electric Service of Pennsylvania.

A 44,000-volt transmission line will be constructed from Provo (Utah) to Price, and other points in Carbon County, 75 miles long, to furnish energy to the coal mines in that section.

\* \* \*

The Essex Storage Electric Co., recently incorporated with a capital stock of \$200,000 is contemplating a large hydro-electric development at Victory on the Moose River to transmit energy for power and lighting purposes to St. Johnsbury, Vermont, and neighboring communities.

The Bigwood Woolen Company at Spencer, Mass., is installing electric motors to run its yarn making department, in order to be able to operate with day and night shifts.

\* \* \*

The Buffalo General Electric Co. has filed application for authority to issue \$3,625,000 in bonds for the construction of its steam-electric plant at Tonowanda, on which work has already been started.

\* \* \*

The New York Central Railroad will extend its electric zone from Harmon northward to Poughkeepsie, discontinuing the use of the old tunnel at Storm King.

\* \* \*

The Leaksville (N. C.) Light & Power Company contemplates the construction and equipment of a distributing station at Leaksville and will purchase power from the Southern Power Company, of Charlotte.

\* \* \*

The formation of an electric power syndicate to be known as the Northern Iowa Gas & Electric Company, involving the expenditure of several millions of dollars has been announced. With the large power plant of the Northern Iowa Power Company at Humboldt (Iowa) as a nucleus, plants will be established in thirteen communities.

\* \* \*

Adams & Company, of Sulphur, Ky., has obtained the franchise for the construction of a new electric lighting plant at LaGrange.

\* \* \*

The chief engineer and promoters of the Nashville and Smithville (Tenn.) Electric Railroad are buying right of way and taking other preliminary steps for the building of the road. W. B. Foster, of Smithville, is interested in the project.

\* \* \*

Commissioner Barber, of Birmingham, Ala., is urging the issuance of bonds to increase the capacity of the present municipal power plant in North Birmingham, which has been under advisement for some time.

\* \* \*

The Cooper Electric Co. (Cooper, Texas), is planning the extension of its transmission lines.

\* \* \*

The Citizens' Water Works & Lighting Company is being organized at Lockhart, Tex., for the construction of a water works and electric lighting plant.

\* \* \*

The Sequin Electric Light & Power Company is making a campaign on electrical appliances, especially cooking apparatus. The company will install a new power house at Sequin, Texas, and will install a turbogenerator to deliver about 200 horsepower.

\* \* \*

According to a report made by the United States Land Office in Salt Lake City the Government has withdrawn eighteen miles of land bordering the Snake River in Idaho for power sites.

\* \* \*

The electrification of the Southern Pacific Company's west side line from Whiteson to Corvallis, Ore. is in course of construction. The estimated cost of this work is \$800,000, not including the terminals at Corvallis.

\* \* \*

The Puget Sound Traction, Light & Power Company is constructing an elaborate system of negative feeders at an estimated cost of \$50,000, by which it is proposed to return stray current to the various substations. The system will cover practically every electric line in Seattle, and is considered the best means of controlling the current with the exception of a double trolley system on the street railway lines which is considered so expensive as to be prohibitive.

The Penn Central Light & Power Company, of Altoona, recently secured contract for furnishing electric power for the great Standard Steel Works at Burnham, Pa., which is the largest power contract ever received by that corporation. Due to the growth of the work at the Burnham plant the Standard Company has decided to purchase electric power, instead of using its own electric power, as before, and has contracted with the Penn Central Company for a load of 4,100 horsepower.

\* \* \*

The Kansas City Light & Power Company, successor to the Kansas City Electric Light Company contemplates a revision of rates for power. All power contracts were annulled by the reorganization of the new company, the rates of some having been very low. Domestic rates are not affected.

\* \* \*

The Westinghouse Electric & Manufacturing Co., has received an order for 30,000-kw., single-unit turbo-generator set from the Brooklyn Rapid Transit Co. for installation in their Williamsburg generating station. The turbine will operate at 1500 r.p.m. on steam at 200 lb. pressure and 115 degree superheat and will exhause into a 28.5 vacuum furnished by 40,000-sq. ft. Westinghouse surface type condenser.

\* \* \*

The Hortonia Power Company, of Rutland, Vt., is tunneling a mountain near Lake Dunmore to tap Silver Lake, where a storage reservoir up in the hills will provide a reserve supply of about 400 million cubic feet of water. A generating plant to be built near the shore of Lake Dunmore will have an ultimate capacity of 7,000 horsepower. A development of about 1,000 horsepower will be at Hortonia, 1,000 at Bethel and 500 horsepower at Gaysville, and transmission lines will be extended south to Brandon, Proctor and Tinmouth; also to Middlebury and Bristol on the north, and from Bethel northeast to the granite region in the central part of the State.

\* \* \*

The large steel mills continue to place orders for record size motors. In addition to the 15,000-hp. machine recently purchased by the Indiana Steel Company, the National Tube Company has purchased another of the same size and two more are going through the Westinghouse Electric & Manufacturing Company's works.

All these motors are used on 40 inch reverse blooming or rolling mills.

\* \* \*

The Great Lakes Power Company, Ltd., a recently-formed corporation, has purchased the entire water-power development and water-power rights at Sault Ste. Marie, Ont., from the Algoma Steel Company. At present 12,000 hp. is sold as water power and a 6,000-hp. hydroelectric development is in operation. The ultimate rating of the development is about 48,000 hp.

In addition to the power rights the Great Lakes Power Company, Ltd., also bought the street railway system, which has about 7 miles of track, and the International Ferry, operating between the customs houses of the United States and the Canadian Governments.

\* \* \*

According to the report of the Canadian Department of Mines which recently made an investigation of electric smelting of iron ores preliminary to establishing a similar industry in Canada, the two types of electric furnaces most used on the Scandinavian Peninsula for iron ore smelting are the Elektrometall and the Helfenstein types. In June, 1915, there were in operation in Norway and Sweden seven Elektrometall furnaces of an aggregate rating of 25,400 horsepower, and there was in process of construction ten furnaces of this type of an aggregate rating of 32,200 horsepower. Of the Helfenstein and Tinfos furnaces there were in operation in June, 1915, seven furnaces of an aggregate rating of about 14,000 horsepower.

## Among the Associations

The Electrical Supply Jobber Association will be held at Hot Springs, Va., June 7, 8 and 9.

\* \* \*

The American Society of Mechanical Engineers will hold its next meeting in New Orleans, April 11 to 19 inclusive. The opening session will be devoted to "Industrial Preparedness" on which a paper will be presented by Mr. S. Spencer Miller, one of the Naval Consulting Board.

\* \* \*

The 1916 convention of the Southwestern Electric and Gas Association will take place at the Hotel Galvez, Galveston, Texas, May 17 to 20 inclusive.

\* \* \*

The American Association of Engineers announces that it has now a membership of 500, sixty-five per cent. of which is in and near Chicago and the remaining thirty-five per cent. is scattered throughout the United States, Canada, England, Philippine Islands and even in South America.

Its course of lectures is highly complimented by engineers of long experience and high standing as conveying a message for a higher standard of ethics between engineers and those who profit by their endeavors. The new association seems to have found a field of activity different from those of the older societies.

\* \* \*

The sixth annual banquet of the Westinghouse Interests in the Pittsburgh district was held at the Fort Pitt Hotel, Pittsburgh, Pa., on March 11. About 500 men were present.

\* \* \*

An association to be known as the "Export Buyers' League" has been formed to consolidate the interest of those engaged in buying for export, a group of men through whose hands passes practically all of the country's export business.

\* \* \*

The ninth annual convention of the Minnesota Electrical Association was held at Minneapolis on March 21 and 22.

\* \* \*

The Illuminating Engineering Society is about to publish a complete new list of its members.

\* \* \*

At the March meeting of the American Institute of Electrical Engineers held in the Engineering Building, New York, the subject of the destruction of iron and lead by electrolysis was discussed.

\* \* \*

The A. I. E. E. directors have nominated Mr. H. W. Buck for president in the next election.

\* \* \*

The monthly meeting of the New York Electric Society was addressed by Mr. Frank J. Sprague, telling of a month he spent with the Atlantic battleship fleet. As an ex-lieutenant in the Navy and as an electrical engineer, Mr. Sprague doubly qualified for getting the useful information obtained on this trip.

\* \* \*

A Radio Club has been recently formed at Louisville, Ky., which is devoting most of its attention to wireless telegraphy and study of general electrical matters. Meetings are held at regular intervals at the offices of the Tafel Electric Company, at which well-known authorities in their lines are present as speakers.

\* \* \*

The Missouri Association of Public Utilities, which represents practically all of the privately owned public utilities in the State, will hold its tenth annual convention on May 11-13 on board the steamer Quincy, en route from St. Louis to Peoria, Ill., and return, traversing the Mississippi and Illinois Rivers.

## Personal

Mr. John B. Sebring has been appointed the Pittsburgh district sales agents of the Ward Leonard Electric Company of New York.

\* \* \*

Mr. L. F. Tissot, formerly with the Century Electric Company, is now sales engineer for Curtis & Carhart, Inc., New York.

\* \* \*

Mr. Geo. Drake Smith, until lately with the General Vehicle Company, is now assistant sales manager of the Edison Storage Battery Co. at Orange, N. J.

\* \* \*

Mr. Ralph B. Coleman has transferred his services from the Electric Machinery Company of Minneapolis to the Moloney Electric Company of St. Louis.

\* \* \*

Messrs. D. W. Mead and F. W. Scherdenhelm have opened up a hydroelectric consulting engineering partnership in the Equitable Building, New York City.

\* \* \*

Mr. N. Kishi, superintendent and electrical engineer of the Osaka Electric Light Company, Osaka, Japan, is now in the United States on a tour of inspection of central-station lighting properties.

\* \* \*

Mr. Geo. L. Hatheway has taken charge of the recently opened New England office of Pass & Seymour, Inc., of Solvay, N. Y.

\* \* \*

Mr. E. Thurnauer, of Paris, France, a well-known electrical engineer of France and the European representative of the General Electrical Company, has been touring the United States since November and is now in the Pacific Northwest. As one of the officials of a big French electrical equipment company and managing director of the omnibus company which handles the traffic of Paris, M. Thurnauer has come in closer contact with the war than the average citizen and declares that one of the most interesting revelations of the struggle has been the adaptation of electricity and motor-driven vehicles to war uses.

\* \* \*

The Bureau of Foreign and Domestic Commerce has commissioned Philip S. Smith, of New York, to investigate the South American market in regard to electrical goods who will report on present and prospective trade conditions. The high price of coal in most parts of South America and the prevalence of water power have caused a considerable development in the hydroelectric industry and American appliances should find a lucrative field.

\* \* \*

## Obituary

Mr. H. W. Pope, a veteran of the early electric lighting days in this country and an old time associate of Thos. A. Edison, died at his home at Bellerose, L. I., Feb. 29th, in his 68th year.

\* \* \*

Mr. Robert M. Jones, one of the pioneer electrical engineers of the West, died at Carlsbad, N. M., March 1st. Mr. Jones is said to have constructed the second Edison three-wire central station in 1883 at Laramie, Wyo. He was also the first in this country to use the double discharge type of Francis turbine at Spearfish, S. D., in 1903. He did much other first class work, both in the United States and in Mexico.

\* \* \*

Mr. J. C. Manly, assistant superintendent of construction for the Commonwealth Edison Company, of Chicago, died suddenly on the 17th of March. He had been with the company since 1895.

# BUSINESS OPPORTUNITIES

## ALABAMA

Decatur.—The steam-power electric plant of the Alabama Power Co., Birmingham will be enlarged at an approximate cost of \$10,000, and its capacity increased from 750 to 1,000 horsepower.

Fayette.—An electric-light and ice plant will be installed by the Sipsey Valley Oil & Fertilizer Co. Thos. H. Robertson, owner.

Opelika.—The installation of an ornamental street lighting system on Eighth and Ninth streets is under advisement.

## ARKANSAS

Fort Smith.—During the next few months the Fort Smith Light & Traction Company will improve the street railway system at an expenditure of more than \$50,000; contemplated improvements to include the reconstruction of portions of the Eleventh St. and Grand Ave. lines, using new steel rails and 6 inch steel ties. Tile drains will be placed underneath the tracks. The ties will be bedded in concrete.

Little Rock.—The Arkansas Light & Power Co. will issue \$5,000,000 in bonds for the purchase of additional plants, etc.

## CONNECTICUT

Norwich.—An appropriation of \$24,850 is contemplated for improvements to the municipal electric light plant, including two boilers, \$14,900; two automatic stokers, \$5,450; induced draft apparatus, \$1,450; repairs, etc., \$3,050.

Rockville.—A white way around Central Park is being planned, for which about 20 two or three-light standards will be purchased.

Torrington.—The construction of an electric railway from Torrington to Waterbury is contemplated. A. J. Patton & Co., of Waterbury, are interested in the project.

## FLORIDA

De Funiak Springs.—The city contemplates an addition to its electric light plant.

## GEORGIA

Atlanta.—A resolution has been passed for the erection of nineteen additional electric light standards on Alabama St.

Cordele.—The construction of a municipal electric-light plant in connection with the municipal water-works plant, to cost about \$50,000 is under consideration. C. F. Wagner, city Engineer.

Junction City.—The city is planning to erect an electric light plant. Address the mayor.

Metter.—The building of a municipal electric light plant is planned, for which a bond issue of \$8,500 is contemplated.

## ILLINOIS

Belleville.—It is reported that the first estimated cost of \$150,000 will have to be increased to \$272,000 for the construction of a municipal lighting plant, which, however, does not include the cost of installing underground conduit.

Brighton.—Arthur Farrell has been granted a franchise to install and operate an electric-light and power plant in Brighton.

Franklin.—The Central Illinois Public Utilities Company has been granted a certificate of convenience and necessity to rebuild the electric lighting plant here.

Hardin.—Peter A. Gotway will install an electric-lighting plant here.

Heyworth.—An ornamental lighting system on Main St. is being planned by the Heyworth Electric Light & Power Co. G. W. Powell, Pres.

Moline.—The Peoples Power Company is making extensive improvements to its Moline power house, changing voltage on transmission lines to East Moline, Ill., and Davenport, Iowa, from two-phase, 4800-volts to three-phase, 13,200 volts. Improvements include the installation of three 5000-kva., duplex, water-cooled, oil-insulated, 4800-volt, two-phase to 13,200 volt, three-phase transformers; the erection of 4800-volt and 13,200 volt bus structures, switches, lightning arresters, etc. Also three 2500-kva. transformers, as described above, with bus structure, etc., at East Moline substation. D. G. Porter is assistant general manager.

Olney.—The installation of a municipal electric-lighting plant is under consideration.

Ottawa.—The Rotary Club, which has charge of the lighting of LaSalle St., south of Main and the Illinois Bridge and approaches contemplate the extension of the ornamental lighting system to these points.

Pekin.—The installation of a motor-generator set to supply electricity for street railway service, also to rebuild part of its pole lines is being planned by the Central Illinois Light Co., of Pekin.

## INDIANA

Gas City.—City is planning to improve the electric-light plant, including the installation of one 125-kva., three-phase, 60-cycle, 2300-volt, engine-type revolving field generator; also a battery charging outfit. T. S. McGee, Supt.

Madison.—The Madison Light & Railway Company has been granted authority to issue \$13,000 in securities for additions to the power plant.

## IOWA

Davenport.—The Tri-City Railway Company is planning the extension of its lines. Address F. E. Wettstein.

Grinnell.—The Iowa Light & Power Company, recently organized with a capital of \$1,000,000, will erect a large modern building.

Newton.—a 6-mile, 3-phase, 230-volt transmission line to the municipal water works station is being planned. C. O'Leary, Supt.

Oxford Junction.—The local electric-light company expects to extend its transmission lines to all small towns between Cedar Rapids and Clinton. Walter Coon, manager.

## KANSAS

Abilene.—The Riverside Light & Power Co. will extend its transmission lines north to Oakhill and intermediate towns and south to Harrington and Hope. Address R. B. Gemmill, Supt.

Barnes.—The installation of an electric distribution system is under advisement. Energy will be secured from the Concordia Electric Co.

Eudora.—A municipal electric-light plant will be installed, for which purpose bonds to the amount of \$10,000 have been voted.

Hanover.—James Barry, of Odell, Neb., the new owner of the Hanover electric-light plant contemplates the construction of transmission lines to Odell, Landham and Diller, Neb., and will supply energy from this plant.

Neosho Rapids.—The Emporia Telephone Company is contemplating the erection of an electric-lighting plant here. W. W. Finney is proprietor.

Wakeeney.—Bids will be asked for in April for equipment of the municipal electric-light plant, including one 80-hp. oil engine, two alternators with excitors, one switchboard complete and a triplex motor-driven pump. H. C. Johnson, City Engineer.

## KENTUCKY

Campbellville.—Campbellville Public Utilities Co. plans to install a 150-hp. engine.

Lone Oak, R. D. from Paducah.—The Home Electric Co. of Paducah has applied for franchise to construct an electric light system.

Murray.—City votes May 20th on \$20,000 bonds to erect an electric light and power plant. Address the Mayor.

## MICHIGAN

Boyne City.—The installation of ornamental lamps on five blocks of the business section is under advisement. Chas. D. McCutcheon, Superintendent.

Dowagiac.—The electric-light department of the Beckwith Estate expects to install a 500-kw. or 1,000-kw. turbine and switchboard in its plant here. G. M. White, Manager.

Lapeer.—A boulevard lighting system is contemplated. Address Mayor Flary.

Marquette.—The output of the city electric light and power plant at Dead River is to be increased at an approximate cost of \$50,000.

St. Charles.—Improvements to the municipal electric light plant are planned, including the installation of boiler feed pumps, a 35-kva. generator and engine, line wire, poles and a new street-lighting system to replace the present arc lamps. George E. Tigner, Superintendent.

Sodus.—The erection of an electric-lighting plant on Pipestone Creek to furnish service here is under advisement.

Zeeland.—Poles will be bought and a boulevard lighting system installed along the Main St.

## MISSOURI

Columbia.—It is reported that interests connected with Keokuk & Hamilton Power Co. contemplate the building of an electric railway from St. Louis to Kansas City via Charles and Fayette, approximately 250 miles.

Cowgill.—The extension of its transmission line from Polo to Cowgill is being planned by the Excelsior Springs Water, Gas & Electric Company, as well as the installation of a distribution system at Cowgill.

Poplar Bluff.—Bids will be received until April 17th for furnishing electrical supplies for the city electric-light plant, including line materials, etc. H. H. Wilcox, City Clerk.

St. Louis.—The Cupples Light, Heat & Power Company has obtained permits to erect more than 20 miles of overhead wires in the West End, and may also lay underground conduits on Newstead Ave.

The Laclede Gas Light Co. has also applied for permission to lay underground conduits.

## NEW JERSEY

Butler.—The Pompton Township Committee has granted the municipal lighting plant at Butler a twenty-year franchise, for construction and operation of lines throughout the township.

Hightstown.—The Hightstown Electric Light & Power Company will rebuild its local system and install new equipment. The Public Service Electric Company will build a new line from its power station at Trenton to the Hightstown company's plant for increased service.

Hoboken.—The Public Service Electric Company will install an underground conduit system along River St. from Hudson Place to Fourth St.

Jersey City.—The City Commission is considering the installation of an improved street-lighting system along Ocean Avenue. The Ocean Avenue Business Men's Association (Harry Reed, president) is interested.

Trenton.—The State Senate has passed a bill authorizing the establishment of a "white way" lighting system at Trenton.

Trenton.—Governor Fielder has signed a bill authorizing the installation of an underground conduit system for electric lighting lines in Stacy Park.

## NEW YORK

Auburn.—The Empire Gas & Electric Company contem-

plates the installation of regulators in various generating and substations, substituting motor-driven centrifugal pumps for the present reciprocating boiler feed pumps in the generating station at Auburn and Geneva; L. C. Reynolds, general superintendent.

Jamestown.—City will install one 1,000-kw. turbine generator, condenser and switchboard panel. Bids will be received by the Board of Water & Light Commissioners. Specifications on file at this office.

## NORTH CAROLINA

Hayne.—A transformer station will probably be constructed near this place by the Southern Railway to supply electricity to operate signal system for double track between Spartanburg and Central now in course of construction. W. H. Wells, Ch. Engr. Constr., Washington, D. C.

Marshall.—A hydroelectric development of 1,200 horsepower is being planned by the Capitola Manufacturing Co.

Mount Airy.—The installation of an additional hydro-electric generating plant is being considered by the Water & Light Commission, which will include the construction of dam and power house, installation of generator, water-wheel, switchboard panel and governor and construction of 2½ mi. transmission lines; develop 300 h. p. I. W. Barber, Supt.

Weaverville.—Weaver Electric Co. expects to install three 5-kw., five 2-kw. and three 1-kw. 2200/110-volt transformers.

Zebulon.—Municipal electric light plant will be constructed; develop 60 to 80 hp.; estimated cost \$8,000; open construction, bids about May 1st. E. C. Daniel, mayor.

## OKLAHOMA

Allen.—P. L. Linebaugh, of Duncan, Okla., has applied for municipal franchise to erect and operate an electric light plant.

Checotah.—The Checotah Water, Light & Ice Co. contemplates installing 75-hp. natural-gas engine to operate 75-kva. generator (belted); pole-line equipment to change present line (3½ mi.) from 2300 to 6000 volts, with proper transformers to give from 100 to 150 horsepower at end of the line, which is used to pump city water; use present wires.

Coyle.—City has the installation of an electric-light plant and water works under advisement. Address the mayor.

Cushing.—Minnesota Electric Light & Power Co. contemplates installing 350-kva., 3-phase, 60 cycle, 230-volt generator, directly connected to simple Corliss engine, with switchboard, etc.

## PENNSYLVANIA

Charleroi.—The Pittsburg Coal Company are erecting a power plant here for power for its Black Diamond Mine.

New Oxford.—A ten-year franchise to furnish electricity in this place has been applied for by the Hanover & McSherrystown Light, Heat & Power Co., of Hanover, also for a street lighting contract, consisting of 35 tungsten lamps of 60 cp. for a period of five years. C. W. Hepperle is manager of the company.

Waynesboro.—The Waynesboro Electric Light & Power Company are planning to extend their transmission lines to Mont Alto to supply electricity to the towns of Nunnery, Quincy, Good Siding, Knapper and Mont Alto.

## SOUTH CAROLINA

Due West.—A conference has been held between H. A. Orr, Mgr. of the Anderson (S. C.) branch of the Southern Public Utilities Co. with the town officials in regard to installing electric-light system.

Honea Path.—Electric Light Com. will install for connection with system of Southern Power Co. 10 kw. 3-phase, 60-cycle, 2300-volt regulator; 2 watt-hour meters; two 2300/110-volt transformers; 900 lbs. No. 4 weatherproof copper wire and 3-pole double-proof oil circuit-breaker, 12,000 volts.

Orangeburg.—A municipal light, power and water plant will be erected here, the estimated cost for building and machinery being \$50,000.

TEXAS

Copper.—Two 5-mi. transmission lines to Klondike and Enloe will be constructed by the Copper Electric Co.

Donna.—It is reported that a municipal electric light plant will be erected here. Address the mayor.

Gunter.—Gunter Power & Light Co. will erect electric-light plant.

Longview.—The construction of a high-tension 23-mi. transmission line to connect the Longview and Marshall plants is contemplated by the Longview Ice & Light Co.

Nixon.—An electric-light plant, to cost approximately \$7,000, is to be constructed by the Nixon Electric Co. and will install 50-hp. oil engine with 37½-kw. generator. J. F. Wood, Jr., manager.

San Antonio.—An electric-light system along the Meridian Road in Texas for about 300 mi. will be constructed by the

Meridian Highway Association. Texas Power & Light Co. will furnish electricity.

WISCONSIN

Janesville.—The construction of an electric railway from Janesville to Portage via Madison is planned by the Jones & Madison Traction Company.

LaCrosse.—Harry G. Wilson has applied for a franchise to construct and operate an electric lighting and power system here.

North Milwaukee.—A transmission line from North Milwaukee to Granville will be constructed by the North Milwaukee Light & Power Co., S. B. Way, President.

Oostburg.—The Oostburg Light & Power Company will erect an electric-light plant here.

Racine.—The Milwaukee Electric Railway and Light Company has secured the contract for street lighting, which will include the installation of 700 lamps and equipment at an approximate cost of \$62,204.

# NEW CATALOG No. 22

LATEST LISTING ON

PANEL BOARDS and STEEL CABINETS--SWITCH BOARDS--KNIFE SWITCHES

See Catalog Page 27 to 65

See Catalog Page 74 to 84

See Catalog Page 6 to 23

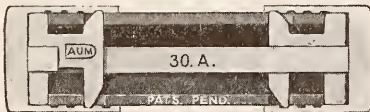
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St. Louis, Missouri.



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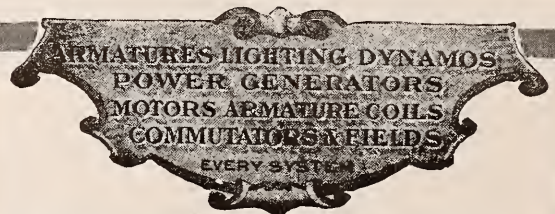
200 N. Third Street, Philadelphia

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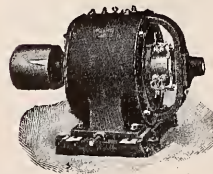
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## ATLANTA ELECTRIC MACHINE COMPANY

111 Marietta St.

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# ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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Vol. 48

MAY, 1916

No. 5

## Largest Turbo-Generator in the World

Description of the Philadelphia Electric Company's Stations and the Methods Used to Expand the System on Account of Increased Power Demands

By Frank C. Perkins

Three years ago the Philadelphia Electric Company was called upon to supply 25-cycle high-voltage energy to the street railway system. At that time no 25-cycle generating units had been installed, and therefore a frequency-changer substation, to be supplied by the company's 60-cycle system was designed and built, and the apparatus put into operation within four months' time. This railway load has steadily grown and 25-cycle generating capacity has since been added from time to time. A year later, because of rapidly increasing demand on the 60-cycle system, a material increase in the company's transmission voltage at that frequency was found necessary, and then it was that the decision was made to change the 6,000-volt, two-phase system to 13,200-volt, three-phase.

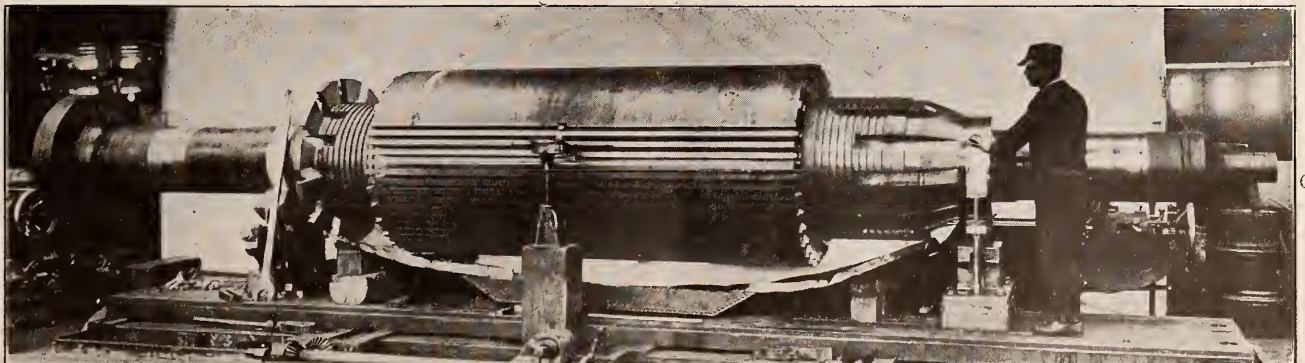
In certain districts the conversion to the higher pressure has already been accomplished, and the other substations of the system are gradually being changed over. However, in no case will the distribution voltages from substations be changed, but throughout will remain 2,400 volts, two-phase, three-wire, 60-cycle, for

alternating-current districts, and 115-230 volts, three-wire for the Edison direct-current section occupying the centre of the city. Scott-connected transformer banks of large capacity installed in the alternating-current substations, will effect the conversion to the two-phase voltages required as above.

### Substations Installed in Railway Company's Steam Plants

Last year, the street railway system again made demand for energy, this time for an outlying district to the northwest of the city. This was met by the extension of 13,200-volt, three-phase, 60-cycle lines from one of the electric company's generating plants to the several steam stations of the railway company, where 60-cycle rotary converter equipments were installed to supplant the steam-driven generators, since dismantled. In all of these railway installations the electric company operates the stations; and energy is billed at 600 volts direct-current at the trolley bus-bars.

This year, still further increases in demands at both frequencies have been coincident with the added neces-

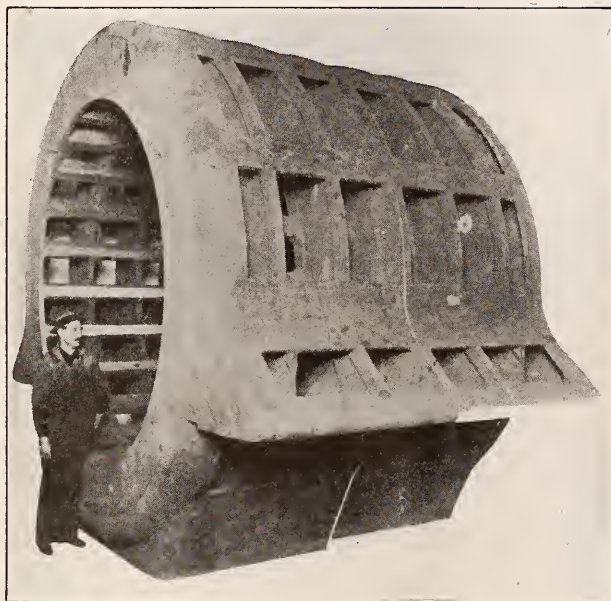


Revolving Field for 25-cycle Generator during Manufacture in Schenectady Works of General Electric Company

sity for the company's supplying energy for electrification of steam railroad lines in and around Philadelphia. This rapid expansion, therefore, has been the cause of erection of the new generating station to augment the present generating capacity necessary for the delivery of electrical energy to the company's thirty-four substations, and to those of the railway and the railroad companies—a supply of energy of which the magnitude may be appreciated from the official figures for the company's output during the year 1915—a total of 250,697,952 kilowatt-hours, the peak load being 77,728 kw.

#### Plant to Contain the Largest Generator in the World

The new power plant will control 151,000 kilowatts of generating apparatus, and will house the largest tur-



*Armature for 60-cycle Generator*

bo-generator in the world. The new generating station is being erected at Twenty-eighth and Christian streets in the city of Philadelphia, contiguous to the present main station. The part of the building on Christian St. will be devoted to switching apparatus and turbine room. This is one-third of the total floor area. It will contain complete electrical and mechanical equipment for two very large horizontal steam turbo-generators; one of them a 25-cycle unit of 30,000-kilowatt rating and the other a 60-cycle unit of 35,000-kilowatt capacity, thus giving a generating capacity of 65,000 kilowatts. The larger of the two will be the largest electric generator in a single unit in the world.

The new station of 188 feet long by 262 feet wide will be a modern steam turbine generating plant, and, although adjacent to the older station, will be separated therefrom by permanent building walls. As viewed from the northern side, the two power plants will present the appearance of a long single building. No steam or physical connections will be maintained between the two stations other than the water intake and

discharge tunnels, which, as later indicated, have been extended from the present station to the new installation. On the other hand, the arrangements of electrical connections between the two plants will be such as to unify in a measure the operation of both electric plants.

#### Both Twenty-five and Sixty Cycle Current Generated

The electrical installation will deliver three-phase 13,200-volt energy at two frequencies; 25 cycles for railroad electrification and railway supply, and 60 cycles for general power and lighting service. In addition to these two very large alternators the new station will control, and will accommodate switching equipment for, three large turbo-generators, each of 15,000-kilowatt rating, which are already in operation in the present main station. A 25-cycle tie-line will be installed between the new plant and the company's frequency-changer substation located nearby, and the control connections of the frequency-changers will be arranged so that these machines also will be controlled from the new station.

#### Generators Wound for High Voltage

This arrangement of apparatus will give the old plant and the one now under construction a total generating capacity in 25-cycle and 60-cycle apparatus, of one hundred and fifty-one thousand kilowatts in nine units controlled by one station. The engineering features relating to the installation of apparatus of the two frequencies are in general similar. Both will be three-phase, 13,200-volt equipment, and it is interesting to note that both of the new machines will be wound to give 13,200 volts. This feature of their electrical design is made possible by comparatively recent improvements in armature insulation strengths, and offers interesting contrasts to the alternative of low-voltage machines with "step-up" transformers, as used only a very few years ago, to secure pressures of 13,200 volts in generating stations. For each frequency duplicate sets of unsectionalized bus-bars will be installed, and the construction of the bus-bar and oil-switch structures will be in accordance with accepted design for large stations, embodying concrete structures located in isolated switching galleries made fire-proof throughout. These galleries will be completely separated from the turbine room by walls.

#### Arrangement of Feeder System

All outgoing feeders will be 13,200 volts, three-phase. Provision will be made for an ultimate installation of twenty-two 25-cycle and fourteen 60-cycle lines, each of 5,000-kilowatt normal rating. These feeders will be connected to the bus-bars in accordance with a group system in which two outgoing feeders compose a group. Cable connections will be made so that no substation is supplied by two feeders of the same group. In each individual feeder there will be connected three per cent. reactance coils (at 5,000-kilo-volt amperes) to provide power-limiting protection against short-circuit currents. Similar protection will be afforded the 25-cycle tie line to the frequency-changer substation.

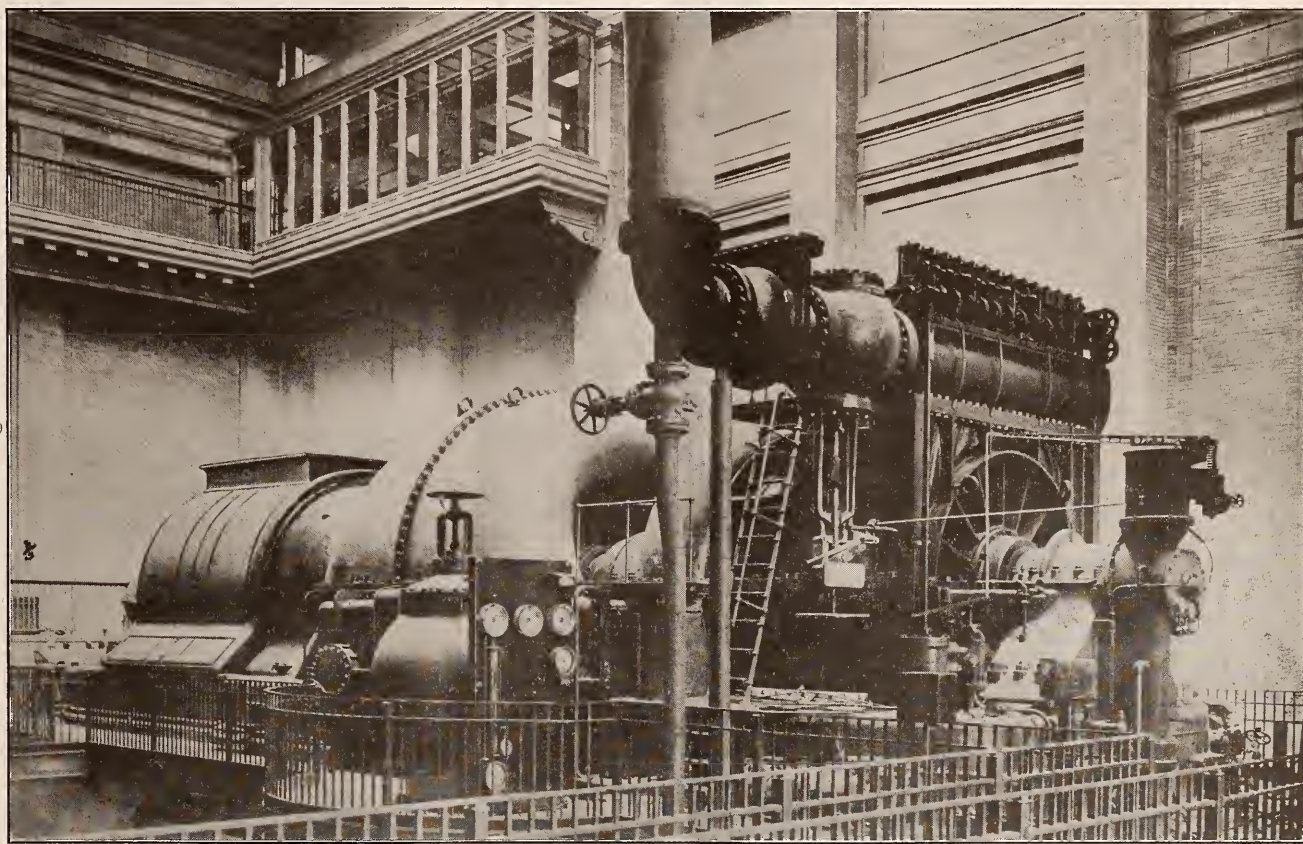


All lines will leave the new station underground, and static ground-detecting instruments will be maintained on the cables. At the generating station end of the feeder cables no lightning arresters will be provided, inasmuch as the bus-bars at substations are furnished with these. The usual protective relays will be installed in connection with the feeders' automatic oil-break switches. Of the three alternators in the older generating station whose leads will be brought to the bus-bars in the new plant, especial interest attaches to one machine; a 15,000-kilowatt, 60-cycle generator wound for 6,000 volts, two-phase, and provided with two 7,500-kv-a. water-cooled, single-phase transformers connected according to the "Scott" method to transform to 13,200 volts, three-phase. These power transformers are the largest ever built for the "Scott" transformation.

### Synchronizing of Alternators

As elsewhere throughout the system, so in the new station all synchronizing will be between machine and bus potential transformers connected in open-delta across the three-phase circuits. By means of suitable low-voltage knife-blade switches, the process of synchronizing may be affected on either one of two phases as selected. Further, through the agency of an interlock, it is rendered impossible for an operator to close a machine oil-switch without the synchronism indicator first showing the phase relationship between machine and bus.

There will be several synchronism indicators used with recording devices which in every instance will show the position of synchroscope pointer at time the machine oil switch is closed, thus giving record of accuracy of synchronizing.



35,000 KW CURTIS STEAM TURBINE, PHILADELPHIA ELECTRIC COMPANY, PHILADELPHIA, PA

### Grounded Neutral to be Used

The operation of the two polyphase systems of different frequency in the new station will be under conditions of grounded neutral, with suitable resistance provided in the connection to earth. The ground connection will be separate for each, and automatic interlocks will prevent more than one generator with either frequency being connected to earth at any time. All machine ground switches will be remote-controlled. The main leads from each of the two large turbines will consist of two 1,000,000-CM stranded cables per leg. These will be rope-core cables, braid-covered.

### Connections to Bus Bars to be Strap Copper

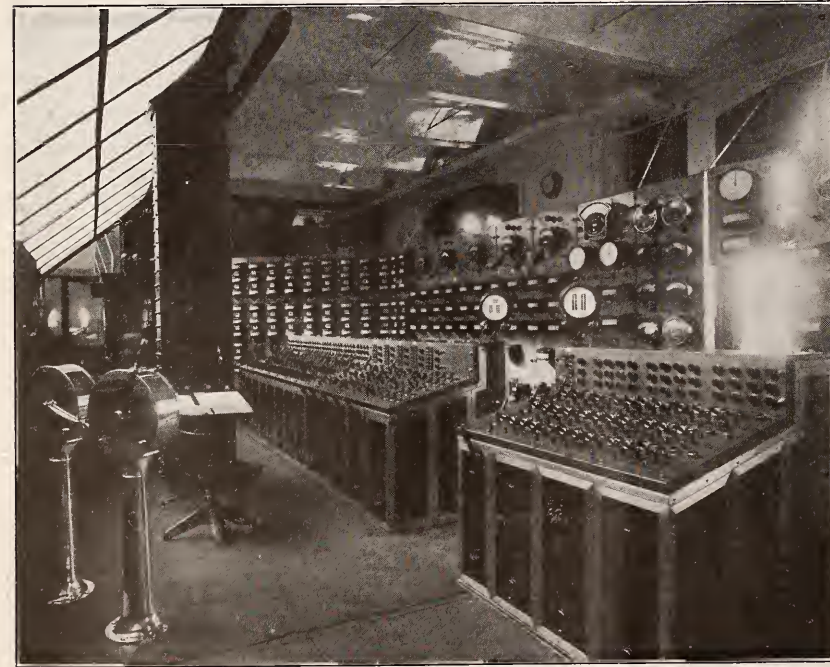
All the electrical conductors between the oil switches and the bus-bars will be composed of strap copper bare of insulation. However, the requirements of safety to operators will be cared for by isolating all live parts in concrete compartments with asbestos lumber or other insulating enclosures. As another precaution for safety to operators and others when work is to be done on the buses, arrangements will be made for connecting any bus-bar solidly to earth through permanent knife-blade switches.

### New Features of Design in Alternators

The two large turbo-generators, both of which are of the horizontal, revolving field type, are of special interest. The 35,000-kilowatt, 60-cycle turbo-generator is of 13,200 volts, three-phase, six poles, operating at 1,200 revolutions per minute; the ampere output per phase at 90 per cent. power factor is 1,460 and the internal reactance, 10 per cent. On the same shaft is a direct-connected exciter, 150-kilowatt, six-poles, operating at 1,200 revolutions per minute, and supplies a current of 600 amperes.

The new 30,000-kilowatt, 25-cycle turbo generator is wound for 13,200 volts, three-phase with two poles, operating at 1,500 revolutions per minute. The ampere capacity per phase at 100 per cent. power factor is 1,313 and the internal reactance, 8 per cent. with external reactance of 4 per cent. It is supplied with field current by a direct-connected exciter of 110-kilowatt, six poles, 250 volts and 440 amperes. Each of these machines will have temperature coils located permanently in the stator windings, and connected to recording instruments located at the switch-board. This will enable the op-

erators at all times to know the temperatures of the high-tension windings, an additional safeguard in the operation of the machines. Cooling air supply to each turbine will be secured by induced draft through independent air-washing equipments.



*The Control-Board in the Present Station*

erators at all times to know the temperatures of the high-tension windings, an additional safeguard in the operation of the machines. Cooling air supply to each turbine will be secured by induced draft through independent air-washing equipments.

There has also been provided a 500-kilowatt Curtiss horizontal steam turbo-exciter set operating at 5,000 revolutions per minute. The steam turbine is provided with speed reduction gear at 900 revolutions per minute, and it is direct-connected to a generator of the shunt-wound, six-pole type supplying 200 amperes at

### Steam Turbines

The foundations which are of massive design, comprising steel and concrete construction, will support these very large units. In every case the sub-foundation will be laid on rock bed. The turbines will be supplied with steam at 215 pounds gauge pressure at the throttle, and superheat not to exceed 200° F., through 20-inch throttle valves. Under steam conditions given above and with a back pressure not to exceed 1½ inches of mercury, absolute, the guaranteed economies of the two machines will be as follows:

Turbine	Steam consumption per kilowatt-hour
30,000 kilowatts (25-cycles)	12.45 pounds at 15,000 kilowatts
	11.9 pounds at 22,500 kilowatts
	12.75 pounds at 30,000 kilowatts
35,000 kilowatts (60-cycles)	12.9 pounds at 15,000 kilowatts
	11.9 pounds at 25,000 kilowatts
	12.0 pounds at 30,000 kilowatts
	12.6 pounds at 35,000 kilowatts

It is expected that all of these guaranteed rates will be bettered under conditions of actual operation. The main bearings of each machine will be 24 inches in diameter by 52 inches in length, and will be water-cooled by the circulation of 60 gallons of water per minute for the 30,000-kilowatt, and 100 gallons per minute for the 35,000-kilowatt machine, both at minimum pressure of 20 pounds per square inch from the turbine-driven pumps. For lubrication of turbine bearings 40 gallons of oil per minute will be required at minimum pressure of 30 pounds per square inch. In each instance the oil is drawn from a tank of 15-barrels capacity, cast into the base of the machine, and is normally circulated by a geared pump driven from the shaft of the machine itself. Further, there will be a duplex steam pump of ample capacity for use in case of trouble with the gear pump.

### Condensing System

The water supply for the new as well as the old stations is taken from the Schuylkill River through a 10-foot common supply intake tunnel with an extension of a 7½-foot diameter funnel with 38.48 square feet area to the new station, the latter requiring circulating water for condensation of approximately 110,000 gallons per minute in summer time for full load of 65,000 kilowatts, which is the maximum capacity of the turbines in the new plant. This amount of water will require a speed of approximately 6 feet per second in the intake tunnel.

*(To be continued)*

# National Electric Light Association Convention

THE thirty-ninth convention of the National Electric Light Association takes place in Chicago, from May 22nd to 26th. The headquarters of the convention will be the Congress and Auditorium Hotels, located at Congress and Michigan Aves. on the Lake front.

This will be the seventh visit of the association to its birth place, since its creation in 1885.

An elaborate program has been prepared and great care taken for the comfort of the members while en route and during their stay. The hotel convention has issued a list of over a score of hotels, while the Transportation Committee has seen to it that sufficient means of transportation will be available. The Red Special leaves the Grand Central Terminal in New York City on Sunday, May 21st, at 12.50 p. m., arriving in Chicago, La Salle Street station, at 11.50 a. m. Monday. The Pink Special leaves the Pennsylvania Terminal, New York City, on Sunday, May 21st, at 11.06 a. m., stopping at Philadelphia, Harrisburg, Altoona and Pittsburgh and arriving in Chicago (Union Station) at 10 a. m., Monday, May 22nd.

The Purple Special leaves St. Louis at 9 a. m., Monday, May 22nd, arriving in Chicago at 4.45 p. m.

The exhibits will be made in the Auditorium Theatre, which is very close to the meeting rooms.

One of the additional features of the convention will be the affiliation of the Electric Vehicle Association. It will hold sessions at which numerous papers and reports on vehicle topics will be presented, and there will be an exhibit of automobiles and accessories.

The method of registering delegates from outside the Chicago district will be the same as that employed in previous years.

Below is given the program of the work to be done at the Chicago convention, May 22nd-26th, the first meeting being held on Tuesday, May 23rd. As usual, the program is subjected to revision, but is not likely to be departed from except in one or two minor respects. At San Francisco, in 1915, the working sessions for various reasons were limited to three days—Tuesday, Wednesday and Thursday—but at Chicago this year, as at Philadelphia in 1914, there will be sessions on Friday morning, it being literally impossible to crowd all the work into three days. The program indicates that a large amount of important business now arranged carries over until Friday, to say nothing of what may possibly develop in the meantime. There are three special new features of the program this year. In the first place, three sessions are occupied by the new Electric Vehicle Section, and in the second place two are devoted to the new Company Section Committee which is doing splendid work in the development of this branch of Association usefulness. The third item of change is that the Public Policy meeting will not be a great big spectacular affair this year, but an executive session, open only to Class A operating companies

and their representatives, to discuss and determine the inner matters of management and outer aspects of relationship to regulatory bodies. It will be noted that there are many new items on the program evidencing the broader and newer conditions of the industry. A more attractive program was never presented to the membership than that which follows:

## General and Executive Sessions

TUESDAY, MAY 23, 10 A. M.

- 1—Welcome to the city, Mayor Thompson.
- 2—Address of President Lloyd.
- 3—Announcements.
- 4—Report of committee on organization of the industry (membership), George Williams.
- 5—Report of the secretary, T. C. Martin.
- 6—Report of insurance expert, W. H. Blood, Jr.
- 7—Report of committee on progress, T. C. Martin.
- 8—Report on Question Box, S. A. Sewall.
- 9—Report of committee on relations with educational institutions.

J. E. Gilchrist.

- 10—Report of committee on company sections, F. J. Arnold.

TUESDAY, MAY 23, 8.30 P. M.

- 1—Report of committee on public policy, W. W. Freeman.
- 2—Report of committee on taxation of public utilities, John A. Britton.

WEDNESDAY, MAY 24, 10 A. M.

- 1—Report of treasurer, W. H. Atkins.
- 2—Election of committee on nominations.
- 3—Report of committee on rate research, Alex Dow.
- 4—Report of committee on constitution and by-laws, R. S. Orr.
- 5—Report of committee on geographic sections, Louis D. Gibbs.
- 6—Address: "The Society for Electrical Development," J. M. Wakeman.

FRIDAY, MAY 26, 10 A. M.

- 1—Awarding Doherty, Williams and Frasse prizes.
- 2—Report of nominating committee.
- 3—Report of committee on president's address.
- 4—Report of committee on memorials.
- 5—Report of committee on resolutions.
- 6—Election and installation of officers; adjournment.

## Commercial Sessions

TUESDAY, MAY 23, 2.30 P. M.

- 1—Chairman's address, J. F. Becker.
- 2—Report of committee on finance, E. A. Edkins.
- 3—Report of committee on membership, H. N. McConnell.
- 4—Report of committee on publications, C. A. Littlefield.
- 5—Report of committee on salesman's hand book, M. S. Seelman.
- 6—Report of committee on education of salesmen, F. R. Jenkms.
- 7—Paper: "The Way to Make a Salesman," Earl E. Whitehorne.
- 8—Report of committee on merchandising and recent developments in electrical appliances, W. G. Stetson.

WEDNESDAY, MAY 24, 10 A. M.

- 1—Report of committee on wiring, R. S. Hale.
- 2—Report of committee on lamps, Frank W. Smith.
- 3—Report of committee on electric ranges, W. R. Putnam.
- 4—Election of committee on nominations.

WEDNESDAY, MAY 24, 2.30 P. M.

- 1—Report of power sales bureau, C. J. Russell.
- 2—Paper: "Central Station Service in the Manufacture of Artificial Ice," C. J. Carlson.
- 3—Report of committee on new industrial applications of electricity, P. Torchio.
- 4—Report of industrial electric heating bureau, C. F. Hirshfeld.

THURSDAY, MAY 25, 10 A. M.

- 1—Report of lighting sales bureau, John G. Learned.
- 2—Report of committee on commercial aspects of highway and municipal lighting, T. F. Kelly.
- 3—Report of committee on industrial and yard lighting, Oliver R. Hogue.
- 4—Lecture: "Lighting—A By-Product or a Buy Product" (illustrated), William A. Durgin.

THURSDAY, MAY 25, 2.30 P. M.

- 1—Paper: "Temporary Service for Municipal Sub-Service and Other Construction," C. K. Nichols.
- 2—Paper: "The Resistance Heater as a Load Builder," E. F. Collins.
- 3—Paper: "Electric Furnaces," R. H. Tillman.
- 4—Paper: "Electric Welding," S. R. Dresser.
- 5—Report of committee on competitive power sources, E. F. Tweedy.

FRIDAY, MAY 26, 10 A. M.

- 1—Report of committee on residence lighting, Fred H. Scheel.
- 2—Report of committee on stores and public buildings, S. B. Burrows.
- 3—Report of committee on electrical advertising, A. K. King.
- 4—Election and installation of officers; adjournment.

### Technical and Hydroelectric Sessions

TUESDAY, MAY 23, 2.30 P. M.

- 1—Chairman's address, Holton H. Scott.
- 2—Report of committee on meters, C. G. Durfee.
- 3—Report of committee on electrical measurements, values and terminology, A. E. Kennelly.
- 4—Paper: "Lightning Protection for Transformers," D. W. Roper.

WEDNESDAY, MAY 24, 2.30 P. M.

- 1—Report of committee on underground construction, E. B. Meyer.
- 2—Report of committee on overhead line construction and inductive interference, R. J. McClelland.
- 3—Report of committee on hydro and transmission progress, T. C. Martin.

THURSDAY, MAY 25, 10 A. M.

- 1—Report of committee on accident prevention, Martin J. Insull.
- 2—Report of committee on prime movers, I. E. Moulthrop.
- 3—Report of committee on electrical apparatus, L. L. Elden.

THURSDAY, MAY 25, 2.30 P. M.

- 1—Report of committee on street lighting, S. B. Way.
- 2—Report of committee on power supply for the electrification of steam railroads, Peter Junkersfeld.
- 3—Paper: "Central Station Electric Systems and Railroad Power," J. Darlington.

### Accounting Sessions

TUESDAY, MAY 23, 2.30 P. M.

- 1—Chairman's address, H. M. Edwards.
- 2—Election of nominating committee.
- 3—Report of executive committee.
- 4—Report of membership committee, E. J. Allegaert.
- 5—Report of committee on classification of accounts, William Schmidt, Jr.
- 6—Report of committee on cost accounting and statistics, T. J. Walsh.
- 7—Report of the library committee, Alex Holme.

WEDNESDAY, MAY 24, 10 A. M.

- 1—Report of committee on form of annual report, C. H. Hodskinson.
- 2—Report of committee on customers' records, E. J. Fowler.
- 3—Report of committee on purchasing and storeroom accounting, H. F. Frasse.

THURSDAY, MAY 25, 10 A. M.

- 1—Paper: "Correspondence Course in Accounting," A. L. Holme and J. R. Wildman.
- 2—Report of committee on Question Box, Edwin A. Barrows.
- 3—Open discussion and experience meeting.
- 4—Report of committee on nominations.
- 5—Election and installation of officers; adjournment.

### Electric Vehicle Sessions

WEDNESDAY, MAY 24, 10 A. M.

- 1—Address of chairman, Walter H. Johnson.
- 2—Report of secretary, A. Jackson Marshall.
- 3—Report of treasurer, H. M. Edwards.
- 4—Report on section activities, Secretary Marshall.
- 5—Report of committee on membership, Joseph D. Israel.
- 6—Report of committee on standardizations, E. R. Whitney.
- 7—Report of committee on motion picture films, Carl H. Reed.
- 8—Report of committee on traffic and good roads, A. H. Manwaring.
- 9—Report of committee on insurance, Day Baker.
- 10—Election of nominating committee.

WEDNESDAY, MAY 24, 2.30 P. M.

- 1—Report of committee on garages and rates, George B. Foster.
- 2—Report of committee on legislation, P. D. Wagoner.

- 3—Report of committee on federal and municipal transportation, James H. McGraw.
- 4—Paper: "Industrial Truck Applications," C. W. Squires.
- 5—Paper: "Electric Truck Problems and How to Minimize Them," F. E. Whitney.
- 6—Paper: "The Relations of Tires to Electric Vehicle Efficiency," S. N. Norton.
- 7—Paper: "Greater Garage Service," Harry Salvat.

THURSDAY, MAY 25, 10 A. M.

- 1—Report of committee on operating records, W. P. Kennedy.
- 2—Report of committee on central station co-operation, E. S. Mansfield.
- 3—Paper: "The Exchange Battery System," P. D. Wagoner.
- 4—Paper: "Passenger Vehicle Problems and Activities," E. P. Chalfant.
- 5—Paper: "Central Station Promotion of Electric Vehicle Use," W. P. Kennedy.
- 6—Report of committee on nominations.
- 7—Election and installation of officers; adjournment.

### Company Sections Sessions

THURSDAY, MAY 25, 2.30 P. M.

- 1—Paper: "The Company Section and the Company," M. S. Seelman, Jr.
- 2—Paper: "Financing Company Sections," A. L. Atmore.
- 3—Paper: "Company Section Educational Work," Douglass Burnett.
- 4—Paper: "Company Section Entertainment and Recreation," A. D. Bailey.

FRIDAY, MAY 26, 10 A. M.

- 1—Paper: "Employees' Activities: Should They All Be Under the Auspices of the N. E. L. A. Company Section," J. D. Israel.
- 2—Formation and methods of conducting company sections, E. C. Stone.
- 3—Suggestions by committee on company sections, F. J. Arnold; adjournment.

\* \* \*

### Professor Pupin Honored

Prof. M. I. Pupin has been awarded the Herbert prize for physics by the French Academy of Sciences for his important services to telegraphy and telephony and his method of harmonic analysis. Professor Pupin has turned over the prize, which was 1,000 francs (about \$200), to a fund for women and children who have been made widows and orphans by the present European war. The Hughes prize was awarded by the Academy to M. R. Marcelin, a young scientist of the first rank, and the Gaston Plante prize to M. Marcel Molin for his researches in radiation. Both of these men were killed in September, 1914. Of the thirty-seven awards made eleven were to men who fell in battle.

\* \* \*

### Electrical Companies Breaking Records

The General Electric Company now has the largest forces it has ever had at work. In the Schnectady plant there are said to be 18,000 employes. Other plants are proportionally busy. Orders are coming in as rapidly as ever and extensions are still being planned.

The Westinghouse Electric and Manufacturing Company also reports unprecedented activity, the employes now numbering over 20,000. Both companies have lately advanced the price of products to per cent. on account of the constantly increasing cost of raw materials.

\* \* \*

### Water Power Project on Mexican Border

A plan to restrict the shifting of the channel of the Rio Grande and incidentally to develop water-power to the extent of 300,000 horsepower, and to provide irrigation for 2,000,000 acres of land, is proposed in a report issued by the Federal Bureau of Water Conservation containing the combined opinions of a number of engineers. The plan recommends the erection of several dams to hold the waters of Texas streams and urges a considerable amount of work along the Rio Grande to prevent the constant changing of the international boundary.

# Present Status of Electric Power Generation, Transmission and Distribution

By Percy H. Thomas, Consulting Electrical Engineer\*

## Load Dispatcher

When two or more principal power houses were originally combined into one system it became impossible for an operator in one power house to personally see and operate the apparatus in the other stations, which perforce introduced the telephone as an intermediary in power plant operation, much to the complication of operation. This condition became more difficult until finally the principal large companies have adopted a "dispatcher" system similar to the railroad "dispatcher." A load dispatcher is located at some convenient point, which often is not at a power house, and is placed in charge of the whole system and personally directs every operation in all stations. He is in telephone communication with all operators and keeps a record of the changes and connections made in each part of the system of a system of pins and markers on a large map or plan of the circuits and apparatus of the plant. This system works very satisfactorily.

## Voltages in Use

A few years ago, when transmission distances were ordinarily limited to about 100 miles, 60,000 volts came to be recognized as a usual standard, though here and there a plant utilized 80,000 volts. With the advent of the steel tower line longer transmissions have grown up and 100,000 to 110,000 has been very generally used as a network voltage and has been found very satisfactory. There are certain instances when special trunk lines have been installed at 130,000 to 150,000 volts (Big Creek Power Company of Los Angeles, California and Commonwealth Company of Michigan), but these constitute rather direct transmissions of a large block of power to local distributions than networks properly speaking. This voltage would be too high for the economic delivery of power in small units on account of the cost of the step-down apparatus. Large plants in the big cities, especially where the distribution is to a considerable part underground, use 12,000 to 20,000 volts for their networks, but systems using overhead construction and involving longer distances will almost universally use a voltage as high as 60,000.

The two standard methods of line construction for high-tension networks, viz: steel towers and wooden poles need not be here discussed.

Within the last four or five years there has been a rapid development in the use of out-door transformer stations and switching stations. This practice which has the advantage of permitting the use of ample spacing for high-tension lines and other apparatus results also in a great saving in building costs. It is found satisfactory in locations where the weather conditions are not too severe. There seems to be no difficulty in building transformer and switches weather proof at a relatively small increase in expense.

The features of these power networks now demanding the most attention are: cost, mechanical capability of withstanding sleet and wind, lightning protection and high-tension insulators. The cost of long lines puts a heavy fixed charge on the earnings of the power company and must be kept as low as is safe. This result is to be secured by painstaking care in the details of design and erection.

While never more than a very small part of any particular line gives trouble, the result is the disabling of a whole line

section, and this accident has resulted so frequently in recent years as to be objectionable, especially is it so with steel tower construction where a tower which falls cannot be erected again to replace the break. The loss of time in getting a section of steel tower line which has once gone down back into service is considerable and often times temporary wooden construction across the break is required. The more usual causes of trouble have been, sleet, insufficient foundations, especially foundations in damp places, and weakening of towers by improper installation.

Some trouble has been experienced when wires have been strung loose in gusty places, such as canyons. This is to be avoided by tight stringing, short spans and extra clearances.

Lightning in some districts is very troublesome, especially in causing interruptions of service, and to a much less extent causing injury to apparatus. Protection from this difficulty is at best uncertain and difficult and should be considered by a specialist.

Millions of high-tension insulators have been manufactured and used during the last few years and while very successful power service has been given by many companies these insulators themselves have not made as good a record as may be expected in the future. Many insulators have deteriorated and shown porcelain cracks without any undue electrical or mechanical stress. This has been due partly to ceramic causes, partly to improper burning and partly to bad design, which has permitted temperature expansion of the metal parts to bring mechanical strains on the porcelain. This condition is like lightning, very obscure and technical, and it is to be met by careful testing of designs and manufactured product and test and inspection of individual insulators after installation. This course, while somewhat expensive, will secure good service as far as the insulators are concerned.

There has been for many years a discussion as to the advisability of grounding the neutral point of a high voltage transmission system. The question still remains unsettled and the various considerations unsolved are too complex to be here discussed.

Another aspect of the power transmission system that is coming into the foreground very prominently is its relation to other electric systems in the same neighborhood such as the railroads, telephone and telegraph systems, and even (from a legal point of view) to the public on the streets and highways. The necessity of crossing over such other systems, which often own their own rights of way, has developed special construction specifications which are insisted on by the companies crossed to safeguard their systems. These crossings are an unavoidable source of annoyance and expense. Again, transmission lines where extended, or of high voltage, may cause inductive disturbance in parallel systems of wires, very detrimental to telephone, telegraph or signal service and sometimes even dangerous. There is a growing tendency for the authorities to assume control of construction and operation as far as such interference is concerned.

Many other considerations naturally arise in the design and operation of networks and power plants, but those here touched upon are the features most discussed at the present time and those which present the greatest need of the exercise of good judgment.

\*Continued from April Issue.

# Care and Operation of Electric Trucks

By Norman G. Meade

Rapid progress in the design and construction of motors and auxiliary appliances for use on commercial electric trucks has been made within the last few years and at the present time such vehicles combine sturdiness, efficiency of operation, and reliability. In the design of the motors the efficiency has been increased to a large extent on normal loads and overloads, while all unnecessary weight has been removed without impairing the speed and torque characteristics so essential to motors taking their energy from storage batteries. Unlike motors for all other classes of work it can have no protective devices such as circuit breakers and fuses, as such protection is impracticable on account of the excessive demand for power made when the vehicle is at a critical point in its operation. This is illustrated by the ascending of a heavy grade or a bad place for starting where power is needed the most and the motor must be relied upon.

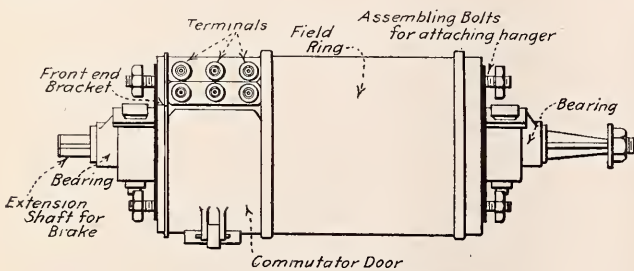


Fig. 1.—A Typical Vehicle Motor

It is apparent, therefore, that vehicle motors must be designed and constructed to withstand all the power that can be applied to the propulsion of the vehicle for which it is built. It is not generally possible to give motors of this kind a rating in horsepower and it has been found preferable to rate

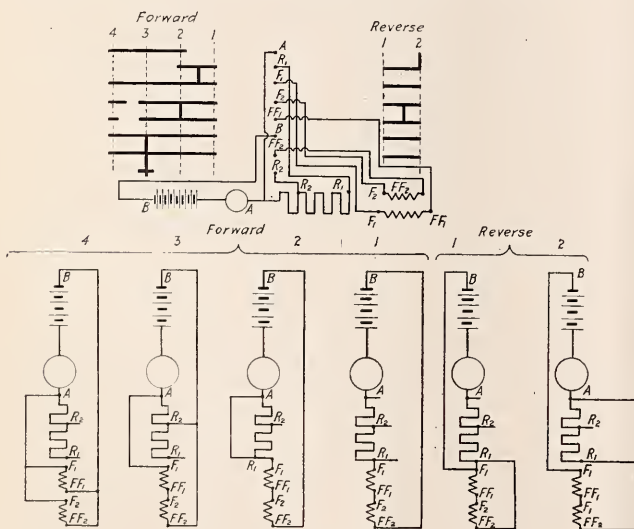


Figure 2

them entirely with reference to the vehicles to which they are adapted. Fig. 1 shows a typical vehicle motor which gives its nomenclature.

Controlling apparatus has been modified and it is standard practice to combine the field windings with proper shunting connections and obtain a large number of speeds at high efficiency. Figs. 2 and 3 show the connections of two modern controllers. By reference to Fig. 2 it will be observed that on the first point of the controller the motor and the batteries

are connected in series with a resistance which is cut out partially on the second point and wholly cut out on the third point. At the fourth point of the controller some resistance is shunted across the field windings; at the fifth point the field windings are connected in multiple, and at the sixth point, or the point of highest speed, the field windings are connected in multiple with a small resistance shunted around them. For the three reverse speeds resistance control is used. In the type of controller shown in Fig. 3, the first and the second points are connected to the rheostat with the field windings in series. The third point shunts some resistance across the field windings which are still connected in series, and on the fourth point, or highest speed, the field windings are connected in multiple. The two reverse speeds are controlled by resistance. This type of controller does not open the motor circuit from the first to the last point, and the torque never falls below a certain predetermined value and is applicable to both single and double motor equipments.

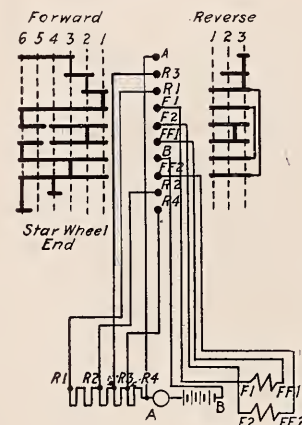
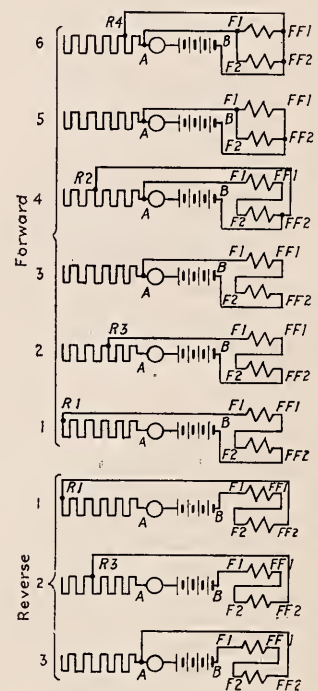


Figure 3



## OPERATIONS AND MAINTENANCE

Operation and care of an electric truck is a simple matter if ordinary precautions are taken. Judgment in driving should be exercised and the vehicle should not be overloaded or driven at excessive speeds. All of the parts should be kept clean and in proper adjustment, and the battery kept in good condition and properly cleaned. It is essential also that all bolts and nuts be kept tight. In starting a truck, time must be allowed to attain a certain speed before moving the controller to the next notch and the car should not be run longer than necessary on the first two notches, which include the resistance in series with the motor. It is advisable to open the main switch and always set the brakes before leaving the vehicle, as by so doing the motor and the bell are disconnected from the battery and the truck cannot start alone. The controller shaft and its bearings should be oiled occasionally and the surface of the controller segments kept in proper condition by the use of fine sandpaper. A small amount of vaseline may be used for lubricating the contacts.

The onyl parts of the motor needing attention are the commutator, brushes, and bearings. Each motor should be inspected at least once a week and the commutator should be examined when the motor is running with the rear truck wheels jacked up, to detect any sparking which may be due to dirty or worn commutator or to a broken brush. The commutator may be lubricated slightly with vaseline on a clean cloth while the motor is running. A good commutator lubricant is made by stirring powdered graphite into boiling paraffine and moulding the mixture into sticks about the size of an ordinary candle. This is applied by touching the end of the stick to the surface of the revolving commutator.

ly adjusted before the vehicle leaves the factory, and under ordinary operating condition they will not need attention for six months, except to clean with kerosene or gasoline and re-pack with non-fluid oil once a month or oftener if it becomes necessary. Wheel bearings should never be adjusted so as to resist rotation and should be adjusted so that a little end shake can be felt. Loosening the axle nut one half a turn after the wheel is set up tightly is usally sufficient. In some makes of vehicles the counter-shaft bearings may be adjusted for wear by adding thin steel adjusting washers between the bearing cones and the sprockets. In single motor types of vehicles the differential should receive the same inspection and lubrica-

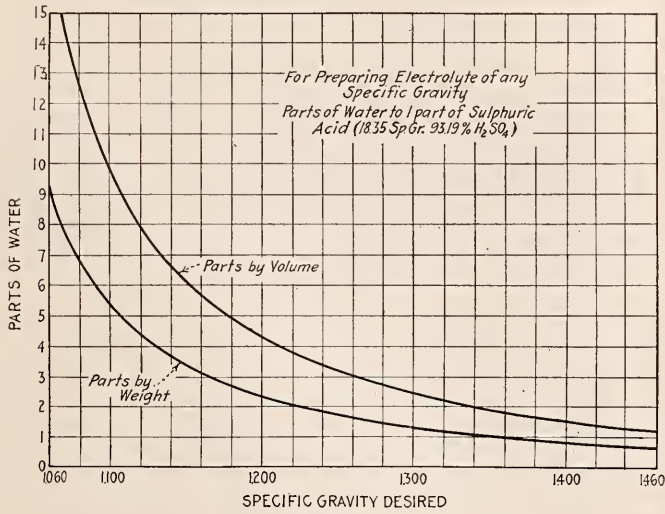


Figure 5

Brakes should be examined daily and the leather brake band facing renewed when much worn. The brake toggle should be adjusted so that there is never more than one-eighth inch space between the brake band and the drum when the brake is released. If the brake does not hold firmly and is found to be sufficiently tight, it may be greasy and should be washed with gasoline. The brakes should not be applied too suddenly except in emergency, as damage to the tires is liable to occur. On vehicles using chains, those driving the wheels should be taken off once a month and washed with kerosene oil and then soaked in hot tallow or heavy grease. The chains should show some slack when running as too close or too tight chains may run off or be the cause of excessive rear. Motor chains should be lubricated twice a week with heavy grease.

Bearings on the motors, wheels and countershafts are proper-

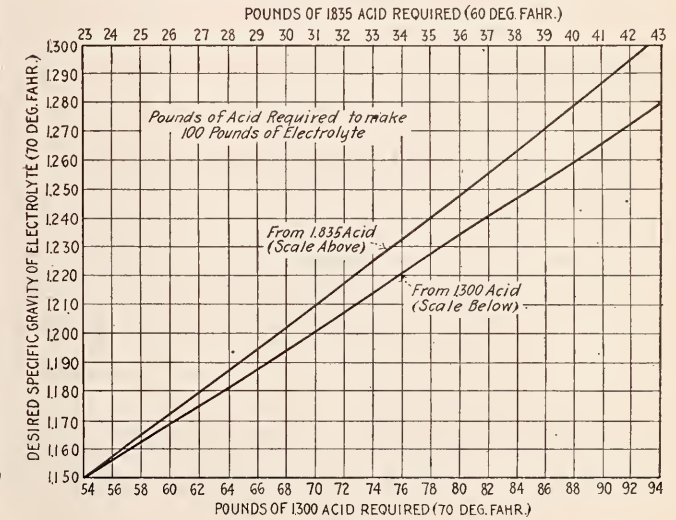


Figure 6

tion as the bearings. The grease cup should be screwed down one turn every morning and all other parts oiled twice a week. All parts of the steering gear bearings must be kept properly lubricated.

CARE OF BATTERY

In the lead plate type of storage battery the electrolyte consists of a sulphuric acid and water solution which, when the cell is fully charged, should have a specific gravity of 1.270 to 1.280. While the battery is being discharged, the electrolyte becomes weaker, as part of the acid is combined in the plates in producing current. Since electrolyte expands when heated, its specific gravity is affected by a change in temperature. The specific gravity is measured by a hydrometer, which is a glass

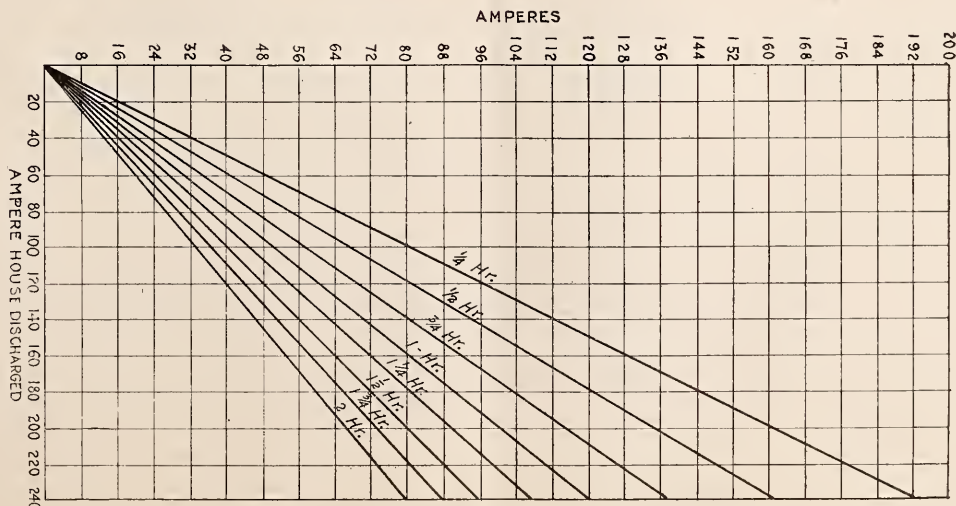


Fig. 7.—Maximum Safe Charging Rates for Boosting

tube in which there is a graduated scale and a bulb at the bottom of the tube which is suitably weighted. The depth to which the hydrometer sinks into the liquid depends upon the latter's specific gravity and is registered by the graduated scale. Figs. 5 and 6 are curves issued by the Electric Storage Battery Company which show respectively parts of water to parts of sulphuric acid for electrolyte of any specific gravity, and pounds of acid required to make 100 pounds of electrolyte.

When a new battery is received there are certain specific instructions which must be followed. In general, when unpacking a battery, the trays should be kept right side up to avoid spilling the electrolyte, and the soft rubber plugs should be removed from the cells after thoroughly removing all packing material, to see that the cells contain the proper amount of solution, which should be about one-half inch above the plates. If the electrolyte is too low, enough pure water should be added to bring the level to the proper height. The battery should be placed on charge at a low rate given on the name plate of each tray until the cells gas uniformly, then the current reduced one-half for three hours when the battery is ready for use. It is best practice to charge the battery not oftener than once a week unless the nature of the service requires that it shall be done. An ampere hour meter, when used, should be adjusted to give the battery the amount of charge necessary to produce uniform gassing at the finishing rate, which indicates the completion of the regular rate. The amount is usually 10 or 15 per cent. in excess of the discharge. The weekly equalizing charge should be given irrespective of the ampere meter.

The battery condition should be checked with the hydrometer once a month after the regular equalizing charge. If the specific gravity of any cell is higher than 1.300 or lower than 1.250, the cause should be promptly investigated and corrected. Evaporation should be replaced every five to fifteen days, depending upon the conditions of service. The best time for adding water is just before a charge. Auxiliary charging, called boosting, consists of a partial charge given in a comparatively short time and at current rates higher than normal. A battery may be boosted when fully discharged, or only partially discharged. Boosting with a fixed voltage is the best method since it is automatic and is applicable where the voltage

available is about 2.3 per cell of battery, for example, 110 volts for 48 cells. When the charging rate is higher than that required it may be cut down by introducing counter-electromotive force cells.

Another method used for boosting is with approximate constant potential with a fixed resistance connected in series with the battery. The battery voltage should be read after closing the circuit and the resistance cut out so that for 48 cells the voltage will be 110; 44 cells, 98; 42 cells, 92; 40 cells, 86; and 38 cells 80 volts. In some cases it is more convenient to give a boost at a constant current, and as there is generally a limited time available, it is desirable to know under any conditions what rate is safe which can be determined from the chart, Fig. 7. In the left-hand column of the chart find the figure nearest to the ampere hours discharged from the battery and follow to the right to the diagonal corresponding to the available time. Immediately below this point in the bottom row of figures the required current is given.

Sediment collects at the bottom of the jar in a space provided for that purpose, the rate at which the sediment collects depending largely on whether the battery has been properly charged. It is best to remove the sediment after 100 or 150 charges to determine the rate at which the sediment is collecting in order to estimate the proper intervals for the regular cleaning. If the battery has not been allowed to become sulphated and the sediment has not reached the bottom of the plates, the cleaning operation is a comparatively easy process. Before cleaning, the battery should be fully charged. If the battery is in a sulphated condition without the sediment reaching the bottom of the plates, or if the sediment has reached the bottom of the plates the battery must be thoroughly cleaned in a manner directed by the instructions accompanying the battery, also treated for sulphation. After the battery has been cleaned it should be placed on charge as shown in Fig. 8 and given a finishing charge at the regular rate. After about fifteen minutes the voltage of each cell should be noted and the readings recorded, which insures that all of the cells have been properly connected. If properly connected each cell should read above two volts, if it does not it is probably reversed in its connections. The cells should then be discharged through a resistance as shown in Fig. 9 to determine if there are any low cells or defective assembling.

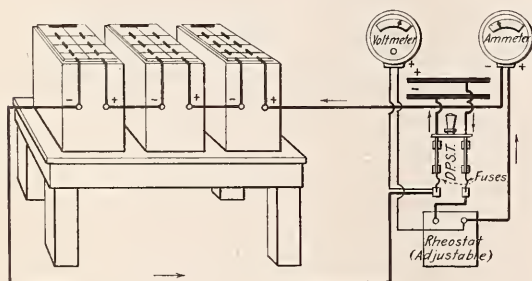


Fig. 8.—Charging Connections

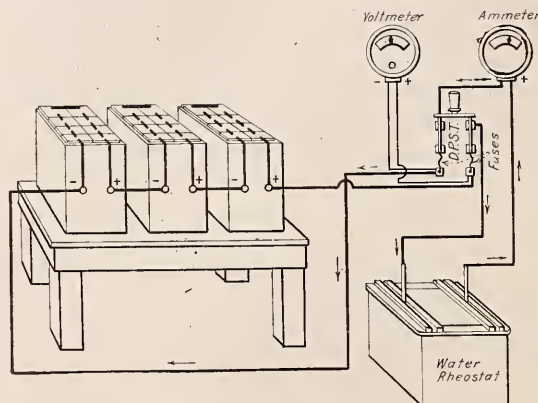


Fig. 9.—Discharging Connections

### "Safety First" Prizes in Louisville

The regular monthly prizes were awarded for Safety First Suggestions by the Louisville Gas & Electric Company at a recent meeting, suggestions being adopted: First prize, Joseph L. Brown, engineer, the placing of an electric gong on the elevated coal switch at the Waterside Station to indicate the passing of engines or cars; second prize, W. H. Kelley, stable foreman, the placing of a fire plug to facilitate action in case of fire; third prize, W. K. Cowherd, use of boxes for keeping rubber gloves for linemen to prevent punctures.

### Lectures on Military Engineering

A course of five free lectures on military engineering, which will be open to all engineers and technical men, will be given each Wednesday in May at Carnegie Music Hall, Pittsburgh, Pa., under the auspices of the Engineers' Society of Western Pennsylvania. The speakers will be Lieut.-Col. F. R. Shunk, Maj. P. S. Boud, Maj. J. C. Oakes and Capt. C. L. Sturdevant, all of the corps of engineers of the United States Army, and A. L. Humphrey, vice-president of the Westinghouse Air Brake Co.



# The Routine Testing of Insulators With High Frequency Alternating Current

By Henry A. Cozzens, Jr.

In the past year or so considerable publicity has been given to the method of testing insulators with high frequency. It is now the practice of every large insulator manufacturer to test with sixty cycle current either parts of insulators or the assembled insulator. This test served to weed out a certain class of faults. Several operating companies have sought to further insure against faulty insulators by submitting every insulator to a routine high frequency test.

for testing is at hand. In the laboratory, the essential is to select the best insulator from various types and designs. On the other hand, in the routine test, it is assumed that all this preliminary work has been done and the remaining object is to decide which are good and which are bad insulators.

### Skilled Labor Not Necessary

In job or routine testing the conditions with which to work are of a vastly different nature. The insulators are shipped to storerooms situated near to where the line construction is being done. There is no equipment on hand and men to do the work must either be hired from the open market or selected from the ground hands of the line department. This results in men of little or no electrical experience being pressed into service to do the testing.

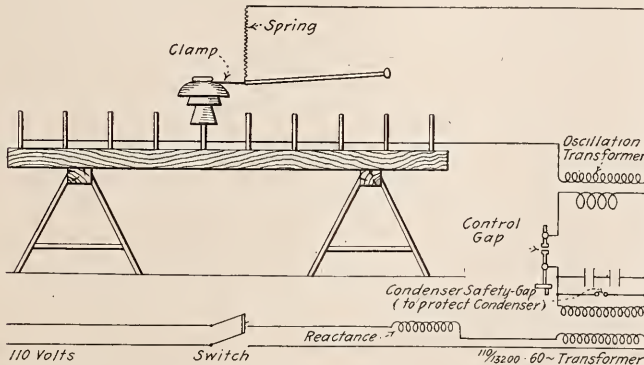
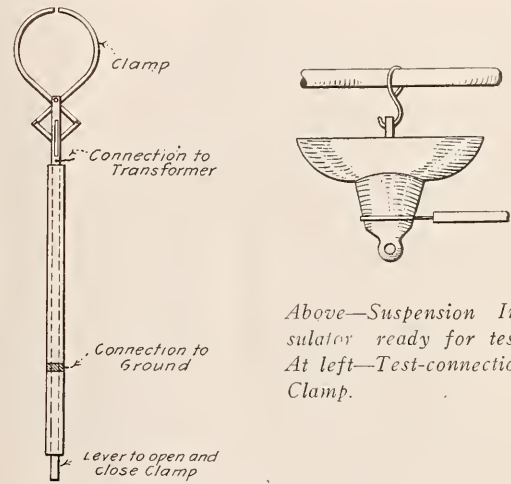
In one electric company approximately sixty thousand insulators have been successfully tested under the foregoing conditions. The testing has been done rapidly and cheaply. Insulators tested in one place were immediately installed and the set moved to the next storeroom.



Insulators Under Test

### Portable Sets Can Be Easily Transported

The high frequency test offers many advantages over the sixty cycle test. High frequency current is very searching and will detect flaws in the porcelain due to the presence of foreign matter which would remain hidden at normal frequency. As a matter of fact many insulators which have failed under the high frequency test will show up all right at normal frequencies. The high frequency test outfit, as built by several manufacturers, is easily transported from job to job and may be used by attachment to an ordinary 110-volt lamp socket. This makes it possible to ship insulators and set to the various sites which are convenient to the construction of new lines. Thus insulators may be installed immediately after testing. There is an element of safety in the use of high frequency as the men become accustomed to slight shocks while the same contacts at sixty cycles would result in a fatality. The method of testing can be arranged so as to have flexibility and rapidity.



In the early forms of high frequency testing sets, one side of the high tension was not grounded, as is now the practice, and care had to be exercised about the testing rack, and no insulators could be removed until the rack was "dead." For testing, a cross arm is provided into which are set ten pieces of pipe about fifteen inches in length. Upon these pins the insulators to be tested are placed. These pins are then tied together with a length of wire which is connected to one side of the oscillation transformer. A clamp, consisting of a split ring which may be opened and closed so as to slip around the side tie wire groove of the insulator, is fastened to a spring which forms a part of the lead to the other side of the oscillation transformer.

Ten insulators are placed upon the rack and the operator places the clamp upon the first insulator. The switch being closed the current arcs around the insulator. The man who inspects the insulators sits in front of the rack, and if the insulator is alright, after a predetermined time element has elapsed, signals the operators to move on to the next insulator. He loosens the clamp and slides over to the next insulator and so on until the tenth one has been tested, when the switch is pulled. The tested insulators are then removed and a new series placed upon the rack. This method of testing has been worked successfully where the testing set has had no grounded side.

The test set consists essentially of a 110/13200-volt, 60-cycle step up transformer across the terminals of which are placed a suitable condenser and oscillation transformer. A spark gap is placed in one side of the circuit by means of which the voltage may be regulated.

The problem of the routine testing of insulators is a different one from the tests which may be made in the laboratory. In the laboratory the tests are usually to determine certain characteristics of the insulator relative to design and manufacture. The ability of the insulator to withstand endurance tests is a matter for the laboratory to consider. The rigging for making these tests can be elaborate and of a permanent nature as every facility

(Continued on Page 47)

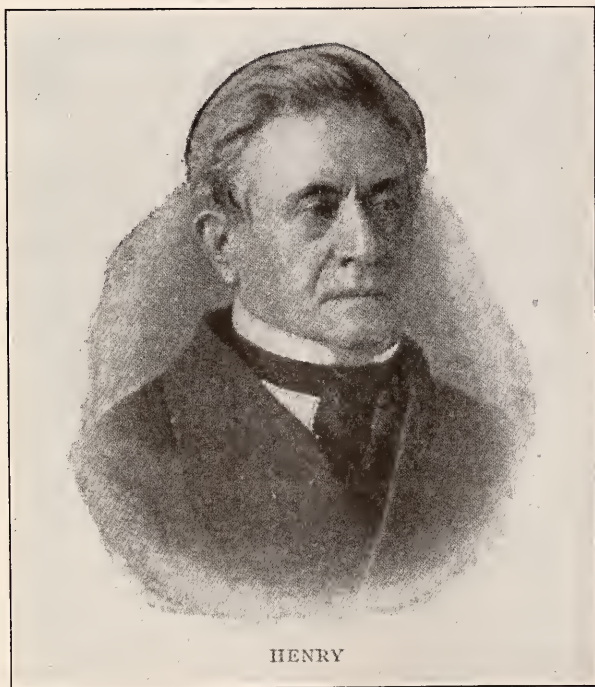
# Electrical Fathers

## Joseph Henry

The first American to make important discoveries in electro-magnetic science was Joseph Henry, who independently discovered the laws of electro-magnetic induction about the same time as Faraday, but did not follow up his discovery in the way that so distinguished the great Englishman.

Joseph Henry was born at Albany, New York, December 17th, 1799. His family were Scotch people who had been in America for only about twenty-five years. True to the tradition of most of the great names in electric science his people were of good stock, but quite poor in this world's goods. His father died when Joseph was seven years old and while his mother took in boarders the lad was sent to live in a small town with one of his relatives.

Here young Henry remained until he was fourteen, when he was apprenticed to a watch-maker at Albany. Later he became a pupil at the Albany Academy and afterward a district school teacher, but he was an assiduous student and was finally appointed Professor of Mathematics at the Albany Academy in 1826. A little while before this he had acted as civil engineer in laying out a projected state road in the southern counties of New York.



In 1827 he produced his first important paper which was a study of the electro-magnets made by William Sturgeon in England in 1825. These were the first "horseshoe" electro magnets to be made and Henry, using, for the first time, insulated wire for the windings, was able to construct magnets that with the small currents then available would nevertheless lift hundreds of pounds.

His next step was the demonstration of the possibility of producing strong electro-magnetic action at a distance by means of what he called "intensity batteries and windings" by which he meant cells connected in series to give higher voltages and exciting turns of the magnet winding all in series to give the maximum ampere-turns. He also showed that the same magnetising effect could be gotten from turns in multiple connected to batteries of cells in parallel, but that the effect could not be transmitted any considerable distance economically.

In 1831 he constructed a reciprocating electric motor and

built a magnet that lifted 2,300 lbs.

In discovering the great principle of electro-magnetic induction Prof. Henry used one of his large electro-magnets capable of lifting seven hundred pounds. Across the poles of the magnet he laid a "keeper" or armature on which he had wound about thirty feet of insulated wire, between the ends of which he connected a galvanometer. When the main exciting current of the magnet was made or interrupted, the inducing of a current in the winding on the armature was shown by a "kick" of the galvanometer needle. This was in July, 1831—about two months before Faraday arrived at the same result.

These inventions excited great interest all through the country and in 1832 the young professor was appointed to the chair of natural philosophy at Princeton, where he remained for fifteen years. Here he had far better resources than he had ever enjoyed before and he continued his original researches with great success.

Among other things he showed that induced currents induce other currents, so that there are various orders of induction. He also showed that the field around a current-carrying conductor extended out in space to an indefinite distance and followed the same law of intensity as light. He applied electric signals to the measure of the velocity of the flight of projectiles; proved that atmospheric electrical discharges are oscillatory and by means of the thermo-galvanometer showed that sun-spots radiate less heat than the rest of the sun's surface.

The National Smithsonian Institute for the "increase and diffusion of knowledge among men" was founded in 1847. Henry, whose plans for its organization were the ones which were accepted, was unanimously elected its secretary and director, and moving to Washington, began the long service with the institute that lasted over thirty years and only ended with his life.

In many respects his acceptance of this honor was a loss to science for its exacting duties left him little time to devote to experimental work. Henceforth he mostly directed the works of others and his services in this line were no less distinguished than what he had done at Princeton, though they were necessarily of much wider range.

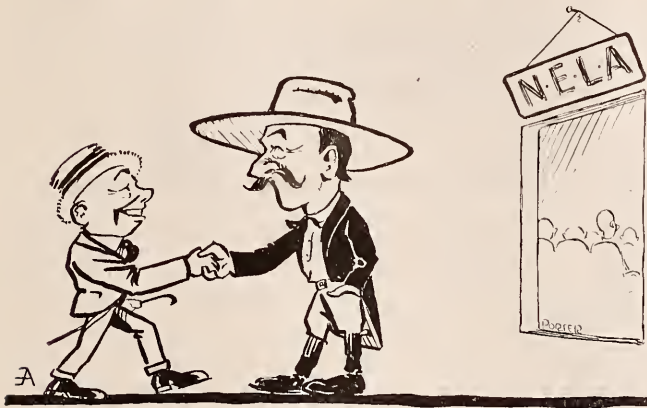
As director of the institute, Prof. Henry laid the foundations of the broad activities of that corporation. He organized the telegraphic transmission of weather reports from all points of the continent and from points in Canada and Mexico. This work later grew into the Weather Bureau. He also introduced the system of international exchange of scientific literature and founded the library of the institute. He found time to investigate the acoustics of public buildings and took great interest in the establishment of light-houses and fog signals along our coast, becoming the head of the Lighthouse Board in 1871.

Full of years and happy in having lived to see his inventions come into practical use all over the world, he died in Washington, May 13, 1878.

Prof. Henry was not only the foremost physicist of this country, but was a man of great modesty and sweetness of manner. He was the soul of honor and generosity, a Christian in every sense and deeply loved by the many young men whose lives he helped to influence at Princeton and also in Washington.

In naming the units of electrical measurement, the International Electrical Congress, as a tribute to Henry's work with inductive circuits, named the unit of self-inductance, the "henry." It is the amount of inductance that with a current of uniform rate of change i.e. one ampere per second, will give a counter-electromotive force of one volt.

# EDITORIAL



**W**ITHIN a few days Chicago will be the gathering place of electrical men from every part of the country. Based on the experience of thirty-eight years, the plans for the annual convention of the National Electric Light Association have left no point overlooked which will add to the success of the occasion. No urging is now necessary to secure a large attendance; the mere announcement of such a program as appears on another page will bring every central-station man who can possibly take the trip.

For those who attend, the returns will be many. Probably the most important will be the getting acquainted with other men who have like difficulties to face, and learning what solutions they find successful. The man from the far West who has a capricious public to keep in good humor is prone to think that his are the very hardest conditions to meet. His brother from the East, however, can tell him of a similar case and how this or that judicious bit of "good-will" publicity turned the tide in his favor. All servants of the public are fighting shoulder to shoulder in a common cause, and such a meeting, bringing men for a few days into close touch, heartens them mightily to renew the battle against ignorance and prejudice.

It is the good fortune of both the stay-at-homes and their more fortunate associates that the proceedings of the convention will be published. The next issue of "Electrical Age" will contain liberal abstracts from the various papers, as well as the news-story of the convention. Members will later receive the proceedings in full. It is thus unnecessary for anyone to burden himself with note-taking. He may listen to and enjoy the speeches with a mind free to catch the inspiration of the able men who speak.

Indirectly, the convention benefits the electrical industry through the evidence it gives the public of the high standards of men and methods in the electrical field. The word of a group of men that they are honestly administering the trust given them is what, in

the last analysis, the public must depend on. No commission control can force a company to be efficient, for an indifferent or dishonest management can evade any "system." The sight of a body of the most intelligent men in the land, meeting together to devise better ways of serving the public, will go far toward assuring in the American public that private ownership of public utilities is best.



**A**S THE AGE goes to press we learn that one of our esteemed contemporaries, who publishes a weekly electrical paper is to bring out a monthly electrical paper, too—sort of a colt to trot at mother's side and eat what green grass the mother misses in the advertising pastures.

This was tried ten years ago by the same publishers with much success; but the colt ate the grass so fast in the weekly pasture the monthly offspring was finally killed to insure sustenance, no doubt, for the parent.

Now that the same experiment is to be tried again it doubly emphasizes the fact that "The Monthly's the thing." Students of technical publishing have had ample proof in recent years that the only demand for a weekly technical journal exists in the pocket of the publisher. We congratulate our contemporary, therefore, for their courage in admitting this, and welcome it most cordially to the monthly fold. We also express our appreciation for the continued privilege afforded ELECTRICAL AGE to represent the industry as a whole, once a month, the announced purpose of our contemporary being only to represent one branch of the trade.

As "the National Monthly of Electrical Practice," ELECTRICAL AGE has already become known as the National Monthly of *Authority* regarding everything electrical, and in attaining this we are not unmindful of the compliment evidenced by the encouragement our success has given to others.

\* \* \*

## A Neglected Opportunity

**T**HERE is scarcely any electrical repair shop, however small, which does not have a show-window before which quite a number of people pass every day. Yet any salesman who gets about among this section of the trade will testify that only the smallest number of these windows contain any display which is likely to make sales.

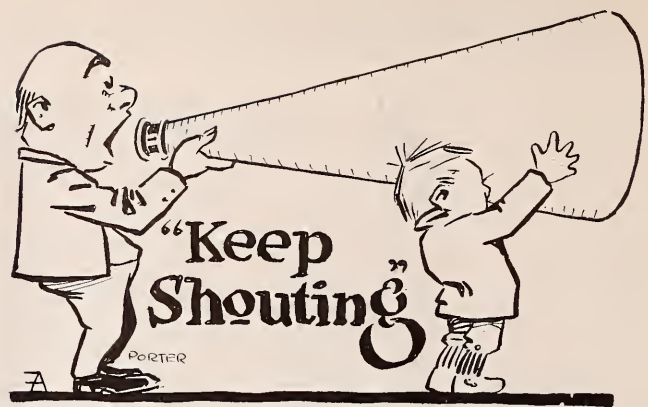
The show-window has several advantages over any other advertising medium. Few persons who see it are not customers, present or prospective, for the owner's goods or services. Its appeal to these people is delivered when they are able to gratify the buying-impulse by merely stepping into the store. It is closely connected with the owner's business and with no one's else; no other dealer can readily convert the message of the display into a "boost" for his own wares. The reader who turns to the advertising pages of this or any other electrical paper will note the wealth of illustrations which endeavor to make the articles offered as real as possible. The pictorial effect, secured at considerable expense in printed advertising, is obtained with little effort in window displays. The actual articles are shown perhaps even in the surroundings in which they will be used.

Window advertising may be either for selling effect or for education. Most men are interested in displays showing how something is done. Small installations of conduit or metal molding; completely wired telephones or bells; dissected motors or other devices are likely to hold attention long enough to make a very definite impression of the quality of the goods, at the present time where business comes easily such displays may well have the preference, for merchants can well afford to wait for the results which though sure, are often long delayed.

To the small dealer the window-display should be a particularly attractive means of publicity. No expense is involved save that of labor, and that indeed may be negligible if spare time is used. Many manufacturers have prepared excellent window material, such as backgrounds, cardboard cut-outs, pasters, etc. Their use will give the dealer the prestige of association in customers' minds with the products they see advertised in the national magazines.

To such a point has the public been educated that it is quick to notice and condemn a slovenly window. Several rules must be observed in order that the sales-message may be driven home. The background should be such that it will catch the eye; the arrangement of the articles should carry the eye toward a central point of interest. Proper balance will be given by one or more points of lesser importance. Nothing incongruous should be admitted; the announcement of an amateur minstrel show has no place in a window full of wiring supplies. The display must be kept clean and changed frequently.

Finally, if a contractor does not wish to use his show-windows to display goods he should either let it give a view of a businesslike office or cover it with a non-transparent sign. If the space must be used for storage or workroom it should be concealed from public gaze. No shop can present an attractive appearance at all times, and the effect of a window piled full of odd coils of wire and pieces of apparatus covered with dust and dead flies will give an impression of the owner's habits of neatness and order which may cost him a customer.



**W**HEN new business is coming in faster than the installation crews or the power-house can take care of it, the management usually stops planning ways of getting more. Salesmen are assigned to other duties, and advertising is cut down. When some newspaper man calls to learn the reason for the reduction in space, he is told that there is at present no need for the company's name to be kept before the public. He hears the same tale from dealers and contractors, who are alike deaf to his warnings of a day of reckoning to come.

There is a real point to that warning, but in order to make it clear we must dwell for a moment on the two classes of advertising. One sort is intended to sell products or services at once; the other tries to create an atmosphere of confidence and good-will about the dealer, so as to influence future sales. The insertion of a simple card at regular intervals will have the effect of establishing a connection in the public mind between "John Jones," and "Electrical Contracting," and the addition of a few words will give the added impression that when John Jones does a job, he does it right. Two or three years may elapse before a reader has such work to be done, but when the time comes, he remembers that he has been hearing about John Jones for a long time, and instinctively he turns to Jones.

There has been much discussion of the future, and speculation as to what business conditions will be "after the war." We may be sure of this much at least—when the demand for munitions ceases, there will be nothing of so great magnitude to replace it, nor will speed be so imperative. The very change in character of many of our industries which will follow the cessation of this abnormal demand will cause a slackening which is bound to be felt. Although we will certainly have to manufacture much equipment to replace that destroyed in Europe, this demand will be only temporary, and during the period of readjustment times are likely to be dull. Then the dealer and contractors who have solidly entrenched themselves in the good will of the public by continuous good service and persistent advertising will find themselves well prepared for any contingency. On the other hand the man who has grown accustomed to living from the business which "comes his way" without effort will find himself in the sad predicament of the man who didn't see the need of repairing his roof in fair weather and couldn't fix it in a storm.

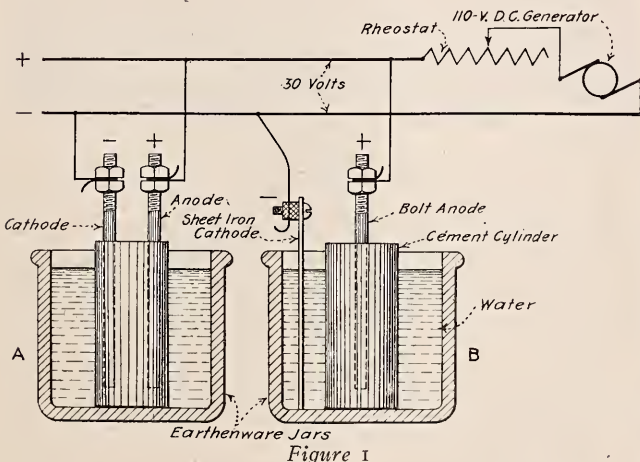
# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## Effect of Painting on Anchor Bolt Corrosion and Bond

By Terrell Croft

Electrolytic corrosion of anchor bolts may occur, when the bolts are set directly in concrete, in locations where "stray" electric currents will pass from the concrete through them, or from the bolts into the concrete. Such corrosion is liable to appear in anchor bolts in electric railway power stations, or in those used for any purpose in cities where earth currents are prevalent. It has been suggested that corrosion of this character might be eliminated by painting the bolts with suitable insulating paints. To determine the effect of painting in preventing electrolytic corrosion, tests were made under the direction of H. A. Gardner, Asst. Director of the Institute of Industrial Research, in Washington. It is the purpose of this article to briefly outline the methods of making these tests and the conclusion derived therefrom.



Objections to painting anchor bolts may be;—First, the paint may weaken the bond between the bolt and the concrete in which it is set, rendering it easy of withdrawal; second, where the bolt is painted the corrosion may be concentrated at a crack in the paint; third, the paint insulation may be short lived. The test (see Table 1) to be described provide some data, which is of a qualitative rather than a quantitative nature, in answer to the objections just recited.

Specimens for the electrolysis tests were prepared as shown in Figs. 2 and 3. Two different sets were used. The first set comprised two 1 in. x 32 in. painted iron rods (anchor bolts) set in a 1:2-mixture, concrete cylinders each about 7 in. in diameter by 21 in. long. Before being cast in the

cylinders the rods were well cleaned and then given two coats of paint a week for drying being allowed between successive coats. Table 1 indicates the different paints that were used on the rods in the test. After these specimens had set for a month they were arranged in a vessel having 2-in. of water in its bottom. One rod of each specimen was made a cathode and the other an anode, across which an e.m.f. of 30 volts (cut down by a resistance from 110) was impressed. After the current had been flowing for a week, two of the specimens showed cracks near their bottoms. Then each of the cylinders with the bolts imbedded in it was transferred to a separate pottery jar and immersed in water to within 1 in. of its top as shown in Fig. 1, A.

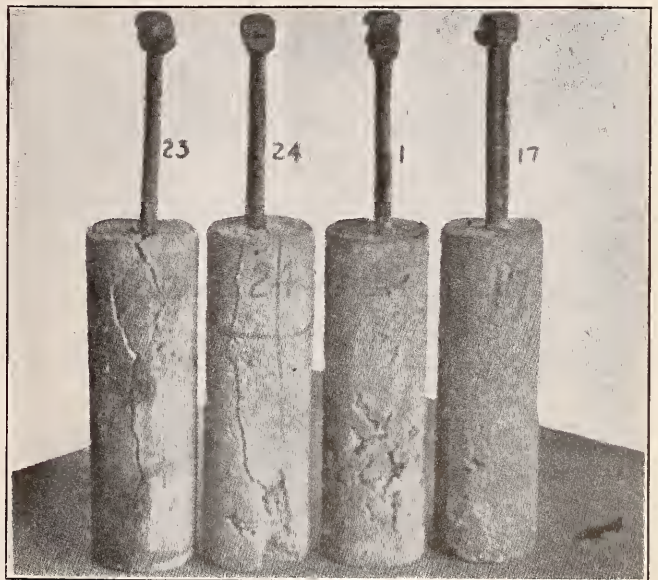


Figure 2

Practically all of the cylinders cracked within ten days, the fracture in each case starting at the anode. The specimens that thus cracked could be split into two sections, Fig. 3. Those which did not crack (see Table 1), were split longitudinally with a cold chisel, so that the imbedded rods could (Fig. 3) be examined.

For the second set of test specimens, single  $\frac{3}{4}$  in. x 12 in. painted iron rods were imbedded in  $3\frac{1}{2}$  in. x 8 in. cylinders (Fig. 1, B). After curing a month, and being immersed

# Table I—Tests of Adhesion of Bond and Corrosion of Painted Anchor Bolts Set in Cement.

Tests were made by H. A. Gardner, Assistant Director of the Institute of Industrial Research, Washington, D. C. These tests were reported in a lecture before the Master Painters' Association in Philadelphia, Jan. 13, 1915.

Specimen No.	PAINT COMPOSITION	CORROSION TESTS		ADHESION TESTS
				SERIES III.
		SERIES I. 500 luc. 2 Rods in 7x21 in. cylinder.	SERIES II. 300 luc. 1 Rod in 3½x8 in. cylinder	1 Rod in 3½x8 in. cylinder.
23	<b>Unpainted Blank Specimens</b> Not painted	Cracked at 240 hr. Large current throughout test. Anodes badly corroded and pitted.	Cracked at 96 hr. Large current throughout test. Anodes badly corroded and pitted.	2010 lb.
24	Not Painted.	Cracked at 50 hr. Badly pitted and corroded.	Cracked at 96 hr. Badly pitted and corroded.	2750 lb.
1	<b>Bituminous Paint</b> Boiled water-free coal tar, lime, portland cement, rosin, and benzol.	No cracking. Only small current. Some excretion of paint at anode.	No cracking only small current.	1530 lb.
17	Blown residual petroleum oil, gilsonite, benzol and turpentine.	No cracking. Only small current.	No cracking. Only small current.	2810 lb.
3	<b>Oil Paints</b> Red lead in raw linseed oil; 30 lb. per gal.	Did not crack but large quantity of iron hydrate at top of specimen.	Cracked at 192 hr. Iron hydrate at surface throughout test. Iron badly corroded.	1870 lb.
13	Chromegreen (2% on 80% barytes) in raw linseed oil.	Cracked at 240 hr. Iron hydrate stain early. Iron badly corroded.	Cracked at 192 hr. Specimen stained. Iron badly corroded.	790 lb.
14	Blue lead in raw linseed oil; 14 lb. per gal.	No cracking. Slight corrosion. Iron hydrate at surface.	No cracking. Slight corrosion. Iron hydrate on surface.	1250 lb.
15	Chromated iron oxide in raw linseed oil. 12 lb. per gal.	No cracking. Only slight corrosion.	Cracked at 144 hr. Iron oxide at top.	980 lb.
16	Blue lead in heavy-bodied linseed oil reduced with equal quantity of turpentine to give flat surface; thin film.	Small crack at 240 hr. No surface deposit shown. Anode showed considerable corrosion	Small crack at 216 hr. No surface deposit. Anode corroded.	1400 lb.
27	Chromated iron oxide in treated tung oil. 12 lb. per gal.; "sanded surface."	Not used.	No cracking; only small current; No surface deposit. Excellent condition.	2000 lb.
28	Equal parts 14 and 16; "sanded surface."	Not used.	No cracking.	1880 lb.
29	Asbestine in processed tung oil; "sanded surface."	Not used.	No cracking; only very small current; excellent condition.	Not used
4	<b>Aqueous Paints</b> Silicate of Soda 40° Be.	Cracked at 240 hr.; little resistance to current.	Cracked at 168 hr.; little assistance to current; some clear iron areas and some pitted.	700 lb.
10	Liquid glue.	Cracked at 240 hr. Passed large current; iron hydrate at top and around anode in concrete.	Cracked at 96 hr.; large current; dense iron hydrate on top. Bad corrosion.	100 lb.
11	Silicate of soda 20° Be. and graphite; equal weights.	Cracked at 144 hr.; considerable current, corrosion marked.	Cracked at 46 hr.; large current; corrosion marked.	Specimen faulty.
12	Silicate of soda 20° Be. and iron oxide; equal weights.	Cracked at 240 hr.; considerable current.	Cracked at 192 hr.; considerable current.	1870 lb.
19	5% aqueous solution sodium resinate.	Cracked at 240 hr.; more current than unpainted.	Cracked at 144 hr.; considerable current.	1890 lb.
20	5% aqueous solution sodium resinate with equal weight iron oxide.	Cracked at end of 240 hr.; large current.	Cracked at 196 hr.; large current.	2580 lb.
7	<b>Lacquers</b> Gum sandarac in alcohol, 32 oz. sol.	No cracking; only small current; no surface stain.	Only small current; no surface stain.	990 lb.
8	Gum shellac in alcohol, 32 oz. sol.	No cracking; small current; no stain.	Small current; slight surface stain.	490 lb.
18	Soluble nitrated cotton in amyl and ethyl acetate, -8oz. sol.	Cracked at 240 hr.; large current; surface stain.	Cracked at 192 hr.; large current surface stain.	2480 lb.
21	Gutta Percha in benzol; 3 oz. sol.	Cracked at 240 hr.; considerable current; surface stain.	Cracked at 96 hr.; considerable current; considerable surface stain.	2600 lb.
26	Synthetic resin (phenal formaldehyde) in alcohol.	Not used.	No cracking; small current; some surface stain and a small deposit of phenol-lime products.	1380 lb.
2	<b>Oils and Varnishes</b> Heat-treated tung-oil compound in turpentine.	No cracking; specimen faulty; cathode exposed; very small current; film tough and elastic.	No cracking; moderate current; no stain.	2665 lb.
5	Double-boiled linseed oil (lead and manganese drier)	Cracked at 140 hr.; considerable current; heavy surface stain.	Only a fine crack; considerable current; no stain.	1680 lb.
6	Kauri gum-linseed oil varnish.	Only slight crack; small current; no stain.	No cracking; no stain.	1790 lb.
9	Processed tung-oil compound.	No cracking; very small current; no stain.	No cracking; very small current; no stain.	1990 lb.
22	Equal parts of 9 and 21.	No cracking; small current; no stain.	No cracking; small current; no stain.	Specimen faulty.

for 25 hrs. together each of these specimens was placed in an earthenware jar, Fig. 1, B, together with a sheet-iron cathode. Water was poured into the jar within 1 in. of its top. All of the rods were connected in parallel to the positive side of the circuit and all of the sheet-iron cathodes to the negative side. An e.m.f. of 30 volts was then impressed across them for 240 hours, (Fig. 1, B), after which period the pressure was increased to 55 volts and continued for 60 hours. The general results as briefed in Table I were similar to those obtained with the first series.

The test for the strength of bond of the painted anchor bolts, that is, for their resistance to withdrawal, were made in a testing machine. A third set of specimen was prepared for this purpose. These were of the same construction as those shown at Fig. 2, B, except that the lower ends of the rods set flush with the bottom surface of the cylinder. After curing for three weeks, the rods were pushed through the concrete cylinders in the testing machine. The loads at which the different specimens failed are indicated in the last column of the table "Adhesion Test."

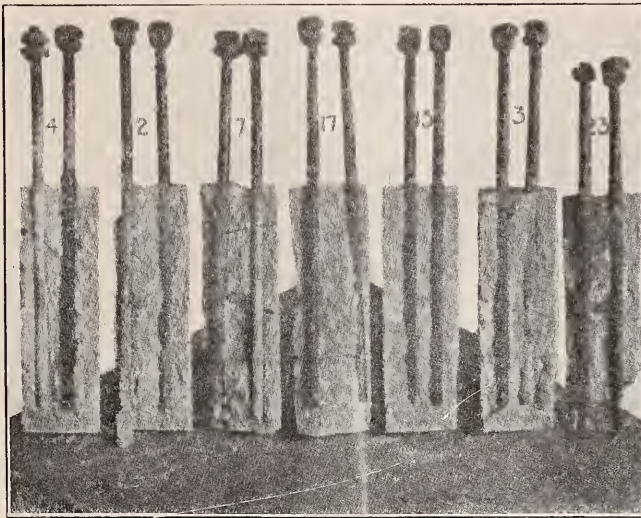


Figure 3

As to conclusions; it is not probable that any paint will provide sufficient insulation on an anchor bolt to effectually protect against electrolysis. The duration of the tests just outlined was scarcely sufficient to justify definite conclusions. It should be noted that some of the paints, for instance, that of specimen No. 17, apparently provide as good a bond between the rod and the concrete as does an unpainted rod imbedded directly in the concrete. Some of the paints provided an excellent bond but were inefficient insulators. For example, the water paints used on specimens Nos. 12, 19 and 20 and the lacquers 18 and 21, provided a good bond but were very poor insulators. In general, the oil pigment paints were inferior both from the standpoint of insulation and of bond.

\* \* \*

### Telephone an aid to "Preparedness"

On Saturday, May 6, the American Telephone & Telegraph Company arranged for the Navy Department a demonstration of the communication service which its lines could afford in time of need. Seated in his office in Washington, Secretary Daniels talked by wireless telephone with Capt. Chandler of the battleship *New Hampshire*, lying in Hampton Roads. Save for a few interruptions by "static," the transmission was excellent. Mr. Daniels then talked by telephone with Navy Yards at Brooklyn, Portsmouth, N. H., and Norfolk, and with the aeroplane station at Pensacola. During a forty-hour test which follow-

ed, the "*New Hampshire*" was never out of touch by wireless telephone with the Navy Department.

Under the general supervision of Chief Engineer John J. Carty, 53,000 miles of the Bell system's wires were utilized in this demonstration. The services of 600 telephone men, and much special apparatus were required.

\* \* \*

### Strength of Interpoles

By E. C. Parham

On a non-commutating-pole continuous-current generator the effect of the armature current is to distort the magnetic field; and unless the design is such as to avoid it, the brushes must be shifted forward, in the direction of rotation, as the load is increased; this is in order to bring the short-circuited coils into a field that is sufficiently strong to stop and to reverse the local current of the short-circuited coil just as the bars to which it is connected are leaving the brushes. On a motor, the brushes must be shifted against rotation for the same reason. In either case, if the field due to the armature is weak as compared to that due to the field magnets, no brush shift will be necessary, but the obtaining of such a strong field is expensive.

By neutralizing the armature reaction at all reasonable loads interpoles effect an equivalent condition without adding so much to the weight or to the cost of the machine.

The general adoption of interpoles has resulted in sometimes confronting operators with the problems of determining if sparking is due to the interpoles being too strong or if it is due to their being too weak.

Bearing in mind that the brushes of a non-interpole compound-wound machine, or of a shunt-wound machine, must be shifted forward with the load, in order to prevent sparking, it follows that if it is necessary to do this on an interpole generator, the interpoles must be too weak, because:—With correct interpole strength, no shift will be required; without interpoles a forward shift will be required; at normal interpole strength, or any interpole strength less than normal, the effects of the forward shift and of the interpoles are of the same sign: therefore, if the forward shift must be used on an interpole generator, it means that two influences that act in the same direction must be used in order to get sparkless commutation, and that, therefore, one of the influences, namely, the interpole field, is too weak. By the reverse reasoning, it follows that if the brushes of an interpole generator must be shifted backward, in order that good commutation may be obtained, the interpole field is doing more than it should and is, therefore, too strong.

This reasoning assumes that the no-load neutral is the reference point of brush movement; reasoning from any other assumption would lead to uncertainty; for, suppose that the brushes are assumed to be on neutral when actually they are forward of the neutral, it is conceivable that a combination of brush shift with weak interpoles might give satisfactory commutation under load, but on removing the load and with it the interpole effect, the brushes might spark on account of being so far forward of the true no-load neutral. Again, if the brushes were assumed to be on neutral when actually they were forward of neutral, then the necessity of shifting the brushes backward in order to get good commutation, would justify the conclusion that the interpoles were too strong when in reality they might be normal. Before drawing conclusions as to interpole strength, then, it is necessary to locate the no-load neutral as a reference point of brush-shift. Under this condition:—

If the brushes of an interpole generator must be shifted forward or if the brushes of an interpole motor must be shifted backward, in order to get sparkless commutation, the interpoles are weak, but if the brushes of an interpole generator must be shifted backward or if the brushes of an interpole motor must be shifted forward, in order to secure satisfactory commutation, the interpoles are too strong.

Bearing these relations in mind may save time in adjusting of interpole shunts or in trying separate interpole excitation.

## Adjusting the Compounding of a Generator

By A. L. Gear

The writer was called to the local street-railway power plant the other evening, to locate some trouble with a 100-kw., 550-volt direct connected unit which had just been installed and had not given satisfaction. This unit consisted of a Ridgeway steam engine, direct connected to a Westinghouse compound-wound generator, rated at 100 kilowatts, 550 volts, 182 amperes, 250 r. p. m., engine operating a steam pressure of 100 pounds gauge. The unit had a very neat appearance, standing upon a slightly raised concrete foundation with all cables from the generator to switchboard passing through conduit embedded under the concrete floor.

The power plant engineer started the unit for inspection, under operating conditions. The voltage built right up to 550 volts without any lagging whatever. The tester then took the load off the old generator and put it on the one, without paralleling the units at switch board, but first taking care that the voltmeter read correctly, the voltmeter leads being connected to the generator leads common to a certain bus-bar. One generator was switched out and the other switched in under light load.

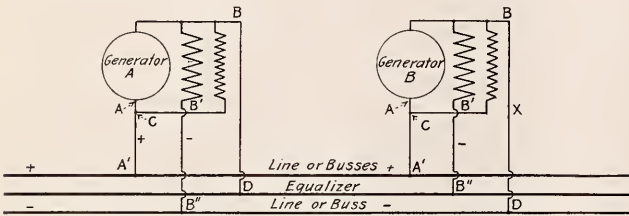


Figure 1

It was now noticed that when the new unit was switched in upon this small load the voltage decrease slightly, and upon the load becoming heavier, the voltage would decrease as the load increased, and upon heavy loads from 100 per cent. to 150 per cent. overload, the voltage decreased from 550 volts at no load to 400 volts at overload. As it was noted that the steam pressure did not decrease with increase in generator load, nor did the engine seem to decrease in speed; it was evident that the cause of the trouble could not be in steam power conditions, but must be electrical. It was then concluded that the generator's series field winding might be wrongly connected up, that is, so connected that the compounding winding instead of assisting the shunt field winding was counteracting its effect.

The series winding was then reversed. Upon putting the unit back in service again, the conditions were practically as before. The compound field winding was evidently useless, and the generator was acting as a shunt machine. The conclusion, therefore, was that in connecting up generator to switch-board some-

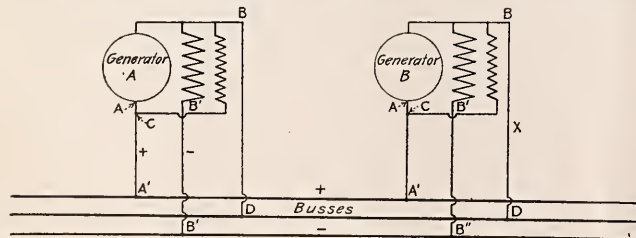


Figure 2

one had made a mistake in the leads and so connected it up as to cut out the series winding completely. This could not be easily traced out on account of the cables being in concrete, and could not be tested with lamps or magneto without considerable trouble. As line and equalizer cables came through

the same conduit that seemed most likely place for mistake. The condition actually found is shown in Fig. 1, and the corrected correction is shown in Fig. 2. Generator B is the new unit under test and the cable X is the equalizer, while cables B'B'' put in for negative line, were interchanged at the three-blade switch on back of the switch-board, cable X being connected at D, Fig. 1, to negative bus (through switch) where it should have been connected at B'' to equalizer bus, and cable B'B'' should have been connected at D to negative bus, as shown in Fig. 2.

However, after this change was made the machine was as useless as before, although in the other way this time, for upon putting the unit under test at 550 volts, no load, the voltage at 150 per cent. overload was up to 750. With such compounding as this, it could not be operated in parallel with the other units, which at 150 per cent. one load were flat compounded and gave 500 volts. The remedy finally used was to place a resistance in parallel with compound field windings to reduce the current passing through them. This was readily accomplished by placing a german silver ribbon across the compound field terminals. One end of this ribbon was placed in an adjustable clamp so that the operator could slide the ribbon in either direction, to lengthen or shorten the shunt. The shorter it was, the greater amount of current it would carry for a given width and thickness; consequently, the greater it would reduce the compounding effect, because a less amount of current was allowed to pass through the compound winding.

This generator being adjusted required some two and a quarter feet of german silver, being three-eighth inch wide and one-sixteenth inch thick. After it was shunted, it was placed in parallel operation with the other generators working smoothly and sparklessly, taking its proper share of the load in proportion to rated kilowatt output. It is well in making shunts for compound wound generators, to be careful to use enough german silver ribbon so that there is no reasonable chance for the shunt to become overheated from carrying too great a portion of load. For should it overheat the resistance will increase and send too large a portion of the main current through the series winding and thereby cause the generator to overcompound, and also may cause the shunt to burn in two and thus lose all the effect for which it was inserted.

\* \* \*

### "Why Generator Wouldn't Build Up"

A steam railroad which has its electrical repair shop for the car lighting equipment in the home town of the writer frequently calls in assistance when anything unusual occurs.

Recently the generator on a coach which had made the trip across the continent was completely burnt out. A new armature, field coils and brushes were ordered from the factory. Connections were carefully made according to the blue print but the machine would not generate. The coach was scheduled to make the return trip on the evening the parts were received. Instructions were issued to the writer to answer the hurry call for help.

This machine was a large four pole shunt generator with two commutating poles, designed especially for an axle-driven car lighting system. The field connections and polarity were checked and found to be correct, except for one commutating pole which was reversed. While this condition would have caused poor commutation, it could not prevent the machine from generating. Being unable to locate any trouble while the machine was apart, it was assembled to be tested as a motor. When putting in the brushes no screw to hold the lug of pig-tails was seen. The writer asked the railroad man how they should be connected and was shown a screw on the back of the brush-holder of the forward arm. Here was the cause of the dynamo refusing to pick up. All of the brush-holder arms were short-circuited together.

R. L. Hervey.



## The Care and Installation of Electric Apparatus

(Continued from the April issue)  
General Care of Machines

Always see that all machines in use are kept free from dust and dirt. It is well, for the good of all concerned, if machines not in use are kept likewise.

After machines have been shut down, or during installation when these machines are not being used see that they are well covered. If possible the cover should be thoroughly water-proof. The cover should be non-inflamable.

During operation of the machines never allow any overflow of oil in the bearings as considerable trouble might occur if oil should get into the windings or leads.

Never use water or ice to cool off bearings as it may get into the windings, the result of which is obvious.

Always keep magnetic articles such as screw drivers, monkey wrenches, etc. off the machines when about to start up or when in operation as they may accidentally fall or be drawn by the magnetism in to the machine and come in contact with the commutator or the armature causing serious damage.

On gas engines and some reciprocating steam engines it may be necessary to lift the brushes on a direct current machine before it stops because the engine sometimes reverses and with small brushes they are liable to damage. This, of course, does not apply to large or sturdy brushes. In fact, it is best not to lift the brushes as they are liable to lose their seating on the commutator.

Never use waste in cleaning off a commutator. It is better to use a soft clean cloth as thin canvas or cheese cloth. Never use a commutator compound of any kind. Instead use a clean cloth very slightly moistened with light mineral oil for a commutator lubricant.

### Machine Defects—Electrical—Sparking

All machine sparking of whatever nature should be eliminated. This trouble is attributed invariably to the following causes:

- (1) Bad condition of commutator,
- (2) Bad condition of brushes,
- (3) For motors—Weak magnetic field, evidenced by increased speed above that given on the name plate,
- (4) Faulty armature.

Under cause (1) for sparking may be found the following troubles:

- (a) Commutator rough or eccentric,
- (b) One or more high bars,
- (c) One or more commutator bars,
- (d) High mica between segments,
- (e) Oily or dirty commutator.

When sparking is due to trouble (a) this can be remedied if the roughness is slight by grinding down the commutator with fine sand-paper using a block conforming to the curvature of the commutator. A piece of fine grind-stone cut to the proper curve can also be used. Never under any circumstance use a file or emery.

After the sanding is completed the commutator surface should be well cleaned and polished with a soft clean cloth slightly moistened with oil. Avoid a cloth having much lint.

### Refinishing Commutators

When the commutator wear is excessive or the commutator is eccentric so that it cannot be remedied by the method just given, it is advisable, if possible, to remove the armature from the frame and turn the commutator down in a lathe. If necessary to submit to this method of putting the commutator in condition only a first class machinist or dynamo repair shop should be allowed to do this work.

It will not be necessary to remove the armature from the frame if a special tool post is at hand suitable for clamping to the machine frame.

After turning down it is necessary to refinish the commutator on account of the rough surface left by the tool.

When sparking is due to trouble (b) this can be remedied (only on small types of machines) by pounding down the high bars with a rawhide or wood mallet, great care being taken not to injure any part of the commutator. This trouble can also be remedied by grinding or turning down the high bars to the level of the rest. Before doing this it is best to see that the commutator is well drawn up and it may be advisable to bake the commutator before turning down.

If sparking is due to trouble (c) the commutator should be drawn up, baked, if necessary, and turned down in a lathe.

When sparking is due to trouble (d) the high mica between segments can be removed by using fine sand-paper if the trouble is only slight. If excessive, the best remedy is to have the commutator slotted or to use enough abrasive brushes to keep the mica low after having turned it down in a lathe.

If sparking is due to trouble (e) the commutator should be thoroughly cleaned, removing all gummy and sticky substance which may have collected on the surface. This surface can be cleaned by using a slight quantity of light mineral oil applied with a clean cloth.

### Sparking Due to Defective Brushes

Under cause (2) for sparking may be found the following troubles;

- (a) Brushes not properly spaced or set,
- (b) Brushes make poor contact with commutator,
- (c) Brush not set at neutral point,
- (d) Vibration or chattering of brushes,
- (e) Some brushes having excessive pressure, thus taking more than their share of the current,
- (f) Brushes being burned or frayed on the ends.

When sparking is due to trouble (a) it is necessary that the brushes be set correctly. For details as to method see G. E. Review for April, 1913.

When sparking is due to trouble (b) an examination of the brushes will show that they touch at only one or two corners, or on an edge, or that dirt has collected between them and the commutator. If the trouble occurs with copper gauze brushes, they should be thoroughly cleaned by using benzine and the contact surface fitted to the commutator. A jig is usually used. The brush should be so set that it bears evenly on its whole width and all frayed and ragged edges should be trimmed off. Brushes if cleaned with benzine should be removed from the holders and taken out of the building.

If sparking is due to trouble (c) the rocker arm must be adjusted either backward or forward until the brushes assume a position of no sparking or that the sparking is minimum.

When sparking is due to trouble (d) an examination of the commutator will show that it has become gummy or sticky; that the commutator has flat or low high bars or that the machine itself vibrates. When the commutator has become gummy or sticky it can be cleaned by using the same method stated above for oily and dirty commutator under "Sparking due to bad condition of Commutator."

If there are flats, high or low bars or high mica this can be remedied by sanding if slight or turning down if necessary.

If the vibration and chattering is due to the machine vibration it will be necessary to re-level or re-align the machines on their foundations.

Sparking due to trouble (e) can be remedied by adjusting the tension of the brushes so that a uniform pressure is obtained.

When trouble (f) is found to occur the remedy is to retrim the edges. This burnt condition is caused by excessive pressure which causes an excessive current density in the brush. It is also caused by overloads and by brushes not being in the neutral. When brushes have been badly burned a re-sanding and setting is necessary.

Under cause (3) for sparking it may be found there is an open circuit in the field, or a high resistance field coil.

If the field circuit is open this trouble can be located by test-

ing the coils for the open as given in "Commercial Electrical Testing" by Collins.

An open circuited coil if external can be easily repaired. The trouble usually occurs where the terminal is attached to the the field wire. If the trouble is internal the coil will have to be rewound. The maker of the machine should be consulted before attempting to rewind a coil.

Cause (4) sparking may be attributed to the following troubles;

- (a) Short circuited coil in armature,
- (b) Open circuit in armature,
- (c) Armature coils crossed.

Under trouble (a) of the above will be found in most cases that copper, solder or some other metallic foreign substance has located between the commutator bars or tangs. A simple method of removing such causes is to apply a potential as in insulation testing. This will burn out what ever metallic substance is located there. As this method is standard it will be found described with complete details in most standard handbooks.

When short circuit is internal it will be necessary to have the armature rewound or opened up and the trouble remedied. If no competent dynamo repair shop is in the locality the maker of the machine should be appealed to for a man.

When looking for short circuits or crosses a careful examination should also be made of the insulation on the brush holders. Oil, dirt or copper dust may have short-circuited the rocker arm and brush holder and thus short-circuited the whole machine.

For testing for short-circuits see any good standard hand-book.

Under trouble (b) it may be that there is an internal broken coil or that an open connection exists at the commutator tang. It may be due to a poorly soldered connection. In case the trouble is internal the only remedy is rewinding. If external the remedy is quite obvious.

For tests for broken coils see a good hand-book.

Under trouble (c) the armature bar to bar test may be applied or other methods used—see hand-book.

### Failure of Dynamo to Generate

Failure of the dynamo to generate may be due to the following causes;

- (a) Field connections reversed,
- (b) An open circuit in armature,
- (c) An open circuit in field coil,
- (d) Brushes not in good contact with commutator,
- (e) A dirty commutator,
- (f) Residual magnetism too weak,
- (g) Broken wire,
- (h) Faulty connections,
- (i) Too much resistance in the field circuit.

A careful inspection of the connections should be made if the machine has been started and failed to generate.

A comparison of the diagram of connections which accompany the machine should be made with the actual wiring of the machine to ascertain if failure to generate on account of (b) and (c) can only be remedied by the repair of the faults. This also applies to (d) and (e).

When due to (f) it will be necessary to excite the fields from an independent source of direct current. About 15 to 20 volts is sufficient in most cases to cause current enough. The current should be sent through in the proper direction. Dry cells may be used if there is no other course available.

Faults (g), (h) and (i) can only be located by a careful examination of the complete circuit. It is absolutely imperative that this should be done before endeavoring to put the machine in service.

### Bibliography

The following list of references will serve, no doubt, better than a long recital of methods. The present development of the art of testing is such that a complete file of methods is available

at any public library. It is for the above reason that the writer decided to give a list of references rather than attempt to discuss each of the necessary tests in use for installation and operation testing.

Appliances for Electrical Measurements, C. D. Haskins, G. E. Review, Aug., 1910—part 1.

Commercial Electrical Testing—E. F. Collins, G. E. Review, Nov., 1909 to Febr., 1911, or in book form published by the G. E. Review Publishing Co., 1913.

Standard Handbook for Electrical Engineers, Fourth Ed. See especially the bibliography following sections 7, 8 and 9.

Management of Electrical Machinery—Crocker & Wheeler—1908.

General Electric Review, May, 1913—Care and Operation of Commutators by H. S. Page.

Thomson S. P.—Dynamo-Electric Machinery—1904, Vol. 1—Spon & Chamberlin, New York.

See also files of papers from Department of Commerce, Bureau of Standards, Washington. These papers are more for design work but help in the location of faults when used by an experienced investigator.

\* \* \*

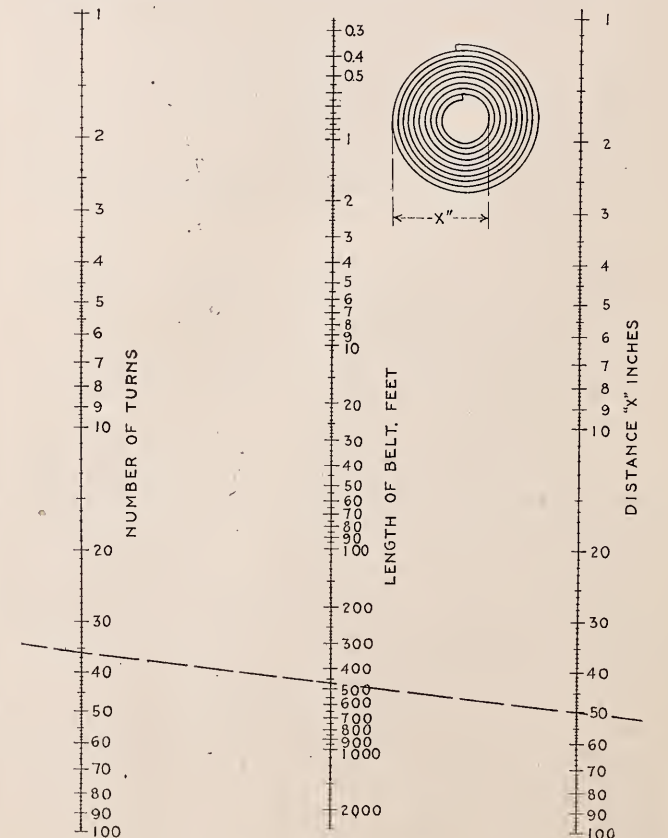
## A Chart That Shows the Strength of Rolled Up Belts

(Copyright, 1916, W. F. Schaphorst)

The following chart is useful when it is desirable to know the number of feet of belting in a given roll.

The sketch shows how to measure the roll. The distance "X" must be measured in inches.

For example: How long is the belting in a roll which has 36 turns, distance "X" being 50 inches?



The dotted line drawn across the chart shows how easily the length is found—it is 470 feet.

You need not actually "draw a line" as is shown, just lay a straight edge across from point to point, and the intersection with the middle column gives the length of the roll immediately.

# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

## Methods of Rating and Determining the Size of Auto-Transformers for a Given Duty

In starting large synchronous or induction motors it is necessary either to use a separate auxiliary motor connected to the shaft of the synchronous or induction motor, or, to use an auto-transformer to reduce the applied voltage until such time as the motor reaches maximum speed and can stand application of full voltage without undue current rush from the line. If an auto-transformer is used the problem becomes that of determining the voltage to be applied to the motor, that is, the tap to be brought out from the auto-transformer and the necessary size of the auto-transformer.

An induction or synchronous motor when thrown directly on a line will develop a starting torque proportional to the square of the line voltage, and if the line voltage is changed or varied, the torque developed will vary in direct proportion to the square of the voltage. Also, at starting, the current drawn by the motor varies directly as the voltage applied to its terminals.

In designing an auto-transformer for starting both of the above conditions must be kept in mind, the first in determining the taps to be brought out and the second in determining the size of winding to carry the starting current.

From the locked saturation tests made on the motor, the current the motor would draw from the line if full voltage were applied, can be determined, and so the kv-a. drawn from the line at 100% voltage. If 50% voltage be applied to the motor the current drawn from the line will be only half of the value with 100% voltage—the impedance of the machine being constant—or the kv-a. drawn from the line will be one quarter of that at 100% voltage: in other words, the kv-a. drawn from the line by a given motor varies as the square of the tap, or voltage, applied to the motor. Knowing the mechanical constants of the motor also the electrical constants we can determine the torque necessary to start the motor and the voltage that must be applied to produce this torque.

### Rating of an Auto-Transformer

An auto-transformer may be considered as a transformer, the primary and secondary windings of which are connected in series in the proper direction to cause the primary and secondary voltages to add. If we then apply a voltage across the whole winding equal to the secondary plus primary voltage, the induced voltages across each section of the winding will be proportional to the ratio of transformation as a transformer. Suppose we have a transformer with a 4 to 1 ratio and connect the high-tension and low-tension windings as described above, then the e.m.f. across the low-tension portion would be 1/5 of the total voltage across the whole winding, or equivalent to a 20% tap on the auto-transformer. If now we put load on this portion of the winding and draw a current equal to the normal full load current of the low-tension winding as a transformer, the equivalent transformer rating of the auto-transformer will be the

product of the current flowing in either winding and the voltage across that winding, these two products being found to be numerically equal. In this case it would be found to be equal to  $(1 - .20) \times \text{kv-a. from line}$ . The relation between kv-a. from line and equivalent transformer rating can be shown in the following way:

$I_0$  = the current motor would draw if full potential were put across the terminals.

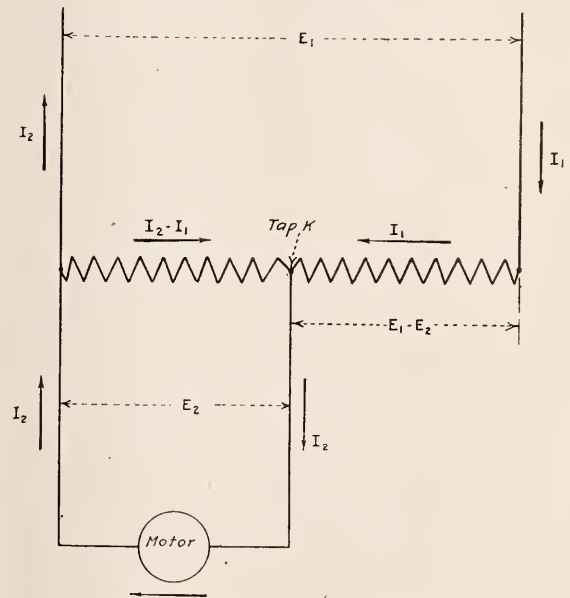
$E_1$  = potential of line.

$K$  = tap expressed (decimally) as percentage of line voltage.

$E_2$  = tap voltage.

$I_2$  = current drawn by motor at tap  $K$ .

$I_1$  = current drawn from line by motor on tap  $K$ .



For simplicity consider one phase of a two-phase motor.

Now if  $I_0$  = current motor would draw if thrown on full line voltage  $E_1$ , then for any tap  $K$  the kv-a. from the line would be  $E_1 I_0 K^2 = E_1 I_1$  and the kv-a. drawn by the motor at tap  $K = E_2 I_2$ .

$$\frac{E_2}{E_1} = \frac{I_1}{I_2} = K \text{ and } \frac{E_1}{E_2} = \frac{I_2}{I_1} = \frac{1}{K}$$

From our definition of equivalent transformer rating we get the equivalent rating in the above case to be  $E_2 (I_2 - I_1)$  or  $(E_1 - E_2) I_1$

or since these two expressions are numerically equal

$$\frac{E_2 (I_2 - I_1) + (E_1 - E_2) I_1}{2}$$

The kv-a. from the line is  $E_1 I_0 K^2$ .

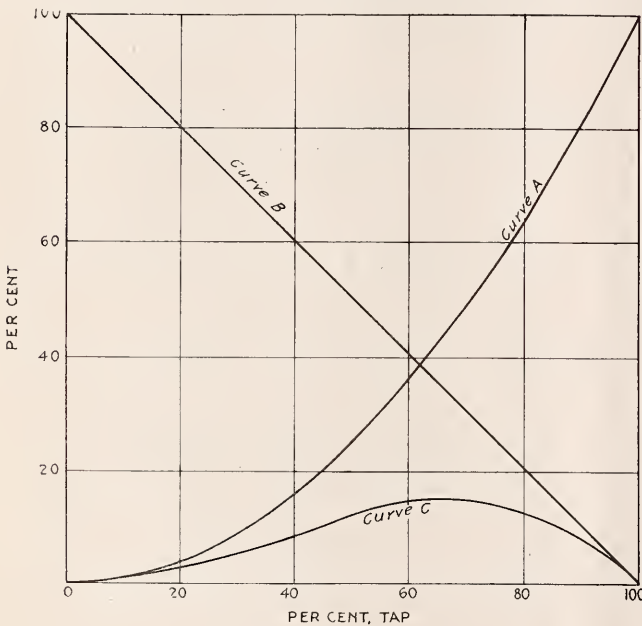
So the relation between the equivalent transformer rating and Equivalent Rating

$$\begin{aligned} \text{kv-a. from line is } y &= \frac{\text{Equivalent Rating}}{\text{kv-a. from line.}} \\ &= \frac{\left[ \frac{E_2 (I_2 - I_1) + (E_1 - E_2) I_1}{2} \right]}{E_1 I_0 K^2} \\ &= \frac{E_2 (I_2 - I_1) + (E_1 - E_2) I_1}{2 E_1 I_0 K^2} \end{aligned}$$

Substituting  $KE_1$  for  $E_2$  and  $KI_2$  for  $I_2$ ,

$$\begin{aligned} \text{we get } & \frac{KE_1 (I_2 - KI_2) + (E_1 - KE_1) KI_2}{2 E_1 I_1} \\ &= \frac{KE_1 I_2 (1 - K) + KE_1 I_2 (1 - K)}{2 E_1 I_1} \\ &= \frac{2 KE_1 I_2 (1 - K) \text{ or } KI_2 (1 - K)}{2 E_1 I_1} \end{aligned}$$

Substituting  $I_1$  for  $KI_2$ , we finally have  $y = I - K$  or kv-a. from line  $\times (I - K) =$  equivalent transformer rating.



For a given motor which draws a certain kv-a. from the line with full voltage across its terminals there must be some one tap at which the equivalent transformer rating is a maximum, or which requires the largest size transformer core. We can determine what tap this will be from the equivalent transformer rating as found above.

Kv-a. from line at tap  $K = E_1 I_0 K^2 = E_1 I_1$  and we have shown that equivalent kv-a. rating  $= (I - K) E_1 I_1 = E_1 I_0 K^2 (I - K)$  or  $E_1 I_0 (K^2 - K^3)$ .

If now by calculus we take the first derivative of this expression with respect to  $K$  and put it equal to zero, solving for  $K$  we will find what value will give a maximum or minimum value to the expression.

$$\begin{aligned} \text{or } \frac{d}{dk} E_1 I_0 (K^2 - K^3) &= \frac{d}{dk} E_1 I_0 K^2 - \frac{d}{dk} E_1 I_0 K^3 \\ &= 2 E_1 I_0 K - 3 E_1 I_0 K^2 \end{aligned}$$

putting this expression equal to zero

$$\begin{aligned} 2 E_1 I_0 K - 3 E_1 I_0 K^2 &= 0 \\ \text{or } 2 - 3 K &= 0 \\ \text{and } K &= 2/3. \end{aligned}$$

To determine whether this is the maximum or minimum we must take the second derivative of the above expression which gives

$$\frac{d^2 K}{dK^2} (2 K - 3 K^2) = 2 - 6 K$$

and substituting  $K = 2/3$  we get  $2 - 4 = 0$  showing  $K$  is a maximum at  $2/3$ . So at the 66 2/3% tap of the auto-transformer the largest equivalent rating is obtained and the largest transformer required.

The curves shown give the various relations described above.

Curve A shows the kv-a. drawn from the line at various taps in terms of the kv-a. drawn from the line with full voltage across the motor.

Curve B shows the equivalent transformer rating as a percentage of the line kv-a. at various taps, e. g., at 25% tap, equivalent rating is 75% of line kv-a., etc.

Curve C shows the relation between equivalent transformer rating and taps, in terms of a given kv-a. from the line at full voltage. From this curve we see that at the 66 2/3 % tap for any given motor, the largest size auto-transformer is needed.

This should be remembered when ordering auto-transformers for starting synchronous or induction motors and if possible, the use of a tap near the 66 2/3% point avoided for that means the most expensive starter.

\* \* \*

### A Motor Trouble

A 2 horse-power series motor used to drive a centrifugal hot water circulating pump has on a number of occasions given trouble. In the fall it was given a thorough overhauling to make ready for the winter service. Shortly after being installed a complaint was sent to the repair shop that the motor was running; but, a trouble man investigated and found the brushes moved forward about 20 electrical degrees, causing the motor to run much too fast. The power taken by a centrifugal pump varies approximately with the square of the speed. Hence a small increase in speed can cause a considerable increase in the load. A resetting of the brushes was all that was required.

About three weeks service was given when the second complaint was received. This time the bearing had been dry, the bearing wearing enough to allow the armature to strike the field poles and rubbing off the bands. While at the shop this time two new bronze bearings were made, and new bands put on. After a thorough test, the motor was sent out again. Five days later word was received that the motor was not working properly. This time it happened to be the writer's lot to answer the call. The brushes were in good contact and in the correct position. The bearings were full of clean oil, but those bands were off once more. By taking out the armature bright places on the bottom of the field poles were clearly seen. This indicated worn bearings but they were tight on the shaft and in the frame. The shaft showed signs of being worn but it was not cut. It was then supposed that the armature was not properly centered. With this thought in mind the armature and bearings were taken out and replaced by ones from a spare machine. Before the new armature could be run it was necessary to do considerable aligning, which added weight to the theory of poor aligning of the injured armature.

The spare field frame, old armature and its bearings were sent to the shop once more. While cleaning out the oil well lumps of metal about the size of a grain of corn were found in the bottom of the well. The motor was one of a type, no longer manufactured, having the self aligning bearing set in

a seat of white metal. When the bearing heated this white metal melted out of one side and let the armature strike the field poles. This motor is running once more and with a little oil it is very probable that it will continue to do so.—  
R. L. Hervey.

\* \* \*

### Two-Phase to Three-Phase Auto-Transformers

Occasionally it is desirable to transform from two-phase to three-phase or from three-phase to two-phase, as the case may be, for the purpose of running a three-phase motor or other apparatus from a two-phase line or vice versa. This may be accomplished by placing on each leg of a three-phase core, single windings as shown in Figure 1. Each leg is wound with sufficient turns for 115.2 per cent. of the line voltage, and taps are brought out for 100 per cent. of line voltage and at 50 per cent. of the winding on the middle leg as shown.

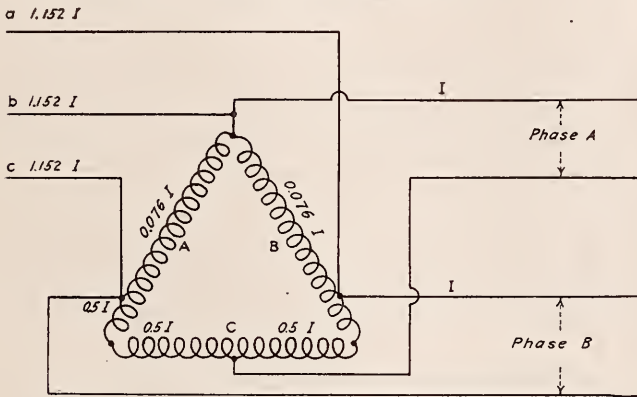


Figure 1

For a better understanding of the two-phase and three-phase relation, reference is made to Figure 2. Lines 1-4 and 2-3 represent vectorally the two phases of the two-phase circuit since they are equal in length and at right angles to each other. Lines 1-2, 2-3, and 3-1 are equal, and are at an angle of 60 degrees with each other, this being the three-phase delta angle.

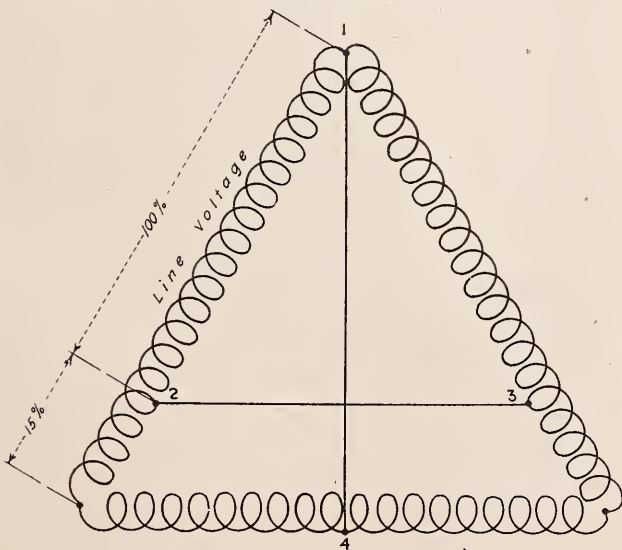


Figure 2

If the current in the two-phase side be represented by  $I$ , the current in the three-phase lines will be  $1.152 I$ , neglecting the magnetizing and loss currents. The currents in the three legs of the delta are not equal but are as shown in Figure 1.

The windings in legs  $A$  and  $B$  required for 100 per cent. of the voltage need be large enough for only 7.6 per cent. of the two-

phase current, while the extra 15.2 per cent. of the winding must be designed for 50 per cent. of the two-phase current. Leg  $C$  must be designed to carry 50 per cent. of the two-phase line current.

In explanation of the different current in the windings, it will be noted first that in Figure 1 the apex of the delta is connected to one three-phase and one two-phase line. Since the currents in the three-phase lines are equal to  $1.152 I$  and the two-phase current is  $I$ , then the currents in the upper parts of sides  $A$  and  $B$  of the delta is  $\frac{1}{2}$  of  $1.152 I - I$  or  $.076 I$ . The remainder of the windings  $A$  and  $B$  must be designed for the same current as in side  $C$ , as these are connected in series.

As the whole two-phase current flows in to the middle of side  $C$  as shown, it can be easily seen that 50 per cent. of this current will flow in each half and the lower side of sides  $A$  and  $B$ .

The size of standard three-phase transformer parts required for a two-phase, three-phase auto-transformer of this type is found as follows:

The value of kv-a. in sides  $A$  and  $B$  is  $2 (.076 I \times E + .5 I \times 1.152 E) 10^{-3} = .304 I E \times 10^{-3}$ .

The kv-a. in side  $C = (.5 I \times 1.152 E \times 10^{-3}) = .576 I E \times 10^{-3}$ .

The total kv-a. in the windings =  $.304 I E \times 10^{-3} + .576 I E \times 10^{-3} = .88 I E \times 10^{-3}$ .

As this amount of power is transmitted through only one winding on each leg, while an ordinary two-coil transformer would have two windings on each leg, for this amount of power, in terms of an ordinary transformer, the rating would be equal to

$$\frac{.88 I E \times 10^{-3}}{2} \text{ or } .44 I E \times 10^{-3} \text{ kv-a.}$$

The power in the two-phase line is  $2 \times I E \times 10^{-3}$ , therefore, the rating of the auto-transformer in terms of a standard transformer as a percentage of the line kv-a. may be expressed as

$$\frac{.44 I E \times 10^{-3}}{2 I E \times 10^{-3}} \times 100 \text{ or } 22\%$$

The most desirable feature of the above described method of transformation over other methods, is its balanced operating condition.

This method was devised by Mr. W. T. Taylor.

R. E. U.

\* \* \*

### Routine Tests of Insulators

(Continued from page 35)

#### With One Side of Set Grounded Operation is Continuous

With the new types of sets one side is grounded, enabling the testing rack to be grounded. This is in itself an advantage since the rack may be safely touched and the only precaution necessary is to keep away from the clamp which is connected to the ungrounded side. With this improvement the testing is faster since the operator moves back and forth with the clamp while one man removes insulators which have been tested, and another on the other side replaces them with untested insulators. The switch is never pulled unless the testing is to be stopped, so that the work is continuous and the time ordinarily required to replace insulators under the former method is used in actual testing.

The handling of the insulators and the men bears an important relation to the smoothness with which the testing may be done. The operation usually requires a man to unpack the barrels or crates, and two men to handle the insulators on the test rack, and a packer, in addition to the operator and the inspector. The inspector is the only one who travels from job to job and represents the only skilled labor in connection with the work. The high frequency arc when constantly watched strains the eyes and the sound emitted, is to the unaccustomed, hard on the ears. Furthermore the arc breaks down the air resulting in ozone which after several hours becomes very disagreeable. Because

of these conditions the testing should be done where there is good ventilation, and preferably out of doors, when possible. Frequent rest periods should be given, especially when the continuous form of test is used, and the men should be changed around so that no one job becomes monotonous.

The time element must be decided by laboratory testing. With one type of insulator it was found that the average failure occurred during the first five seconds after the application of the current so that the test period was placed at fifteen seconds. This is purely arbitrary and can only be determined by experience with various types of insulators.

With the above mentioned time element approximately from 1200 to 1500 insulators could be tested in a day at a cost of from one to two cents per insulator.

#### Faults Found of Several Kinds

The criterion of a good insulator is when it arcs over from the clamp to the pin. The usual run of faults occurs in the insulator joints in which case the path of the arc passes in between the skirts and through the faulty spot. After a little experience the inspector merely looks at the insulator for a few seconds after the first ten seconds have elapsed, and relies chiefly on his hearing to detect a faulty insulator. Another class of faults are due to imbedded matter as hair in the porcelain which burns out resulting in the arc puncturing through. The path of the arc is then along the surface of the shell and then through the puncture and then along the surface. These faults can sometimes be detected an instant before puncture by the appearance of a red spot on the surface of the porcelain.

Experience has shown that it is advisable to test one insulator at a time. If two be tested in multiple one may have a streak of dirt which lessens the surface resistance causing that insulator to receive the arc. Considerable time is lost in trying to balance the arc between the two insulators.

#### Testing Suspension Type Insulators

With suspension type insulators, a length of iron pipe, to which are attached iron hooks, is used in place of the cross arm. The insulators are suspended from these hooks inverted so as to enable the inspector to easily detect the faults. The pipe is grounded and the clamp is touched against the cap of the insulator. These insulators may be tested in series, the only objection to testing in series being, that if one fails, the voltage necessary to arc over the two is impressed on the single insulator, causing breakdown. Small suspension type insulators can often be successfully tested in multiple. The failure most often encountered in suspension type insulators, is a porcelain failure, in which the path of the arc is from cap to pin, showing no discharge over the insulator. Some insulators have porcelain holes in the corrugation which alter the path of the arc.

#### ❖ ❖ ❖ Correction

In our April issue we published an article entitled "Testing Relays With Cycle Recorder" erroneously giving the author as H. A. Cozzens, Jr., only, whereas names of the joint authors should have been given: H. A. Cozzens, Jr., and G. F. Walter. We apologize to Mr. Walter for this omission.

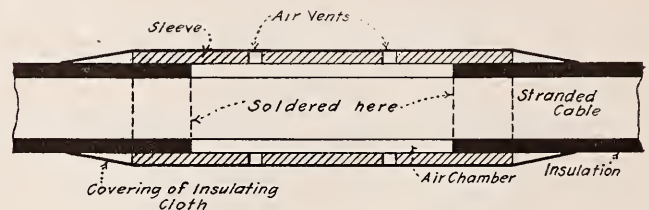
#### ❖ ❖ ❖ Non-Syphoning Joints

Trouble is often encountered on account of the oil in transformers, induction regulators, rotary reactance coils and similar apparatus creeping up through the strands of the cable or between the conductor and the rubber insulation covering it, and seeping out over terminals and producing an oil surface mess to which dust and dirt adhere. This action is due to a syphoning action and capillary attraction between the cable strands, and may occur whether the conductor hangs down or rises upward. As oil has a very pronounced and deleterious effect upon rubber, causing a continual and rather rapid deterioration of its mechanical

and dielectric properties, and in addition causes stickiness to which flying particles of dust and dirt adhere, it is advantageous to the welfare of the apparatus and to the appearance of the whole station that this syphoning be overcome.

There are several ways in which this may be done, with varying degrees of success. The oldest way, and perhaps the most well known, is to solder the strands of the flexible cable together after cutting back the insulation for an inch or two. This is a very simple way, but does not always accomplish its purpose completely.

Another way, and one that will be found in every way satisfactory, although more troublesome to do, is to introduce an air gap between the cable and the insulation covering it for length of three or four inches. An idea of the general arrangement of this joint may be obtained from the sketch. In making this non-syphoning joint the procedure is about as follows: The rubber insulation is cut back about six inches, and the cable cleaned thoroughly in between the interstices of the various strands. The ends of the insulating covering are pared off, as shown. At each end, and close to the insulation, the strands of the cable are soldered or, better still, the complete distance of the "cut." A sleeve of insulating fiber or similar material is now placed over the naked cable. This sleeve had better be in two halves so that it may be placed upon the cable instead of having to be slipped along the cable as it would were it in one piece. The length of this sleeve must be such that its two ends rest upon the insulation as shown in the sketch. Two or three holes, small holes about  $\frac{1}{8}$  inch diameter, are drilled in this sleeve, in about the middle. Where the sleeve is composed of two separate pieces of fiber they must be clamped together as convenient.



Having accomplished this all that now remains to be done is to insulate the sleeve with empire cloth and friction tape, or friction tape alone where the potential of the circuit is comparatively low, and cover completely with a coating of insulating varnish. This joint makes a very satisfactory job, and has a neat appearance. For overcoming syphoning in the leads of oil-filled induction regulators, rotary reactance coils for railway service, and transformers, it will be found to give pleasing results. It will have, however, somewhat larger diameter than the remaining portions of the conductor, but usually this does not interfere with anything.

#### ❖ ❖ ❖ Economy of Three-Phase Transmission

In answering the query by A. W. in April issue of ELECTRICAL AGE, as to why it is that electrical power, at the same voltage and proportion of loss, can be transmitted three-phase with only three-fourths of the amount of copper that would be required for direct-current (or single-phase) transmission, under the same conditions, the following basic facts must be borne in mind.

The voltage and current in an alternating-current circuit are all the time rapidly changing and what we refer to as the voltage of an alternating current circuit is the voltage indicated by an ordinary voltmeter which is called the "effective" voltage. The same applies to the alternating current.

Now this effective voltage and current is, by definition, the value of the changing alternating voltage and current that is of the same effect as an equivalent direct-current voltage and amperage in transmitting electrical energy—that is why it is called the "effective" voltage and current.

Bearing this definition in mind, it follows directly that in a direct-current circuit and in an alternating-current circuit where the voltages and currents, as above defined, are equal, the total power, which is the product of voltage multiplied by the current (where the power factor is unity) will be the same in the two circuits.

From this it follows that equal amounts of copper are required for the same economy of transmission at the same voltages in single-phase alternating-current and in direct-current circuits.

Passing to the consideration of three-phase transmission, the principal point to remember is that a three-phase circuit is the equivalent of three single-phase circuits with the alternations 120 degrees apart and the six wires that such circuits might have, tied together in three pairs, thus forming three interconnected circuits having three wires.

If the current in each of these three circuits was one-third of the current in the single-phase, or direct-current, circuit carrying equal electrical energy, then the total energy of the three would be the same provided the three currents were in phase.

Now with the currents in the three-phase circuit coming 120 degrees apart, if we call the total energy or wattage of the circuit  $W$ , the effective voltage  $E$  and the effective current  $I$ , the expression of the total energy of the three-phase circuit of unity power factor is found by a simple calculation to be

$$W = \sqrt{3} E I$$

that is the total power of the three-phase circuit is the square root of three times the product of the voltage between wires by the current in each wire, instead of being exactly the product of the voltage between wires by the current in each wire as in the case of single-phase and direct-current circuits.

The economy of three-phase transmission over direct-current and single-phase transmission follows from this fact, as may be shown from the following calculations:

Under the conditions given of equal power transmitted, at equal voltage between wires and unity power factor in the two cases, we have

For three-phase circuit, current in each wire is

$$I = \frac{W}{\sqrt{3} E}$$

and the loss in each wire, whose resistance we will call  $R$ , is

$$\text{Three-phase loss} = I^2 R = \frac{W^2 R}{3 E^2}$$

$$\text{Now single-phase loss is } I^2 R = \frac{W^2 R}{E^2}$$

This shows that, under given conditions, since the three-phase current per wire is  $\frac{1}{\sqrt{3}}$  or approximately 57.8 per cent. of the

current in each wire of the single-phase circuit, the loss per wire of the same resistance  $R$ , in the three-phase circuit is only one-third of the loss per wire in the single-phase circuit.

For the total losses in each circuit with wires of the same size and resistance  $R$ , we have

$$\text{Total three-phase losses} = 3 \times \frac{W^2 R}{3 E^2} = \frac{W^2 R}{E^2}$$

and

$$\text{Total single-phase loss} = 2 \times \frac{W^2 R}{E^2}$$

That is, the total single-phase loss is twice as great as the total three-phase loss where all the wires in both circuits are of the same size and resistance.

Now the given condition is that the losses are also to be equal.

From the above we see that to make the three-phase losses equal to the single-phase losses, each wire of the three-phase

circuit must be one-half the size of the wire of the single-phase circuit and twice the resistance. Then the total losses in the two circuits will be equal.

Calling the total weight of copper in the single-phase circuit 100, the weight of one single-phase wire will be 50. The weight of each of the wires of the three-phase circuit of equal loss will therefore be 25 and the weight of the three wires will be 75.

So the copper required for the three-phase circuit, under the conditions given is only three-fourths of that required for the single-phase, or direct-current, circuit, each three-phase wire being one-half the size of the single-phase wire.

And the reason for it is the much smaller current per wire required in the case of the three-phase circuit. W. K.

\* \* \*

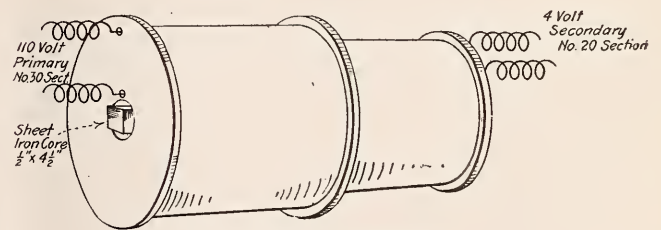
### Problems for Solution

In your last issue you state that shifting the brushes on a motor "reduces the counter-electromotive force by causing a certain number of armature-coils on each side of the normal plane to oppose each other." Will you please explain this? E. L. T.

*Ans.*—Certainly. The magnetic field of the machine by reason of its position and polarity divides the motor armature winding into bands of conductors whose counter-electromotive forces are in the same direction. When the brushes are in the right place on the division lines between the bands of common direction, the main current flowing through the armature coils will be of the same direction as these forces and the number of effective conductors is a maximum. If the brushes are now shifted to one side or the other of this position in order to reach them the main current will have to flow through the coils, over which the brushes have been shifted, in a direction opposed to the counter-electromotive forces of these coils. This is to say, it "bucks" them. This occurs at each pair of brushes and diminishes by just so much the effective counter-electromotive forces of the machine. Hence, as stated, the motor tends to speed up to compensate for this difference.

### Unsatisfactory Bell-Ringing Transformer

A transformer for ringing bells, fed from 110-volt, 60-cycle alternating-current and designed to give four volts on secondary side has been made according to sketch given below.



Bell Ringing Transformer

When in operation, however, there is an annoying variation in the sound of the buzzer which is quite different to the effect given when operating the same buzzer with a 4-volt dry cell. Can you suggest what the trouble is and how it can be remedied? C. K.

When in common wire or ground return is used for a telephone and alternating-current electric light systems, and a direct-current trolley system, how do the various currents dispose themselves in the conductor? M. L. T.

*Ans.*—It is not easy to say just what occurs in the case of a common leg for different kinds of currents. We know, though, that the resulting resistance, reactance and heating effects are the sum of the separate effects of all the different kinds of current involved; each being developed as if the other were not there. But as to the actual disposition of the currents in the conductor aside from the fact that the higher the frequency of the alternating currents, the less they penetrate in the interior part of the conductor, we know very little as yet.

# Questions and Answers

1. What is selenium?
2. How is a selenium cell made?
3. Does such a cell deteriorate with age?
4. What is the present market price of selenium?

F. G. B.

*Ans.*

1. Selenium is a non-metallic element very similar to sulphur in its nature and chemical reactions. It is manufactured in two forms depending on how much it is annealed. One form is a brownish-red, non-crystallized mass, the other of a grey, dull metallic-looking structure, usually sold in sticks. Selenium acts on all metals but gold and platinum, but is a poor conductor of electricity, and its use in electrical work depends on the fact that its resistance changes when it is exposed to light, sometimes as much as several fold.

2. The so-called selenium cells are really not cells at all. They are selenium resistances and are more accurately called selenium "bridges." They come in many forms, but the most common consists of a pair of wires, usually copper or nickel, wound on a flat slab of porcelain or slate in such a manner as to lie close to, but not touch each other. The slab is then "battered" with melted selenium or exposed to selenium vapor. This forms a thin film, all exposed to light, which connects or bridges the two wires together, whence the name a selenium "bridge." The selenium must finally be annealed before it is ready for use.

3. Such a cell will not deteriorate with age if properly handled and not overheated.

4. About \$4.00 per pound, according to our latest information.

\* \* \*

I am not clear as to the nature of alternating-current electric power. If direct-current power is a steady flow, how is alternating-current power to be compared to it? What is two and three-phase power? I know the expressions for all these, but want the reason behind the expressions. S. T.

*Ans.*—Your difficulty will disappear if you will refer all your various kinds of power to heat, which is a form of power. You must also remember that the heating and working effects of a current are absolutely independent of its direction. By definition, the root-mean-square values of the alternating-current and voltage read on the alternating-current ammeter and voltmeter are those of a current and voltage having exactly the same heating effects as those of a continuous current on the same amperage and voltage. Therefore the wattage, or power of a single-phase alternating-current circuit, where the current and voltage are in phase with each other, is the same as that of a direct-current circuit where the instruments read the same number of amperes and volts on the circuits.

As for the power in polyphase circuits; in the case of a two-phase circuit where the alternations were exactly opposed to each other, or were 180 degrees apart, there would be no power result. If, on the other hand, it was a two-phase circuit with the alternations coming together the total power would be twice the product of the current and voltage in one of the two circuits. Now, where the two sets of alternations are at right angles with each other, or 90 degrees apart, as is the case in commercial two-phase circuits, the total mean power expended is between the two extremes given above. It can be shown by geometry that it is equivalent to the  $\sqrt{2}$  or 1.414 times greater than the power of one of the two phases. In an exactly similar manner it is shown that where there are three sets of alternations each 120 degrees apart, as in the case of a three-phase circuit, the mean power expended is proportional to the  $\sqrt{3}$  or 1.732, the power of one of the circuits. All of the foregoing holds true in all alternating currents of unity power factor.

Is there any relation between efficiency of a machine and its power factor? A. G. S.

*Ans.*—There is no direct relation between efficiency and power factor, but a poor power factor reduces the efficiency of a machine by increasing the losses in the windings for a given wattage of output or input.

\* \* \*

Please give the formula for calculating the weight of a fly wheel on a gas engine for driving a dynamo. R. E. V.

*Ans.*—A formula commonly used is

$$\text{Weight} = \frac{22,500 \times A \times l \times p}{D^2 \times R^2} \text{ where}$$

$A$ , is the area of the piston in square inches;  $l$ , is the length of the stroke.  $p$ , the mean effective pressure;  $D$ , the outside diameter of wheel in inches and  $R$ , the number of revolutions per minute. The weight is that of the rim, the weight of the spokes and hub being allowed for in the constant.

\* \* \*

In making photometer tests of incandescent lamps, what is the best speed for rotating the lamp? E. R. H.

*Ans.*—The lamp manufacturers generally use 180 rev. per minute.

\* \* \*

Are three-phase motors better in any way than two-phase motors? If not, why are they so much more generally used? L. S.

*Ans.*—There is little or nothing to choose between the characteristics of two and three-phase motors themselves, but, for equal currents and voltages applied to the motor, the lead wires to the motor need be only three-fourths as heavy for the three-phase as for two-phase with equal line losses. The superior efficiency of three-phase transmission is the sole reason for the more general use of three-phase induction motors.

\* \* \*

Can the horse-power of a gas-engine be determined without using an indicator? F. B.

*Ans.*—Not in any way that we know of.

\* \* \*

Is there any way to calculate the current carrying capacity of a fuse wire? N. D. S.

*Ans.*—If the wire is of copper or of some other unalloyed metal the carrying capacity can be figured from formulas that are published in various hand-books and elsewhere. If the wire is an alloy, as most fuse wires are, the current carrying capacity can be determined only by experiment.

\* \* \*

What is the difference between "inductance" and "self-inductance?" A. R. E.

*Ans.*—Inductance is a property of an electric circuit, small in some kinds of circuit, as in a long line; great in other kinds, as in a coiled wire. It exists in the circuit whether any current or no current is passing through it, being as much a part of it as its weight or length and corresponding to the momentum of a moving machine.

Self-inductance is the effect of a varying electric current in a given circuit on the circuit itself. So self-inductance is only present when a varying current is passing through the circuit or coil. The expression for the self-inductance in the case of a

coiled circuit in air is  $L = \frac{4 \pi N^2 r^2}{10^9 l}$  where  $N$  is the number of turns in the coil;  $r$ , the radius of the coil and  $l$  its length in centimeters. The expression contains no term of current in it, but it is based on unit current, or 1 ampere, and  $L$  becomes the coil's self-induction in henrys.



# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## Some Novel Effects With Electric Light

By Felix J. Koch

Down Cincinnati way, latterly, there has come into unwonted popularity the sign built of electric lights. Not only the ordinary blazon, telling in letters as of golden fire, that this may be the emporium of A. or B., or C., or that here you may eat, drink, or make merry, but novel signs, curious signs, signs of such sort that the stranger within the city's gates would stop—instantly—upon their coming to view, watch the play of the electric current, as it achieved its curious marvels, and then go on, to remember and tell of, wherever things electric, affairs of store-life, came up for review!

The variety of these novel signs is such as to baffle him who would describe them.

On one hand, a giant squirrel glows out on the night from the top of one of the leading sky-scrapers turning 'round and 'round, as in a cage, then suddenly giving way to the legend which suggests you patronize such-and-such a household stand-by. Almost within the edge of the radiance cast by this, a restaurateur whose name is Mills has set up a huge Dutch windmill—all of lights and, so soon as evening falls, the sails revolve their varied lights gleaming and beckoning the hungry. 'Round the



*Electricity Advertises Itself*



*Electric Clock in Cincinnati*

corner, just down a square, a more unique concept still awaits you—a billiard-table, with its players done in lights—the sign, however, so arranged that you see the player make his move, the watch the "ball" travel slowly to the pocket at end even as you might on some real pool-table—except that here the travelling "ball" is only the current of electricity lighting lamp after lamp, each in turn.

The most notable work of the sort in the Queen City—and in all the great Mid-West, for that matter, is a monster form of

electric-clock mounted on its establishment by a leading department-store at the intersection of two leading business-highways. By day, this clock not alone shows the correct time in numerals, rather than upon a dial—as most clocks now do—but holds aloft the name of the concern as well. By night all these blaze aloft in a flood light, while the momentary changes of the numerals to mark the passing of time, stops even those who travel that street, day upon day, for another brief watching of the wonder. The clock, in fact, has much to interest even the practical worker with electric-currents. The "time" for it is supplied by one of the great telegraph-companies, but not hourly, as with so many of the familiar "correct-time" clocks, but is sent in every second! Putting up the clock, in consequence, required the labors of five skilled workmen for a period of ten days. Five miles of wire were employed in all, this tremendous circuit passing in and out from clock to store and store to clock so as to permit the playing of the tremendous numbers of the lamps. Altogether there are eight hundred connections made in this monster affair, and these operate in such wise that, as the electricians in charge say, "if one is out, they are each and all wrong." While in process of completion, the clock was tested four times each working day, that is, every two hours.

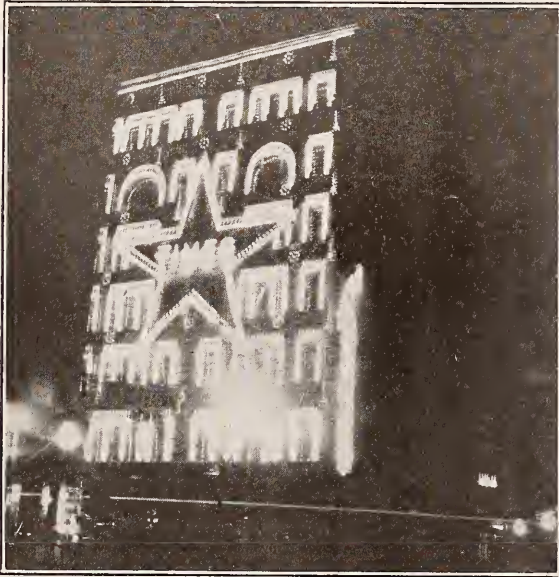
The construction, once completed, is such in the clock that it now substantially cares for itself; requiring hardly any "checking" whatsoever. There is no "wearing out" to it, as a whole; and, with proper repairs from such weathering as may come, should last, so to speak, forever.

While the dial of the clock is twelve inches across, the clock, as a whole, stands eighteen by thirty-six inches, and, with the accompanying ornamental devices goes to form the piece de resistance of an electric sign twelve by fifteen inches in all.

Cincinnati also has her Electrical Prosperity Week, when electrical signs, advertising the great displays of wares in such field, are put up on the main plazas.

So again, there is the municipal Christmas Tree in the holiday time with its myriad of electric lights.

The piece de resistance of the art of the electric lighting engineer, however, is the adornment given its Walnut Street facade by the Cincinnati *Times-Star*, one of the large evening dailies.



The accompanying picture tells the story better than words could do. Forty men are employed, for a space of five days, in putting in place the general decorative scheme of light rows, with big star at center. This is exclusive of the other sign of a capering newsboy at one corner. Tremendous as the effect, however, the burning of these natural colored lamps only costs the paper \$3.60 the hour, since the law sets the tariff for such service by scale of quantity, and the numbers here employed bring the order to the "minimum light rate" of such law.

The lights burn from six at night until twelve, and when one recalls that the building stands ninety-five feet high and notes the rows on rows of lights used to outline, it is plain to see the reason for the claim that is made of its being the best illumination for a newspaper building, west of New York at any rate.

The most unique feature of the *Times-Star* lighting device is a moving sign of a newsboy shown as though running down the city street, crying his "extra."

While its makers could turn out a sign of this sort in two weeks, they state about thirty days is asked ordinarily for such an order.

The sign is run by high-speed flashes for, like all flashing signs, the "running" newsboy is really an optical illusion.

The *Times-Star* is reported to have paid \$1200 for the sign—the boy alone being built of 1000 lamps of 10 watts and 150 volts each. The flashes upon these are arranged so that the boy makes ten "strides" a minute, and by combination of white lamps and green—to typify the green baseball extra issued—the effect is one of the most striking to be found among electric signs in all the Middle West.

\* \* \*

The Esterline Company, Indianapolis, Ind., has just received a contract to build the largest graphic meter in the world for totalizing the entire output of thirty generating units with a total of 250,000 kilowatts at the Mississippi River Power Company's

plant at Keokuk, Ia. This instrument is being designed by Esterline and Angus, consulting engineers, and will be built by the Esterline Company. It will be placed in operation in the Fall of 1916.

\* \* \*

The Betts & Betts Corporation, New York, is building a 20-foot self-winding "Elektrik Klok" for the new Circle Theatre in Indianapolis. This "Klok" will have electric hands, numerals and minute marks. There will also be an attractive electric sign equipped with a special flasher and several hundred colors caps. This will be about the most elaborate electrical display in that part of the country. The contractors for this work are the Sanborn Electric Company of Indianapolis.

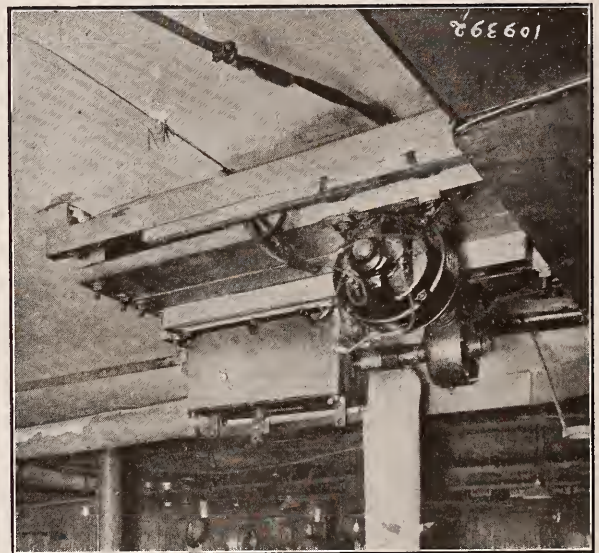
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It is reported that the exports of Tacoma (Wash.) show record breaking results. In the month of February the exports amounted to \$13,750,000, exceeding all previous records of any Puget Sound port. The American Smelting and Refining Company have constructions and improvements under way involving an expenditure of several millions of dollars.

\* \* \*

### Very Small Motor Aids the Cabaret

Each year the cafes in New York's far famed Lobster Palace belt strive for something new and novel with which to attract their patrons. This year was no exception, and one of the more enterprising, Murrays, at 42nd St. and Broadway, sprung a surprise on its neighbors and patrons by the introduction of a "revolving dance floor," which is advertised quite extensively. The object of this floor was to add exhilaration and excitement to the disciples of Terpsichore who pursued the intricacies of tango and other popular steps.



Motor which rotates Dancing Floor

In order to provide the motive power for the floor, a Westinghouse type CD  $\frac{1}{2}$  horsepower, 1165 r.p.m. motor was secured. When the installation was started, however, it was found that the speed was excessive even for the patrons of the "Great Wet Way" and a Westinghouse type DA regulator was added to the equipment which reduced the speed to such an extent that dancing could be indulged in by anyone so desiring with comfort and pleasure.

Each evening the floor twirls merrily with its load of human freight, resembling a human whirlpool, propelled by a small electric motor. The management, it is said, still retains the high speed arrangement, however, that in case the constantly increasing desire of the American people for more excitement in its hunt for pleasure demands more speed, it can readily be provided.

## National Electrical Range Campaign Planned

A special meeting was held April 14th, 1916, at the Executive Offices of The Society for Electrical Development to consider the undertaking of a national electric range campaign, both within the industry as well as directing public attention to the advantages of electric cooking. Those attending were representatives of leading electric range manufacturers. The meeting was preliminary to the appointment of a national electric range committee composed of representatives of all electrical interests.

It is recognized that the attention of leading interests is being focused upon the desirability of the electric range as a means of building up the domestic load. Several manufacturers are contemplating big campaigns to promote electric range sales and it was reasoned that The Society for Electrical Development would be the best organization to act as a clearing house for the campaign as it did in the "Wire Your Home" movement, which has just come to a successful close.

It was suggested that the Society direct its special efforts to the securing and publishing of data showing cost of cooking in the various communities of the country. Much of this data it already has on hand. It was shown that in over 2,800 communities a cooking rate of 5c or lower is in existence. Of this

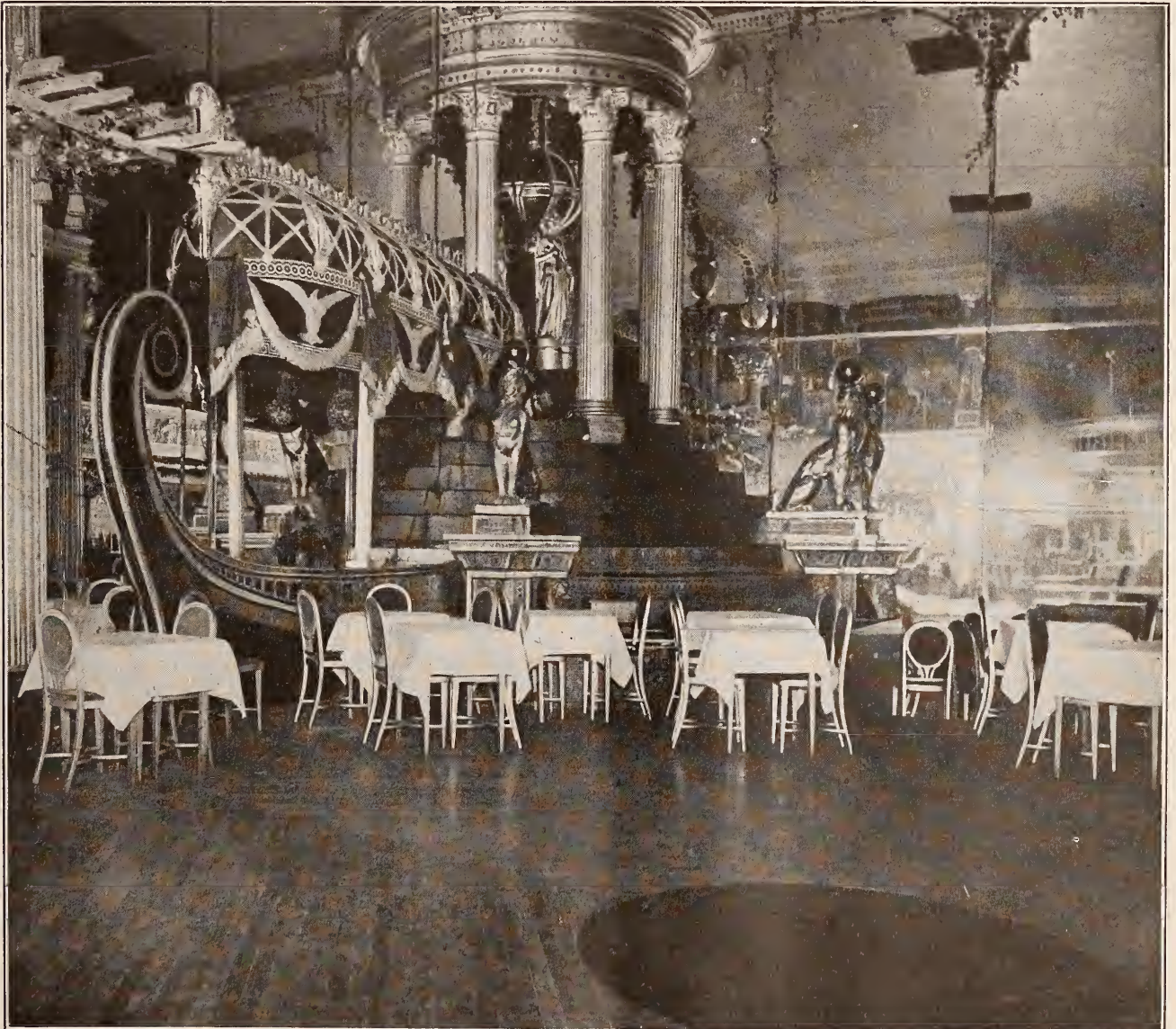
number over 70 per cent. or 4c or lower and 27 per cent., or lower. It is recognized that the rate must be 4c or less to be sufficiently attractive to the householder before a range is purchased.

It would be the function of the Society to lend support to central stations by giving them specific data on the desirability of range business, and to aid them in conducting range campaigns. Sales arguments for range salesmen to use could be standardized as much as possible, and then published in book form to be used by the individual salesman. It was proposed that the Society issue a booklet on how to put on a range campaign.

Considerable stress was laid upon the suggestions that central stations include cost of installation in their range prices. In other words, quoting prices with the range installed, thus avoiding selling the range and having to then argue out cost of installation.

The Society would aid in developing the public demand for ranges by disseminating advertising and publicity matter through its various channels.

It was decided to appoint a special committee, to take up in detail the plans for a national electric range campaign. This committee to meet at Chicago, May 22nd, 3 P. M. which will be N. E. L. A. Convention registration day.



*Rotating Dancing Floor in Murray's Restaurant, New York City*

# Electricity For Municipal Housecleaning

## A Statement of the Advantages of the Electric Vehicle for City Purposes

NEVER was opportunity better than at the present time for replacement of horse-drawn and gasoline-propelled vehicles by those employing batteries in certain classes of work. One of the most promising fields in this respect, and one that is quite accessible to the progressive and aggressive salesman, is that of municipal service—the sprinkling and sweeping of streets, the flushing of sewers, lineman's wagons, arc-light trimmers ladders, run-abouts for park maintenance, garbage disposal, etc. Of course each class of vehicle has its own sphere, and the use of one may overlap that of the other with equality of economy, but on close investigation it will often be found that the battery car has very great advantages over the gasoline vehicle.

### Opinion of Satisfied Purchaser

Usually it is the viewpoint of the seller rather than that of the buyer that we hear in the matter of salesmanship. Recently the writer had the privilege of listening to a man who has gone thoroughly into this matter for one of the younger very progressive western cities. That the result was pleasing had been borne out after considerable practical trial. That the change from gasoline-propelled and horse-drawn vehicles was not made without considerable careful deliberation was apparent by the statements of this man.

These statements are particularly interesting because they are those of the buyer, and a satisfied buyer. They also make interesting talking points for the salesman—they are so much to the point—that they seem most certainly worth taking advantage of.

Everyone is familiar with the salesman who has something to sell, and the talking points he uses to dispose of his wares. And we all know how, when he has come to the end of his stock of talking points, he starts again, going round in a circle. Talking points are useful when they apply and are backed by facts as they are, but they are liable to do more harm than good when this is not the case. Electric vehicles should not be sold on talking points even when it is possible to do so, and it frequently is, unless the salesman is familiar with the conditions that his product will have to meet. If this fact is not kept in mind such sales may react to the detriment of the electric industry. The electric vehicle in the right place is the best advertisement in the world, but if it is in the wrong place it may do irreparable harm, since it is difficult if not impossible to win back the good-will and confidence of a discontented and disgusted customer and prevent his advertising his grievances at every opportunity.

The salesman who has at heart the best interests of the industry he professes to serve will not attempt to make sales irrespective of the suitability of his product to meet them, but he will look into the facts very carefully before recommending his firm's goods. A sale to-day that is a misplaced sale may mean no-sales to-morrow. Study the facts before making your claims. It is only when you know all the conditions that you can feel truly confident. The confident salesman makes a better showing than the one who lacks confidence. Confidence often clinches a sale. And remember that nothing does more to win a man's confidence than ability to show him that you know his business as well if not better than he does himself.

### Factors to be Considered

There are many factors affecting the choice of vehicle to use for municipal service, and the work in one city may, and will, vary with that of another but certain factors have a predominating influence in all cases. The chief of these are the lay-

out of the city, the class of service; class and condition of streets, grades, paving, etc.; climatic conditions; routing of the different classes of work, distances to be travelled, the load, number of trips per day; cost of labor; cost of energy for various demands and load factors; cost of real estate. Some of these items are difficult to determine, others again are comparatively simple. But it is well worth the time in obtaining some idea as to all of these, for it shows at least that you know something of what you are talking about. When you know your facts then is the time to use your talking points, and not until then.

### Advantages Over Horse Drawn Vehicles

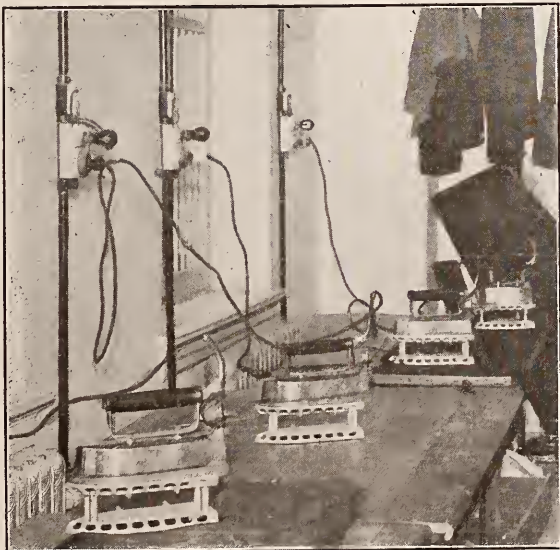
It is probably more simple to replace the horse-drawn vehicle by the electric than it is to supersede the gasoline car. The advantages of the electric over the horse-drawn vehicle are so obvious to all after a little thought that there seems really no need to mention them. In the first place for a definite amount of work the cost of operation and the initial investment will be less for the electric, than for horses and their equipment; or expressed in another way more work and quicker work can be done by electrics for the same cost. Horses require feeding whether they work or not, whereas electric batteries need little attention if not in use. The horse fails at the crucial period—extremely hot or cold days—whereas the battery is unaffected. A sick horse is a continual expense, but a battery can be easily renewed if damaged. It is difficult to calculate the depreciation of a horse, whereas that of an electric battery is a known amount; the former is comparatively high, however, and speculative. The insurance rates on the two are very favorable to the battery. Since the electric is able to accomplish more work than the horse-drawn vehicles fewer are needed, and the saving in teamsters and other labor is very materially reduced. One man can look after more electrics than he can horses, and the space required for the former is less than for the latter on a basis of equal number of vehicles or equality of output. A stable cannot be built anywhere because of the unpleasant conditions that may exist in its vicinity—whereas a garage for electric vehicles requires no thought on this matter, because it is noiseless, odorless and can cause no objections. The horse leaves dirt wherever it goes, in this way tending to defeat its own purpose. In city streets, which are, unfortunately far too narrow and congested, the slow turning of teams on sprinklers, etc., not only tends to make the congestion worse but brings in the element of danger also. These facts are so obvious that the horse is being rapidly superseded by self-propelled vehicles without any particularly strenuous efforts of the manufacturers of these vehicles.

Placing the electric in place of the gasoline car is more difficult, however, and requires extra effort, especially where the one is to replace the other. Here competition is keen, and a combination of facts and strong talking points are required. It is a question of economy—as in all instances—with the addition that aesthetic considerations and questions of flexibility enter also. It is not everywhere that the electric should compete with the gasoline car. But in municipal work, on level streets, sprinkling, flushing, etc., there is every opportunity for economy to be obtained. As has been pointed out before each case must be given careful thought and deliberation. When this has been done the talking points to bring into play are somewhat as follows:

### Slow Speeds Advantageous

The electric vehicle is ideal for flushing and sweeping of streets and boulevards, and unfavorable to the gasoline car, because of the speeds required for this work. For sprinkling,

about six to eight miles per hour is about the most desirable speed. The battery car is admirably adapted to these comparatively low speeds, whereas the gasoline cars will have to be operated on low speed gears or with slipping clutch. The gasoline car uses nearly as much gasoline when going fast as slow whereas the electric takes current from the battery that is proportional to the speed: the lower the speed the lower the current. The gasoline vehicle is rather noisy, especially when changing speeds, gives off pungent and obnoxious odors; on the other hand the electric is noiseless and odorless, both important factors in its favor where work in residential districts, hospital zones, and parks has to be done. The electric battery is of higher efficiency than the gasoline engine. Fire risks and insurance rates are lower for the former than for the latter. The entire absence of smell and noise with the electric enables it to be housed in residential districts where necessary, whereas the smell of carbonized oil and the noise of back-fires, racing engines that accompany the gasoline cars precludes their housing in such localities. The frame of the electric is of simpler construction, and there are fewer rotating parts and less auxiliary apparatus to become deranged, making maintenance and depreciation less therefore. The skill for operation will also be of lower grade without interfering in any way with the operation of the electric vehicle. As the driver has less to think about in the electric—the motor cannot be easily damaged in these vehicles—there is less likelihood of accidents due to this cause. The labor required for the gas car should be of fairly high grade, both for operation and for repairing, whereas for the electric the only really skilled labor needed is that for the maintenance of the batteries. The floor space is less for the electric than for the gasoline car, and the space required for repairs is also in its favor. Perhaps one of the most important items, and one that should be made to carry considerable weight, is that of the cost of energizing the two classes of vehicle. The cost of electrical energy for charging batteries is steadily becoming less as time goes on, and the more vehicles there are to be charged the lower becomes the charge for doing it. In striking contrast is the cost of gasoline. The price is steadily rising, sometimes soaring, and as the number of gasoline vehicles increase the cost of gasoline may be expected to increase. In any case it is not a fixed quantity but one that varies. This fact alone deserves careful consideration without the influence of the many other factors that are favorable to the electric vehicle.



*Electric Irons in a Cloak and Suit Factory*

#### **Civic Pride Favors Electric**

The large department stores, packers and others use vast fleets of electrics because they find that it is economical of time, main-

tenance, depreciation, insurance and labor, to do so. It seems reasonable that a city will find the same results obtaining with them. While economy is the criterion in practically all cases, the greater the other advantages the better. In municipal work—especially in political campaigns, etc.—civic pride is a phase of the subject that is worth mentioning. Cities are, in the majority, progressive and proud of their progressiveness. Civic pride is in favor of electric vehicles. The silent, smooth-running, clean electric is a very good advertising feature for any town or city. It attracts the attention and comment of the transient, and breeds interest and satisfaction in the resident. The silent methods of transport suggest business-like methods and efficiency; they tend to make one place trust in the foresightedness and business acumen of the civic government.

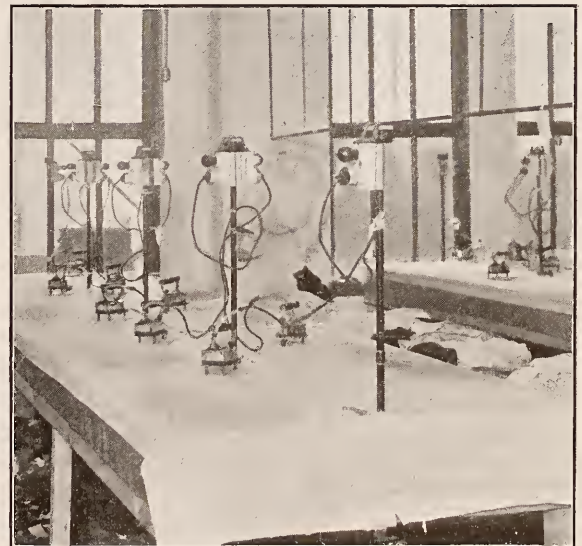
#### **Central Stations Advertising Opportunities**

A subject of this nature must, of necessity, be somewhat general. When trying to place sales the likelihood of doing so is very much greater when the salesman is able to be specific instead of general, and this is possible only after investigation of the pros and cons of the case in hand. The importance of carefully doing this has been pointed out, and for the sake of the good of the industry as a whole attention is drawn to it again.

#### **The Importance of Practicing What They Preach**

It cannot be impressed too strongly upon central station companies. Let them use the electric vehicle for their work—delivery of lamps, lineman's wagons, lamp trimmers, and general purposes. Such usage is often dictated by reason of economy, but the value of doing this from the advertising viewpoint is often overlooked. The electric light company has its men and wagons going round the city all the time and everywhere. The sight of these electrics cannot fail to impress all who have eyes to see their silent, steady effectiveness.

The opportunity is here, and now, for the salesmen of the manufacturers and central station companies to increase their sales and load. The returns are well worth going after. And there will be returns, big returns, if those who have the opportunity act with conviction.



*Electric Irons in a Tailor's Shop*

#### **Use of Electricity in Garment Trade**

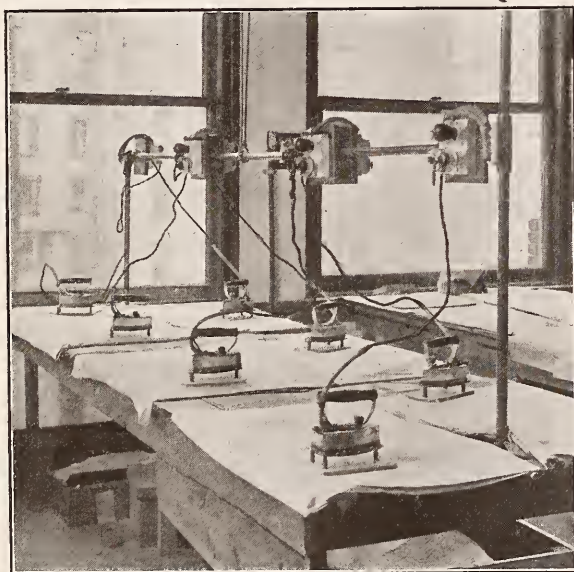
Some interesting figures in connection with heating installations for industrial uses have been collected by the Heating Bureau of The New York Edison Company. The yearly report showed a gain in the number of articles installed of more than

twenty per cent., and a gain in fifty watt equivalent of approximately twenty per cent. These figures, however, do not adequately represent the increased load on the lines when electric heating is being judged as a revenue producer. The reason is that the average heating appliance in commercial use is in service many more hours a day than an equal installation in lights. To prove this, an investigation was made of representative heating installations of this character.

A study was made of eight flat iron installations by Mr. C. N. Lewis, manager of the Heating Bureau. These eight installations totaled 105 irons which consumed 67,659 kw-hr. for the year, representing an average yearly consumption of 644 kw-hr. per iron, or an income at an eight cent rate of \$51.52 an iron per year.

The first case was a cloak and suit manufacturer with an equipment of 20 Simplex irons of the 770-watt type. By actual meter readings this installation for 1915 brought in a return (at a 5c rate) of \$1,113.15 to the company. Case No. 2 was a fashionable men's tailoring establishment on Fifth Avenue. Here thirteen G. E. flat irons produced \$402.75. A "waist house" using eighteen 6-pound Reimers irons was tested, this being a type consuming only half as much current as the irons used by the tailor; the company's annual income here was \$486.36. Another "shirtwaist house" using 24 of this lighter iron consumed \$750.72 worth of current.

As New York is the center of the garment trade for the United States, it can easily be seen that this is an extensive and lucrative field.



*A Waist-Shop which "Does it Electrically"*

### Dealers' Problems

**The Successful Store—The Part Location Plays in the Success of a Business Enterprise**

By G. D. Crain, Jr.

One of the big things connected with every mercantile enterprise, which determines, almost from the beginning, its chances for success or failure, is its location. If it is properly located, it is likely to succeed, other conditions being favorable; while if it has a poorly selected location, it will have a hard time making a good showing, even though it is well managed and adequately financed.

In view of the fact that the business of selling electrical merchandise, as such, is fairly new, and most members of the trade are graduating or overflowing into it from contracting and other allied lines, it may be worth while to consider some of the things which logically should be taken into account in selecting a location for a store.

In the first place, you must of course have a "stand" which is passed by a reasonably large number of people, because transient trade is the life of the retail business. If you could not count on pulling a certain amount of business into the store by means of the window displays, you might as well get quarters on some side-street, at a fraction of the expense represented in the use of a store-room in the heart of the retail section.

But, while this is true, it is also evident that the expense to be assumed must not be out of proportion with the business which could reasonably be looked for. Rent is the biggest item in overhead expense, in most instances, and there is no reason in favor of assuming an overhead expense which is out of line with the volume of the business. Such a plan would insure loss from the very beginning.

The electrical dealer is therefore between the Scylla of his necessity in the way of a good location and the Charybdis of economy. If he goes too far in the way of getting a bang-up location, he is likely to "spill the beans" in assuming such a heavy running expense that the only place where he can expect to come out for a long time to come is at the small end of the horn.

#### Failure at the Point of Success

Right here it may be worth emphasizing that every business must expect to make a poor showing, as far as profits are concerned, at the beginning. It is the exceptional retail enterprise which can show a balance on the right side of the ledger from the very beginning of its operations. In fact, the writer knows of two electrical concerns which, having an ambition to develop retail business, established branches in the principal retail district some distance from their main establishments. This involved considerable expense, including the salary of a manager. Likewise, it took some time to get people in the habit of buying there, in spite of fairly consistent and aggressive advertising. The result was that just about the time when the efforts which had been put forth were beginning to count, and when the capitalization, so to speak, of the advertising and sales work had begun to produce, the heads of these concerns decided that they had lost enough money, and closed up their retail stores.

The action was so nearly simultaneous, as a matter of fact, that it was suggested that the two concerns, which have been rivals in a business way for a long time, had been running the stores merely to compete with each other, and that the pleasure of doing this had finally lost its savor.

However, the moral is that if you are going to invest money in an expensive location, have the nerve to stick it out, and give your enterprise a chance to accumulate the good-will which operating at a stand for months and years will finally develop. Don't expect to produce a full-fledged, profitable retail business in three days or three weeks or three months; it can't be done.

If you have a shop or general store in a location which suits you for all of your business except retailing, and are looking for an opportunity to start a branch, remember, too, that one of the most important things of all is getting the right kind of manager. A good many electrical concerns have made the egregious mistake of trying to hire a good manager at the salary paid a fair clerk; and their experiences have not been satisfactory. If you expect to put the responsibility of making good on the shoulders of your manager, you must pay enough to be able to get a man who will rise to the responsibility, rather than collapse under it.

#### Best Location for Electrical Store

The writer believes that the average electrical store could best be located just off the main thoroughfare. That is, in most cases the business which could be developed at the beginning would hardly support a store located on the best street and therefore operated with the largest rental. In most cities there are certain main avenues of trade, where the principal traffic is to be found, and there are other streets running into them, which are almost as good from the retail standpoint.

If you can find a street of this kind, especially one which

is "coming," and which is getting the business crowded off the main avenues by increasing rentals, the chances are that you have a location which will constantly increase in value, and which would be worth tying up with by means of a long lease. It often happens that the value of a certain street, normally a second-rate location, is increased by the too rapid advances of realty values on the main thoroughfares, forcing merchants whose margin of profit and volume of business are limited into quarters in less expensive surroundings. A street which is getting the stores of these merchants would be a good place for the electrical store, because the more stores, the more customers for everybody. It makes a market, so to speak, and helps to build up traffic, which one store can hardly control.

A man who was entering the electrical goods business a short time ago made a ten-strike by taking a location which was obviously good. At least, it seemed obvious after he had taken it, though prior to that time no one had appeared to realize the situation. It happened that the central station in that town had decided to discontinue sales of electrical merchandise, so that while it continued to show appliances for the purpose of interesting its customers in their use, prospective purchasers were referred to the various dealers carrying the goods in stock.

This new-comer in the business realized that a great many people visited the office of the electric light company to pay their bills; likewise that they were being influenced by the displays of the merchandise, which was attractively shown, with current turned on in most cases. He appreciated the fact that if he were in the immediate vicinity, a good many people who had been interested in electrical goods through visiting the office of the lighting company would probably buy from him.

The central station has its offices on a side-street, a good location, if not the best from a retail standpoint. The dealer found that he could rent a store almost directly across the street from it, and he proceeded to sign a lease for the space at a figure which, compared with what he would have had to pay on the principal street, was extremely small. As he figured it, however, it was almost as good, if not better, for the reason that it gave him a chance at the very persons who were most likely to be good prospects for the appliances with which he stocked up.

#### Window Display Plays Big Part

The plan which he adopted has worked out very well thus far. He has paid special attention to his window displays, so as to get the maximum value from his location, and he has not stopped with depending on sales in the store, but has advertised, put salesmen out on the street and in other ways has sought to develop business, the net result being that he has made a go of the proposition. But he figures that he has an ideal location for his specialty, and the chances are that this is the case.

In this connection the matter of window displays is worth commenting on. No matter how poor your location, and no matter how few the number of people who come by, don't forget that you have sales opportunities by means of your windows, and that neglecting these opportunities is like throwing dollar-bills into the waste-basket.

Your windows may not be as valuable from the display standpoint as those of the department stores—but they don't cost you nearly so much to maintain. In proportion, you can get just as much out of the windows as the merchant who is paying possibly thousands of dollars a month for the privilege of displaying his wares to the passing throngs. If you only made one sale a week from the windows, it would be worth while, and in the meantime the attractive displays would be impressing those who passed with the fact that here is a live dealer, who is taking advantage of every business opportunity.

Get as good a location as you can, in view of your limitations as to rental expense; and then proceed to make the most of it. That is the thing to remember in this connection, with special emphasis, when it comes to selecting a store, on the adage of Davy Crockett, "Be sure you're right, and then go ahead!"

#### American and English Military Cars

The accompanying illustration, Figure 1, shows a most interesting form of light armored motor car developed at the Berry Works at Thames Ditton, Surrey, England. This was the first English armored car light ever made. The attitude of the operator in this car is peculiar. It is necessary for him to sit on the floor of the car. The steering wheel is rather far forward, standing in the mouth of the tunnel-like armored scuttle. Behind the driver's back, there is a strip of board to give pedal purchase, and before his eyes a slit some twelve inches long by an inch wide. This gives a surprisingly wide view of the road straight ahead, but no great amount of sideway vision, the result being that when taking a



Fig. 1.—English Armored Car

sharp corner it is rather difficult to see, and turning completely around in the road is a two-man job.

Figure 2 shows an American portable searchlight for military field use as demonstrated at the Marine Barracks, League Island, Navy Yard, Philadelphia. It was also tested out before the Engineering Department at the Washington Barracks, and the Maryland State Militia made very interesting experiments with it in their manoeuvres. It is stated that after the first test was made at League Island, a very thorough and appreciative report was made by the officer in charge which showed that on a dark night with sleet falling each lamp gave good illumination at distances up to 1500 yards. The military officials have taken particular interest in this motor search light because of the use they have been put to in the European war and also during the operations of the American Marine Corps at Vera Cruz and Culebra the need and the varied uses for such an equipment was clearly shown.

The features that any such portable light must combine are reliability, ruggedness, ease of carriage, and construction of such nature that all of the set may be quickly assembled and placed in operation. The electrical apparatus of the equipment is mounted on a special body on an autocar chassis, as shown in

Figure 3. The body is designed so as to furnish protection for the power plant, and to support the four reels of flexible cable, and the spring mounted tracks on which the two searchlight hand trucks rest. These springs are quite essential in eliminating road shocks from the delicate mechanism of the lamps.

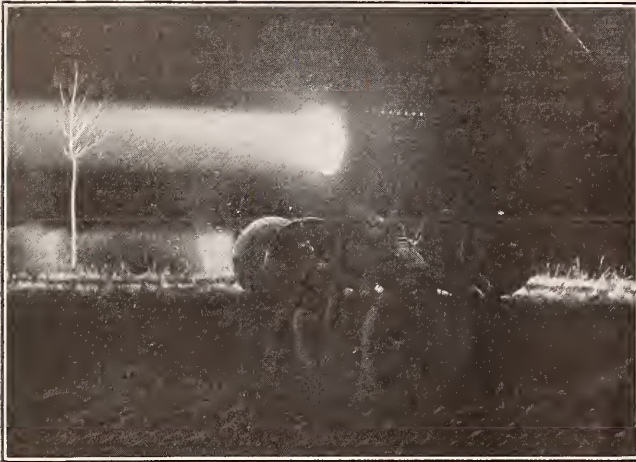


Fig. 2.—The Searchlight in Use

The power plant consists of a gasoline motor  $4\frac{3}{4} \times 4\frac{1}{2}$  inches, coupled direct to a 7-kilowatt Westinghouse direct-current generator. This generator is designed to run 1200 revolutions per minute, at which speed it gives 125 volts and delivers 56 amperes. The motor is equipped with a Pierce fly-ball governor, regulating the speed with very close limits. The engine driving this generator is supplied with its own gasoline tank, and also an independent radiator kept cool by a high-speed fan.

The two hand trucks which carry the searchlights and reels of flexible wire are constructed entirely of steel and aluminum, and have two wire wheels, each equipped with  $28 \times 3$ -inch pneumatic tires. These trucks are light in weight and rigid in construction, and so designed that they have large road clearance beneath the light to enable them to be operated in very rough country.



Fig. 3.—Power Plant for Lights

For supplying the necessary current, each light carries 1350 feet of cable, divided into two lengths of 675 feet each, so that each lamp can be operated at any distance within the limits of the cable from the power plant without unreeling all of the wire to get at the inner end. The inner ends are arranged to pass through the heads of the drums, so that the attachment may be readily made. Each searchlight is 14 inches in diameter and has an arc of 5,000 candle power, which is effective up to a distance of one mile on a clear night.

In order to get the maximum value of the lamp, the observer stands at some distance to one side, and by means of a field

telephone the officers control the operation of the light as found necessary.

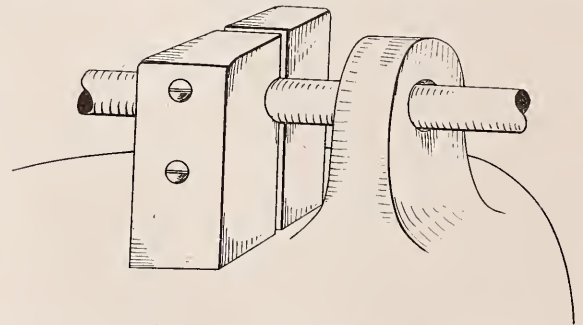
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### A Simple Brake for Feeder Regulators

Trouble is often experienced, on circuits carrying heavy and violently fluctuating loads, due to the induction regulator "over-running." This is particularly liable to occur in the older types which were built with a very heavy rotor, because the inertia of this heavy mass tends to maintain the rotor in motion, although the regulator has reached the position corresponding to the correct voltage.

Consider the starting of a large induction motor. With the sudden rush of current the regulator starts to turn, and possibly continues turning even though the current has dropped somewhat. It over-runs, and then when at last it does actually stop, starts back in the endeavor to bring the voltage back to the correct value. Perhaps the current again fluctuates and the regulator starts off again. In this way over-running results in a continual see-sawing back and forth of the regulator, causing needless wear and tear of the regulator and the various mechanisms controlling it, and at the same time seriously interfering with the regulation of voltage. To overcome this difficulty the later types of induction regulators have been built with a much lighter rotor, and with less inertia therefore, and have, in addition, been fitted with some form of brake that will either apply itself directly the current to the motor ceases, or that is on all the time and is only capable of bringing the rotor to a stop when the motor is not energized.

Many of the older forms of regulators had no brake at all, hence they tend to give trouble from over-running, especially when the load is a heavy and fluctuating power load such as when supplying large hoist motors, draw-bridges, large compressors of ice plants, etc. Where this is the case a very simple and inexpensive means may be employed for overcoming the difficulty. It is, in effect a brake of the constant-friction type, and is obtained merely having two pieces of wood clamped together around the shaft operating the regulator rotor in such



a way that they will bring the rotor to a quick stop directly the motor is disconnected from the source of power supply. The general arrangement is shown in Fig. 1. The blocks are of wood, any wood will do although hard wood is preferable, about 1 inch wide and three-quarter inch thick. The faces adjacent to the shaft are bored out to about the same diameter as that of the shaft they are to work upon. The fit should preferably be a good one. These two wooden blocks are clamped together by means of wood screws, stove bolts or in any other way that is most convenient. The blocks will be found to be most satisfactory if made of such length that they are able to rest at their base upon the top of the regulator casing, and on one side against the bearing of the shaft, as in this way they are kept in position in two planes. The friction is varied by screwing or unscrewing the screws or bolts, the desired amount being found by actual trial according to the loads supplied by the regulator. This brake requires no attention whatsoever although it is best to lubricate it occasionally with a little vaseline, graphite or kerosene.

This form of brake is most effective, while costing very little to make.



# New Products And How to Use Them

**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

*The Names of Manufacturers not appearing in this Section will be gladly supplied on Request.*

## Ward-Leonard Field Rheostats

The inevitable deterioration of exposed-wire rheostats due to oxidation has long been a serious problem with every manufacturer and user of these devices. The hot wire is peculiarly exposed to the attack of oxygen in the air which surrounds it, and as time goes on the metal is gradually converted into oxide, which is a very poor conductor. Thus the area of the wire is reduced and its resistance and temperature are increased until eventually it burns through and breaks.

The whole problem has been neatly solved by the Ward-Leonard Electric Company, of Mount Vernon, N. Y. By enclosing the resistance unit in vitreous enamel, baked on at high temperature, all access of the air is prevented. The enamel is chosen to have a temperature coefficient of expansion such that it expands at the same rate as the wire. Thus there is no tendency for the two to pull apart or crack. Further, the enamel is an excellent conductor of heat, and it offers a larger surface for radiation than could the wires themselves.

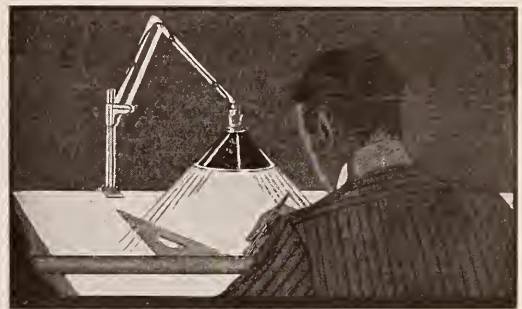


The prices of this line of apparatus are as low as is consistent with the company's policy of sending out only the very best of material and workmanship. The six-inch size, illustrated herewith, lists at \$2.50 each.

## The Mechanical Arm

A Massachusetts manufacturing company has put on the market a device known as the mechanical arm, for holding telephones, lights, etc., which makes it possible to place these articles in any position desired by giving a combination of all possible motions. Not a single nut or screw has been used in the construction of this device, and yet it is so compensated that the light or telephone remains in any position in which it is placed. It cannot drop, twist, or lean to one side.

With this device universal motion in three dimensions is obtained. Located in the tubing that is fastened to the base is a spring and a friction plug. By tightening a little screw the friction can be adjusted to any degree so that heavier light shades can be used on the lamps.



These arms for light use are made in lengths of 25 and 30 inches, in the following forms; with base, with clamp for typewriters and flat top desks, with wall bracket, or with a flange for use on work benches.

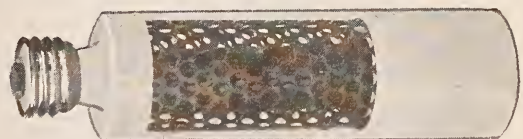
They are excellent lamps for hospitals, reading rooms, offices, machine shops or any place where a concentrated light is needed in different positions.

Anyone who has tried to hold a telephone and write at the same time will appreciate the convenience of having the telephone stay before him, wherever placed and have the freedom of either hand. These mechanical arms are made for telephone use in lengths of 28 and 33 inches.

## A New Adapter Resistance

A new type of resistance has been put on the market by the Ward Leonard Electric Co., of Mount Vernon, N. Y.

It consists of a Ward Leonard Enameled Resistance unit arranged with an Edison base screw plug at one end, and an Edison socket at the other end.



This compact little article called an "adaptor" resistance provides a very convenient means of introducing resistance in a circuit. As it can be furnished practically any size or capacity, its uses are many, among them being with the universal type motors to adapt them to either alternating or direct current at any constant speed, also in connection with low voltage apparatus when run on high voltage.

The resistance unit uses a wire, with a low temperature coefficient-wound on a porcelain tube, the whole being embedded in a coating of vitreous enamel making it impervious to electrical, mechanical and chemical disintegration.

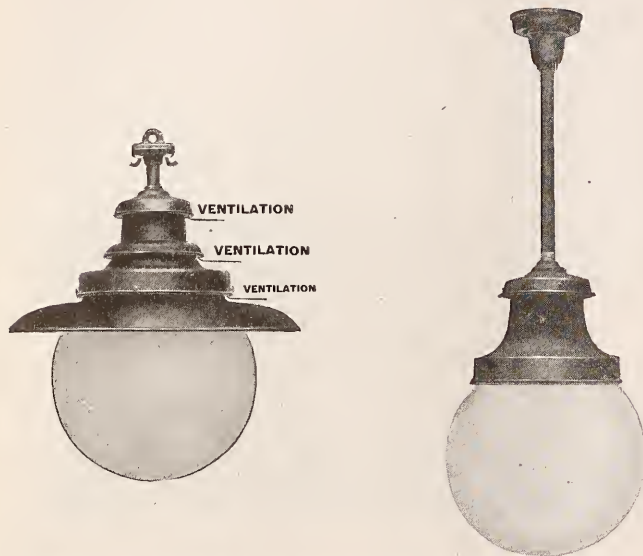
### Outdoor Fixtures for Electric Lights

Below are illustrated some of the recent fixtures brought out by the Herwig Art Shade and Lamp Co., of Chicago, Ill.

This firm manufactures a complete line of fixtures for type "C" nitrogen filled lamps built especially for outdoor service store front, yard and dock lighting.

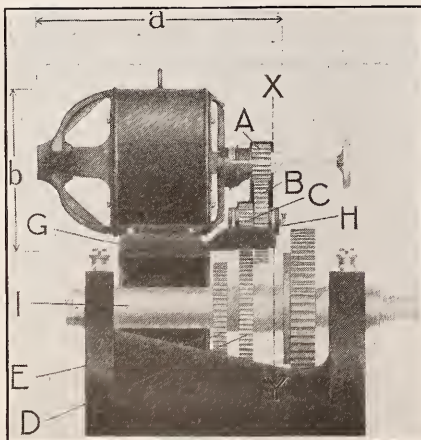
A number of these units have also been used for interior lighting with very satisfactory results.

All the parts of these fixtures are made of cast metal and fire enameled to prevent rusting. This treatment makes them very durable and also presents a very pleasing appearance.



### Motor Drive for Application to Cone-Pulley Lathes

Most cone pulley lathes are equipped with a single back gear giving at least a 1:10 reduction in the spindle speeds as compared with the direct drive. A motor having a 1:3 or 1:4 speed ratio cannot be applied to such a lathe without adding a second gear change, or if this is not done without having a very objectionable gap in the very middle of the range of spindle speeds. To add a second back gear is an



expensive and complicated proposition as compared with obtaining the same results with the existing back gear shaft and bearings. In the machine illustrated a motor having a 1:6 speed ratio is used, no second back gear is required and by changing the existing back gear ratio from 1:10 to 1:6, the same total range of spindle speeds is obtained without a break. This gives the most compact all-gear drive with

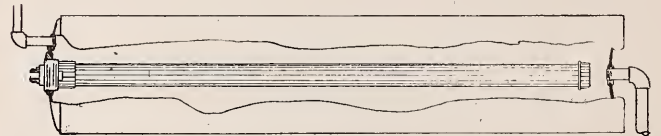
the least number of gears for the range of spindle speeds obtained of any motor-driven headstock on the market.

The motors are supplied either 115, 230 or 550 volts direct current, no alternating current motors are furnished.

The equipment includes motor, automatic starting panel, drum type operator's switch, giving start, drift, dynamic brake and reverse, motor base casting G, intermediate shaft H (including bearings and grease cups), gears A, B and C, and gear guard for same, all mounted and fitted complete on base casting G, also gears D and E, data for which is obtained from customer. Customer furnishes quill I or some other means of supporting base casting G. Customer fits and mounts parts on lathe, which requires about two day's interruption in use of the machine or the customer ships complete headstock from his lathe to the factory where the company furnishes, fits and mounts motor and all parts and returns it with starting equipment to customer ready to again mount on lathe bed and run as an all-gear motor-driven lathe. Customers mount starting panel and runs necessary wires to starter and motor.

### Electric Water Heater

The Lee Electric Radiator Company, 629 Peoples Gas Building, Chicago, Ill., have lately placed on the market a water heater for use in water tanks or boilers which are generally heated by some other means. The heating unit consists of a pipe 1.25 inches in diameter, and 56.5 inches long, which can be inserted in the opening through the top of a tank or boiler, as shown in the cut. The unit is threaded for 1 inch at the top and consists of an open resistance coil or heating element submerged in an



insulating, non-oxidizing, fluid. These units are made with single-heat elements rated at 500 watts and 750 watts, and with three-heat units rate at 1,500 and 2,000 watts. From tests it has been found that approximately 45 gallons of water can be had every 24 hours at a temperature of 115 degrees Fahrenheit.

### Electric Ranges

The California company manufacturing ranges, illustrated herewith, use the open-coil reflector type heating element.

The heating element is made of steel and porcelain imbedded in steel, in a truss form of construction that makes for rigidity and absorbs a minimum of heat.



The importance of the heating element, or burner, in an electric range makes the following information exceptionally pertinent to those interested in electric range cooking. The claims of the company for these ranges are:

Speed: Working temperature is reached within 15 seconds after current is applied and an element wound for 1,500 watts with a diameter of not more than 8½ ins. approximates the speed of a modern sized gas burner.

Economy: Highest economy is obtained because the principle upon which this element transmits heat to the cooking utensils is very similar to the gas burner and any type of cooking utensils can be used to good advantage.

It is a well know law of physics that dark surfaces attract or absorb heat and bright surfaces reflect or repel it. That's why we wear dark colors in winter and light colors in summer.

Careful house to house investigation showed that the majority of utensils used in the home had a more or less dark or dull bottom. This fact influenced the construction of the reflector type of burner as it shows great economy and efficiency when using the ordinary utensils found in the home. It operates directly on the principle that dark, dull surfaces absorb heat rays more rapidly than light colored, bright surfaces.

The element is easily removed by taking out three screws which make the electric connections.

Each range is controlled by a three-heat indicating snap-switch.

The range is made in five models—to suit the needs of either large or small families.

Four of the models are of the standard gas range design; another is modeled after what is known as the "gasoline stove type."

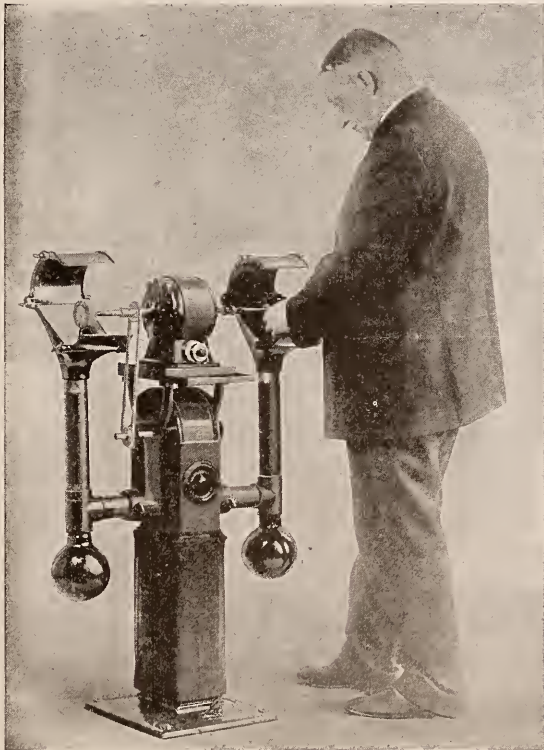
All models are finished in black enamel. The ovens of four of them are lined with aluminized steel and high grade mineral wool is packed between the walls.



### Electrical Polishing Lathe

An electric polishing lathe, that "Saves the gold and bags the dust," is shown in the accompanying illustration.

The complete outfit consists of a Westinghouse motor



mounted on a pedestal equipped with fan, dust traps, and universal hoods.

When polishing and grinding is being done the particles of

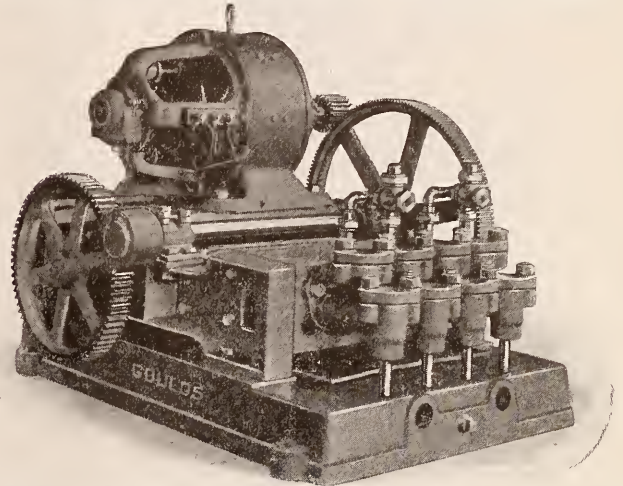
dust flying from the wheels are thrown against the universal hoods and adjustable shields, and drawn down the vertical suction pipes. This dust is then separated from the air during the passage of the air through four traps which dispose of it without clogging the apparatus. Thus all the valuable dust is collected and saved.

These outfits are fully guaranteed by the makers and a free ten-day trial offer is made to all reliable jewelers.



### Oil Pressure Pump for Electrical Machinery

Builders of electrical machinery and consulting and contracting engineers will be interested in a motor-driven pump designed

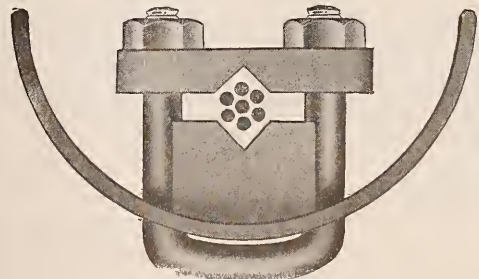


especially for forcing oil under the bearings of electrical machinery, which has lately been placed on the market by a pump manufacturing company. This pump is of the single-acting quadruplex horizontal type, with ¾-in. cylinders and stroke of 4 in. It has a capacity of 2 gallons per minute against a pressure of 1200 lbs. The base of the pump is built with a self contained reservoir of 10 gals. capacity to which the oil returns from the bearings. The pump is equipped with brass-lined cylinders, plungers of hardened tool steel, bronze crossheads running in bored guides, forged steel crank shaft, and cast steel connecting rods, babbitted on the crank end and bronze bushes on the cross-head end.



### Guy Wire Protector

A heavy metal shield for covering guy wires and protecting passers-by when they accidentally run into them has recently been brought out to take the place of iron pipe, wooden boxes and similar devices that have hitherto been employed for this purpose.



The shield consists of a heavy-gauge steel formed into a half-circle, as shown in the accompanying illustration. It is 7 feet long, weight 12 lbs. and is provided with two clamping devices 18 in. from each end for attaching to the guy wire at any point desired. One clamping device on the protector is provided with a bolt 1 in. longer than the other, thus enabling the longer clamp to be clamped over the rod, if de-

sired, while the other clamp can be attached to the guy wire in the usual manner. The protector is said to be neat in appearance and presents sufficient surface to be plainly visible from all sides. It is finished in a light-gray color, very easily installed and can be used for a long time.

\* \* \*

### Diffusers for Nitrogen-Filled Lamps

The general tendency with modern intense radiants at command is to light too brilliantly, to key the vision to too high a pitch.



For every day work the thing most needed is an efficient light of moderate intrinsic brilliancy.

Save under special circumstances, very powerful radiants are disadvantageous, particularly if of great intrinsic brilliancy.

In actual practice it is a matter of difficulty to place the light wholly out of the field of vision and the more brilliant the light the greater the necessity for a shield. Hence it has been a difficult matter to treat modern illuminants without loss of efficiency.

Seeing the necessity for shielding the eye from the direct rays of these highly brilliant illuminants, and at the same time preserving the luminous value of these rays, the diffusers illustrated herein have been developed to remove the objectionable features, and at the same time preserve the luminous value of useful light of the modern illuminants.



They can be installed in any fixture now used or with any existing installation of shades or reflectors, or in any fixture in which you can place the new type "C" lamps. They are easily installed by simply slipping the holder over the base of the lamps and snapping on the diffuser. For new work there are three special types of reflectors which can be highly recommended.

\* \* \*

### No More Cold Feet for Pittsburgh Policemen

This winter a convenient foot-warmer has added greatly to the comfort of Pittsburgh policemen, for the Westinghouse Electric and Mfg. Co. has made a heater which resembles in

## H. M. Byllesby & Company

Engineers and Managers

Tacoma  
Gas Building

CHICAGO  
208 So. LaSalle Street

New York  
Trinity Building

Purchase, Finance, Design, Construct and Operate Electric Light, Gas, Street Railway and Water Power Properties.

## EXAMINATIONS AND REPORTS

Utility Securities Bought and Sold

appearance a griddle, and which is connected with a plug and switch on a pole at the curb. The intermediate connection is flexible and armored cable about 10 feet long. The warming plate is 18½ inches square and 1½ inches thick.

The heater may be run at four different temperatures to suit the requirements of the weather. Under ordinary circumstances it can be operated on less current than two 40 watt incandescent lamps would consume. At no time does the temperature reach a point where there is danger of burning the soles of the shoes.

This ingenious device was developed for the City Council by the Westinghouse Company. Various ideas were discussed



(Courtesy Pittsburgh Industrial Development Commission) such as stationary sidewalk heaters, and heaters imbedded in the street pavement, but were abandoned in favor of the portable heater described. The cut shows one of the heaters in use at Sixth Avenue and Smithfield Street, Pittsburgh.

\* \* \*

### "Official Public Service Reports"

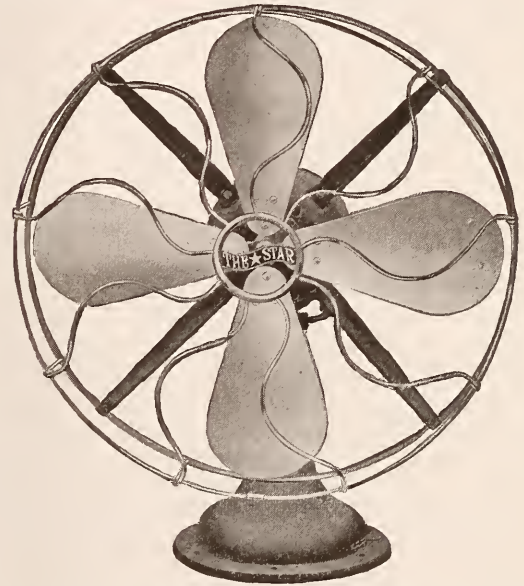
The Public Service, Railway and Corporation Commission of the several States, through the National Association of Railway Commissioners, with which all the State Commissions are affiliated, have completed arrangements for the official publication of all State Commission decisions, under the title "Official Public Service Reports," giving it the exclusive advantage of authoritative-ness. As a result of its official relation to the Commissions, it will have also the advantages of entire completeness and promptness of issuance.

It is edited by J. H. Goetz formerly Assistant Counsel of the New York Public Service Commission for the First District, and W. H. Bohling, formerly with the Missouri Public Service Commission. Publication will be by the Law Publishing Company, with offices at 74 Broadway, New York City.

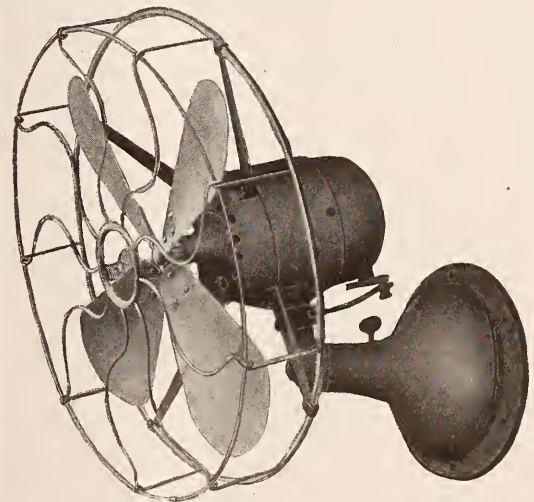
This system of reports and digests is published in Weekly Advance Sheets with head-notes and syllabus-digest, and Permanent Volumes of about 1,200 pages each, standard law style, bound in law buckram, paging the same as in Advance Sheets, with tables of cases and statutes construed, and complete syllabus-digest index for each volume

### "Star" Fans for 1916

The 1916 Star fan retains all the features that have made this line so popular in the past. A few of these are efficiency, low operating cost, pleasing appearance, simplicity, durability and quietness in operation. These fans are made in 12 and 16-inch sizes, for direct-current, all voltages, both oscillating and stationary types. These fans can also be had with 6 blades if desired. This enables it to move the necessary quantity, etc., of air at a lower speed, thus reducing the volume of sound.



All Star fans are made with a ball and socket joint which allows them to be used either as a desk or bracket fan. Adjustment is obtained by a slight turn of a thumb screw which locks the joints securely. The mechanism on the oscillating type fan is of the simplest and most practical design. The patented slip collar prevents stripping of the gears which are entirely enclosed in an especially constructed gear case. This eliminates all possible leakage of oil or grease.



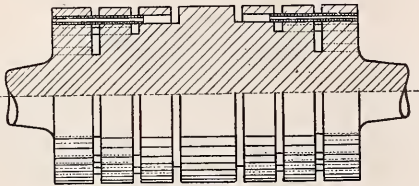
The rheostat in the base is provided to give three different speeds, 900, 1200 and 1500 r.p.m.

The fact that the oscillating base and gears run continually in grease greatly minimizes current consumption. On both types of fan accessibility of the speed regulator is an important point to take into consideration.

Drawn metal construction and high class finish together with graceful design make these fans attractive for both home and office use.

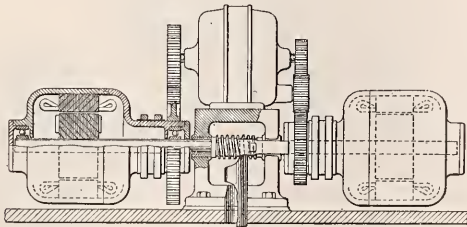
# Recent Electric Patents of Interest

**Rotar for Dynamo Electric Machines.**—The rotars for dynamo electric machines have been cooled by drawing in air through the core axially and discharging it through a number of radial passages by centrifugal action. The disadvantage with this arrangement is that the greatest quantities of air are discharged through the radial passages nearest the ends. The result is that the ends are most effectively cooled while there is want of ventilation in the central part of the armature. In a patent granted April 11, 1916, A. Zehring and R.



Rudenberg, of Berlin-Wilmersdorf, and Reinhold Rudenberg, of Berlin-Charlottenburg, Germany, is described a more uniform cooling which is provided by separate axial channels and individual radial discharge openings in the interior of the machine at different distances from the ends thereof. The construction is such that air taken into the axial channels must flow to the radial channels with which they are connected. The construction is clearly shown in the cut. Patent No. 1,178,771.

**Induction Regulator.**—In automatic voltage regulation by induction regulators, the movable members of the regulator must be promptly adjusted in response to the varying conditions. To secure this result a continuously running motor has been employed which was clutched and unclutched to the movable member of the regulator as conditions might require. While this secures prompt operation of the regulator, there was considerable shock of the parts owing to the rapid acceleration and inertia of the masses of the parts involved. This objection is overcome by an apparatus described in a patent issued to Chester B. Mills, of East McKeesport, Penn., on March 28th, last. According to Mr. Mills invention a continuously running motor is employed which is connected with the movable member of the induction regulator by induction motor devices, there being one for each direction of movement of the regulator. The arrange-



ment is shown in the cut wherein the continuously running motor is indicated at 1 and is geared to drive the primary members 4 and 5 of the induction motor devices 2 and 3, in opposite directions. The secondary members 6 and 7 of these devices are secured on a shaft which drives the regulator shaft 21 in one direction or the other through a worm 9. The windings on the primary members are such as to produce rotary fields and when one is energized it promptly drives the shaft 8 in a certain direction and with an acceleration and speed dependent upon the relative speeds and di-

rections of the rotating magnetic field and of the mechanical driving of the primary member. It will be apparent that upon the energizing of the winding 16 or 17 the regulator shaft will be driven in one direction or the other. This arrangement will effect prompt movement of the regulator, but avoids the jolt of a rigid mechanical connection. Patent No. 1,177,349.

**Electric-Magnet Switch.**—In the usual magnet operated switch the pick-up and release currents bear a definite relation to each other. It is often desirable to be able to adjust one of these currents without disturbing the other. This advantage is secured according to a patent issued to Mr. Robert H. McLain, of Schenectady, N. Y. Mr. McLain's invention is for use on alternating current circuits and involves a bucking coil inductively energized from the usual lifting coil and also a special form of magnetic plunger. This particular form of magnetic switch is shown diagrammatically

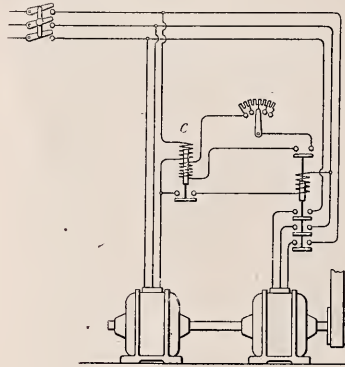


Figure 1

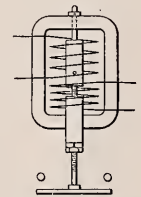


Figure 2

in Fig. 1 in its circuit relations for the purpose of bringing an auxiliary motor B into action when the motor A is overloaded, and is shown in detail in Fig. 2. It will be seen that the usual lifting coil 11 is in the work circuit of the motor A so that it closes the switch 12 when the working current exceeds a certain value. The contacts 16 will then be closed and will connect the motor B with power and also the switch 14 will be closed completing circuit of the inductive bucking coil 13. As shown in Fig. 2 the core of the magnet C is divided into two portions 18 and 19 adjustably connected by a screw 20. The current at which the coil will be picked up may be varied by varying the width of the air gap 22. The inductive winding 13 is not energized until the core picks up consequently it has no effect on the value of the picking up current. On the other hand it has an effect, according to the adjustment of the rheostat R, upon the amount of current required in the coil 11 to hold up the core. Patent No. 1,177,427.

**Variable Rate Meter.**—The principle and operation of the variable or multiple rate meter is well known. In a patent granted April 4th, 1916, to Mr. Chester I. Hall, Chicago, Ill., is described a simple and effective device for accomplishing the desired result. The variable rate mechanism may be made in the form of an attachment which may be applied to a standard meter. This attachment comprises a transformer supplying the potential coil of the meter and a switch controlled by the work current. This switch connects the potential coil to line independently of the transformer at one rate of registration and connects the potential coil through the transformer for another rate of registration.

# TRADE LITERATURE

## Catalogs and Books

### A Review of the Latest Publications

**Pole Line Hardware**, Catalogue No. DS846, has just been issued by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa. This publication gives a complete list of accessories used in pole line construction with prices and dimensions.

"**Thordarson Miniature Electric Power Plant**," a leaflet, describes the electrical toys manufactured by the Thordarson Electric Mfg. Company of Chicago, Ill.

**Pipe Welding**. An elaborate discussion of the welding of National pipe, manufactured by the National Tube Co., Pittsburgh, Pa., is contained in Bulletin 26 from that company. Besides a general treatment of the subject of welding, instances are shown of the adaptability of National pipe to that made of unions and the difficult shapes into which it can be successfully formed. The most prominent feature is the welding of gas pipes on the job.

**The Elblight Company**, of New York City, illustrate some of the electrical illuminations executed by them in folder entitled "The Elblight System of Electrical Decoration."

**The Holtzer-Cabot Electric Company**, Roxbury, Boston, Mass., has issued an attractive pamphlet giving a historical outline of the company's progress during the past forty years, also describing its new plant.

**The National X-Ray Reflector Company**, Chicago, Ill., has issued four new portfolio plates, Plate No. 30 covers indirect lighting systems for factories, Plate No. 31, Church-lighting systems, Plate No. 43, has sketches and photographs of stage lighting systems without foot lights, and Plate No. 44, artificial daylight systems for art museums.

"**Colonial**" Copper-Clad Wire is the subject of Bulletin No. 202-1 issued by The Standard Underground Cable Company, of Pittsburgh, Pa.

**The C. & C. Electric & Mfg. Co.**, of Garwood, New Jersey has designed and perfected a new line of motors, with ratings up to 10 h. p. They are bi-polar, commutating pole, semi-closed and totally enclosed motors, and have been designated type "IB." Advance bulletin 102-x gives a full description of these motors and may be had, on request, from the C. & C. Electric & Mfg. Co.

**The Bowlers Manufacturing Company**, of Springfield, Ohio, has issued an illustrated folder which contains information of its chain-drive boring machine.

"**The Schoop Metal Spraying Process**" is the title of a booklet issued by the Metals Coating Company of America, Boston, Mass. In this booklet is given an outline of the theory and operation of the process and the spraying pistol, also the various uses to which the process may be put.

"**Transforming for Lighting and Power**" is the title of a leaflet issued by the Adams Bagnall Elec. Co., Cleveland, Ohio, describing their standard transformers for voltages from 2200 to 33000, single phase and three phase, also a Constant Current Regulator for Series Mazda lighting.

**The Pelton-Westinghouse Waterwheel Generator Sets**, and their applications are very attractively illustrated in an art circular recently issued jointly by the Pelton Water Wheel Company of San Francisco, and the Westinghouse Electric and Mfg. Co., of East Pittsburgh, Pa. The circular describes some applications in the home and farm and gives some specific information on the analysis of a proposed water power company. The circular will be sent on request to any one interested.

**The Hazard Manufacturing Company**, of Wilkes Barre, Pa., has lately issued a publication on Keystone railroad signal wires and cables. This booklet of sixteen pages describes the construction of Keystone insulation, and also gives some information on the distribution of electrical streets in insulation resistances. It is written in a clear manner, and is well illustrated with cuts and curve sheets.

**Gantz & Leist Electric Company**, Cincinnati, O., has issued a catalog showing their line of low-speed motors and generators for the deposition of metals.

**The Bleadon-Dunn Company**, 208 North Fifth Ave., Chicago, Ill., manufacturer of "Violetta," high-frequency generators, has prepared a booklet dealing in a clear, understandable manner with the history of violet-ray high-frequency electricity for medical purposes. A considerable portion of the text is devoted to specific instructions for treating various ailments, illustrations being included wherever possible. The booklet also contains descriptions and prices of various combinations of electrodes for treating the scalp, face, throat, body, etc. This booklet will be mailed upon request.

**Voss Brothers Manufacturing Company**, Davenport, Iowa, has given out an attractive 40-page catalog describing its washing machines. A number of styles of electrically operated combination washers and wringers are illustrated. These machines have a reversible wringer, which may be operated both by hand-lever and foot treadle-control. The washer and wringer may be operated independently, and are driven by a specially designed motor.

**The Jefferson Glass Company**, main works and general office, Follansbee, West Virginia, has just issued a very attractive folder on Diamond Twist Prismatic Reflectors. It seems that reflectors of this character have again come to the front. They are certainly very attractively treated in the folder in question. Copy of it will be sent to any subscriber of this paper who will write direct to the Jefferson Glass Company, Follansbee, West Virginia, for same.

**Storage Batteries** for lighting and ignition service are told about in Catalog No. 2 and "Revivo" storage batteries for electric lighting in catalog No. 3 issued by the Cook Railway Signal Company, Denver, Colo.

**Storage Battery Parts and Supplies** are the subject of the second edition of Catalog B of the Electric Storage Battery Company, Philadelphia.

**Electric Ranges** are also described in a series of leaflets devoted to the output of the Globe Stove & Range Company, Kokomo, Ind.

## Legal Notes

### Results of Electricians' Licensing Law in Massachusetts

A law which went into effect December 1st, 1915, requiring all persons engaging in installing wires, conduits, apparatus, fixtures or other appliances for using electricity for light, heat or power in Massachusetts, to take out licenses, is attracting much attention in various parts of the country, where sentiment is crystallizing in favor of procuring similar legislation. Licenses are issued by a State Board of Examiners and consist of two classes: A, masters' or employing electrical contractors', and B, journeymen's.

As at present interpreted, a class B man may take work on his own account and employ helpers, but must work continuously on the job himself and not employ other journeymen. An amendment now being considered by the Legislature would prevent journeymen procuring licenses under a provision which allowed workmen engaged in electrical installation for five years or more to receive a certificate without examination. It is claimed by the clerk of the Licensing Board that a large number of men have received licenses improperly, through representing themselves to be experienced electricians, when they had done electrical work incidentally to such occupations as stationary engineering, janitor services, etc.

Up to the present time about 7,000 certificates of both classes have been issued. A large share of these have been issued under the clause which exempts experienced men, but examinations are held from time to time in the various cities of the State, when new applicants are examined both by written questions and practical demonstrations. The Board of Examiners are procuring a test board, on which candidates will make connections, install fixtures, etc., in future examinations.

On the question of inspections, it has been ruled that the local inspector must inspect any job of wiring offered to him whether done by a licensed workman or a workman acting without license illegally, and if the wiring is all right, approve it for use. He may report the case to the State Gas & Electric Light Commission for action as they may see fit. Any interested person may enter a complaint to the local court on his own initiative. An amendment that is being urged would make it obligatory on "all officers of the law who now have the right to complain of criminal offenders" to complain of the violations of the licensing law. In addition, power to prosecute violations would be given to wire inspectors.

The Gas & Electric Light Commission has adopted an order to the effect that masters and journeymen electricians shall be governed by general and special State law and local ordinances or by-laws, but in matters not expressly provided therein the National Electrical Code shall be the authority.

Local inspectors have in many cases notified all local contractors that failure to report work is a violation of the law, and that such cases will be reported to the State authorities, the penalty being suspension or revocation of the license.

In conjunction with the new law, there has come about in Massachusetts a closer community of interest among electrical contractors. The work of the State Association has been broadened to include the services of a special representative who follows up reports of infractions of the law and keeps office hours daily for the convenience of the trade. The electrical workers' union is in harmony with the new legislation, and is bringing about a purging of the ranks of unfit workmen, and also gives a definite credential of competency to holders of B certificates.

The Supreme Court of Indiana in the case of Miller vs. Southern Indiana Power Company held that a corporation organized by law to furnish electricity for light and power to cities and the public in general is entitled to condemn land for a power site, because the use is a public one and the company is bound at common law to impartially serve the public.

\* \* \*

According to a recent decision of the New York Supreme Court it is not necessary that an employer's foreman keep watch

on a lineman who has been furnished with rubber gloves for the handling of live wires, in order to see that he uses such gloves when engaged in this work.

\* \* \*

The Mayfield (Ky.) Water & Light Company, which has been in receivership, has been restored to its owners by the Circuit Court. D. B. Stanfield has been elected president and Ed. Gardner general manager of the company.

\* \* \*

## General News

Should the present rate of orders received weekly by the General Electric Company continue it will have on hand the largest amount of unfilled orders in its history at the end of the year. It is stated that it is receiving approximately \$3,000,000 worth of orders weekly, which will mean about \$150,000,000 at the close of the year, to which must be added about \$20,000,000 contracts which remained unfilled at the close of 1915. Many of the orders received are for less than \$25,000 worth, which indicate generally prosperous conditions throughout the country.

\* \* \*

For the benefit of their foreign patrons the Stow Manufacturing Company, of Binghamton, N. Y., have made arrangements with the American Express Company, whereby orders for their products may be made out to them and placed through the nearest express office of the American Express Company in the following cities: London, Liverpool, Glasgow, Southampton, Rome, Naples, Genoa, Paris, Havre, Marseilles, Copenhagen, Rotterdam, Stockholm, Christiania, Petrograd, Buenos Aires, Manilla, Honkong.

\* \* \*

A corporation capitalized at \$1,000,000, has been organized in Detroit, Mich. The company will build a car line from Dearborn to Highland Park with a view of connecting the Ford plants, the motor car factory in Highland Park and the tractor factory planned for Dearborn, and to furnish car service between the Michigan, Grand River, Hamilton and Woodward lines. Robert Oakman, Mayor Oscar B. Marx, L. W. Tuller and others are interested in the company.

\* \* \*

Application was made by the Cincinnati Gas & Electric Company and the Union Gas & Electric Company to the Ohio Public Utilities Commission for authority to issue \$15,000,000 of first sinking fund, 5 per cent. bonds to run forty years, and permission to sell \$4,500,000 of these bonds at 95 was also requested; \$4,100,000 to be used for the construction of a new plant on the river front at the foot of Rose St. and \$400,000 for improvements made on the property.

\* \* \*

The Bureau of Standards has just issued a series of papers of the Correlation of the magnetic and mechanical properties of steel. This paper is a review of the work done in correlating the magnetic and mechanical properties of steel. Among the mechanical properties studied are hardness, toughness, elasticity, tensile-strength, and resistance to repeated stresses. This paper may be obtained free on request from the Bureau of Standards, Washington, D. C.

\* \* \*

### Kentucky Hydroelectric and Steam Companies Have Equal Rights

Electric utility companies operating in Kentucky and generating by steam are put on an equal basis with hydroelectric companies in two bills which have passed the lower house of the Legislature. The more lately developed hydroelectric companies have enjoyed certain rights on the public roads besides the right of eminent domain, which the Legislature is now seeking to confer on the steam companies. Similar measures are before the upper house.



# Review of the Month

A Complete Record of Important News Edited for Busy Readers

The voters of Sioux Falls, S. D., have turned down a proposal to issue \$350,000 bonds for the erection of a municipal electric plant.

A \$3,000,000 three-year 5 per cent. gold note issue is being offered by the Union Railway, Gas & Electric Company, New York; notes are purchasable at 98.5 to yield 5.55, due April 1, 1919.

The city of Birmingham, Ala., has asked the Birmingham Railway, Light & Power Company to replace all arc lamps with tungsten lamps.

It is reported that the Murfreesboro (Tenn.) Electric Light & Gas Company has been sold to J. C. Beesley, George Beesley, J. M. and John Butler for \$65,000. The new owners will reduce the rate to 7 cents per kilowatt-hour.

Bids recently submitted for the installation of an electric lighting system in Choteau, Mont., were rejected, the respective figures being too high.

The City Council, of Howe, Okla., has under construction the installation of a municipal electric light plant and water works system, for which purpose it is proposed to float a \$100,000 bond issue.

The Shirley Electric Co., Shirley, Mass., is erecting fifteen miles of 22,000-volt, three-phase transmission line. Two substations are also being built and new equipment installed.

Permission has been granted the Buffalo General Electric Co. by the Public Service Commission to issue \$3,625,287 in securities, proceeds to be used for a new steam generating station now under construction in Tonawanda.

It is reported that a high-tension transmission line will be erected by the Central Electric Company of Canton, Ohio, to Fostoria, Tiffin, Newark and other cities at an estimated cost of about \$2,000,000.

The New York Air Brake Company will construct two power plants at Watertown, N. Y., one of which will develop 1200 horsepower. The company now secures its power from the Northwestern New York Utilities Corporation.

The Ozark Power & Water Company, which supplies Springfield and other cities in Southwest Missouri with power from their hydro-electric plant on White River has improvements under consideration amounting to \$300,000.

The Cupples Station Light, Heat & Power Company, St. Louis, contemplates increasing its capital and constructing a large generating plant, which will allow the company to compete successfully in the local lighting field.

The Kentucky Public Service Company has placed a \$2,000,000 mortgage on its properties. This company operates electric power plants at Hopkinsville, Owensboro, Bowling Green and Frankfort in Kentucky and Clarksville, Tenn., and will also supply Guthrie with energy for light and power.

Application has been made to the Public Service Commis-

sioners by the A. L. Swett Electric Light & Power Company of Medina (N. Y.), for permission to issue \$700,000 in bonds.

The sale of the municipal electric light plant at Price, Utah, valued at \$50,000, will be made the issue of a special election to be held May 15.

The Great Western Power Company will construct a class A substation 68 by 137 feet on Bush St. and Grant Ave., San Francisco, Calif. The estimated cost is \$90,000.

The proposal to offer a \$500,000 bond issue for the erection of a municipal electric-light plant at Dallas, Texas, was defeated at a recent local election.

Benjamin Thompson Company has received a contract for the construction of a combined electric-light and water plant at Ocala, Fla., for \$97,254. The engineers are Twombly & Henney, of New York City.

The Iowa Light, Heat & Power Company, of Grinnell, Iowa, has been incorporated with a capital of \$1,000,000. Lindsey Hooper, president; Manning A. Williams, vice-president; Chas. A. Olsen, secretary and treasurer.

Altorfer Bros. Company has removed its general office from Roanoke, Ill., to Peoria, Ill., retaining its factory and a branch office at the former city.

The Department of Water Works, Youngstown, Ohio, contemplates installing two 15,000,000 gallon electrically-driven centrifugal pumps for filter bed water supply and one 4,000,000 gallon pump for water wash, the latter to furnish water to wash filtering basin.

The Spencer Electric Light & Power Company, of Belden, will build a temporary dam at Smyrna on Flat River (Mich.) to replace the dam washed away at this point on March 29th. Arrangements are being made to construct a reinforced concrete dam.

Pierce City, Mo., will hereafter purchase its electric light from the Ozark Power & Water Company and will sell its municipal plant which it has been operating since 1902.

An interurban trolley line will be built from Tampa (Fla.) to Lakeland by way of Plant City by Western capitalists. The new venture will involve an investment of \$1,000,000.

The municipal electric plant at Watervliet, N. Y., will probably be closed down and the lighting of the streets and public buildings of the city will be contracted for with a private corporation.

The General Electric Company, Wilmington, Del., has received a contract from the National Properties Company, New York City, for an additional turbo-generating unit, with boilers, etc., to be installed at the Wilmington & Philadelphia Traction Company's plant, which will increase the latter's output 50 per cent.

The General Public Service Corporation, of Philadelphia, Pa., which will conduct a general lighting business, has been

incorporated with a capital stock of \$100,000, by William White, William A. Welsh, of Philadelphia, Pa., and R. R. Kenney, of Dover, Del.

\* \* \*

The Choctaw Railway & Lighting Company, M'Alester, Okla., has been purchased by C. M. Mason, chairman of the bondholders' protective committee, of New York, for \$450,000. The installation of new machinery and other improvements are contemplated.

\* \* \*

It is reported that the Edison Electric Illuminating Co., Cumberland, Md., will continue the high power transmission system from Lonaconing, Md., the present terminus, through George's Creek Valley to Piedmont, W. Va., to supply electricity to mines and towns along the route.

\* \* \*

The City of San Francisco and the electric light, power, telegraph and telephone companies, also other corporations that maintain poles and overhead wires in San Francisco, contemplate a joint pole agreement. At present each company has its own poles.

\* \* \*

The Public Lighting Committee of Minneapolis, Minn., is contemplating replacing 530 gas lamps with electric lights. There has been a material decrease in the number of lamp-lighters in that city in recent years, there now being only 40 men who light gas lamps for a living against 100 men eight years ago, due to the replacing of gas with electric lights.

\* \* \*

The construction of an electrolytic plant in Spokane, Wash., for the treatment of zinc ores is planned by the Constitution Mining & Milling Company. The proposed plant will use about 6,000 h. p. and is capable of handling 100 tons a day. The estimated cost of the plant is \$425,000.

\* \* \*

Application has been made to the Public Service Commission of Rochester, N. Y., by the Rochester Railway & Light Company for permission to consolidate the properties of the Canandaigua Gas Light Company, the Eastern Monroe Light & Gas Company and the Dispatch Heat, Light & Gas Co., and for approval to take over the holdings of the Ontario Light and Traction Company, except its railroad physical properties.

\* \* \*

The Cumberland County Power & Light Company will erect a 20,000-hp. hydroelectric station at Hiram Falls, on the Saco River, Maine, with a generating station on the Baldwin side of the river, from which power will be supplied to Portland and other centers on the Cumberland company's system. An initial expenditure of approximately \$500,000 will be used for the construction of a dam, station building and for machinery aggregating 6,000 hp. in capacity. A 66-ft. head will be developed.

\* \* \*

The lighting franchise recently approved by the voters of Dallas, Texas, provides that at least \$1,000,000 shall be expended in extension and improvements of the Dallas lighting system within the next 18 months, the system to be capitalized at \$3,485,964. The traction franchise passed at the same time provides for a similar amount to be used within the same time for extensions and improvements of the four street railways in Dallas, which have been combined with a capitalization of \$4,790,124.

\* \* \*

The following changes in branch office location is announced by the Standard Underground Cable Co. Their Chicago office, formerly located in The Rookery, has moved to the Conway Building. The Detroit office has moved from the Free Press Building to the Whitney Building. The Portland (Ore.) office has been discontinued and a new office opened in the Newhouse Building, Salt Lake City, in charge of F. W. Wilson. An office will also be opened in Minneapolis, Minn., in charge of W. J. Weld.

The United States Geological Survey will investigate the water power possibilities in the southeastern part of Alaska in the very near future in addition to studying the mineral conditions and work in connection with the Government railroad in that country.

\* \* \*

What is known as the "church power plant" in Salt Lake City, Utah, has been purchased from the Mormon Church by the Utah Power & Light Company. This plant supplies the electricity for the Temple Block, the Hotel Utah, Desert News Building and several business blocks.

\* \* \*

With net earnings of \$2,866,634 in 1915 as against \$2,364,370 in 1914 the Northern States Power Company showed an increase of 21.2 per cent. The properties controlled by this concern now serves upward of 100 municipalities in Minnesota, North and South Dakota, Wisconsin and Illinois.

\* \* \*

The connection of the Red River Power Company's system, Grand Forks, N. D., with the Electrical Development Company's water power at Crookston, Minn., has been completed.

The Red River Power Company, which owns the transmission line, will purchase its power from the Electrical Development Company.

\* \* \*

The contract for furnishing small electric lamps for street lighting in Bridgeport, Conn., has been awarded to the United Illuminating Company of that city. These lamps were formerly furnished by the American Street Lighting Company, of Baltimore. The extension of ornamental street lamps from State St. to Gilbert St. is being contemplated.

\* \* \*

The power plants at Bridgeton, Wenonah, Woodbury, Pitman, Glassboro, Salem and Pennsgrove, in the southern part of New Jersey have been taken over by the International Electric Light, Heat & Power Company, of Philadelphia, Pa. These plants were formerly controlled by the American Railways Company. B. Frank Hires, of the Bridgeton plant has become general manager for the South Jersey Division.

\* \* \*

The Westinghouse Electric & Manufacturing Company has received contracts for record size machine during the past six months, consisting of turbo-generator sets of about 45,000-hp. capacity, 60,000-hp. and 73,000-hp. capacity, also 8,000-hp., 12,000-hp. and 15,000-hp. motors. It is further reported that the company is now designing a turbo-generator which will exceed any of the above in size.

\* \* \*

For the twelve months ended February 29th, 1916, the gross earnings of the Cities Service Company amounted to \$5,002,685.60 which is an increase of \$1,060,086 or 27 per cent. over the same period of the previous year. After providing for all expenses and the interest on the 7 per cent. notes, the balance available for payment of preferred dividends was 2.63 times the requirements for these dividends. After providing for the preferred dividends the balance available for the common stock was equivalent to 17.54 per cent.

\* \* \*

The annual report of the Standard Gas & Electric Company shows gross earnings of \$1,618,467 in 1915 against \$1,475,029 in 1914, and net earnings of \$1,575,441 in 1915 against \$1,435,418 in 1914. Earnings amounted to 6.3 per cent. on the preferred stock, after the payment of fixed charges, upon which dividends were paid at the rate of 4 per cent., leaving a surplus for the year of \$270,979. President Byllesby reported that the company has made substantial progress during the year, while at the same time permitting subsidiaries to re-invest \$1,322,792 in the properties through depreciation reserves and undistributed surplus.

**Personal**

Mr. C. E. Robertson, formerly commercial manager of the Consolidated Gas, Electric Light and Power Company, Baltimore, Md., has been appointed sales manager of the General Vehicle Company, Inc. Mr. Robertson is an expert sales director with exceptional executive capacity and broad experience, and is now



C. E. Robertson

actively engaged in directing the distribution of the vehicles produced by the General Vehicle Company. This company is expanding its sales organization and making great plans to increase both its electric and gasoline vehicle productions. Its general sales policy has not been changed, but it will be represented more generally and agencies established in a large number of the commercial centers.



Mr. Sydney N. Baruch, chief electrical engineer of the Baruch Electric Controller Corporation, of San Francisco, an authority on thermo protection of electrical apparatus and thermo electrostatic protection of cables, delivered a lecture on these subjects April 18, at the University of California, Berkeley.

Dossert & Co., New York, manufacturers of "Solderless Connectors" will be represented at the N. E. L. A. convention in Chicago this month by Mr. H. B. Logan, president of the company. He will make his headquarters at the Congress Hotel.



Mr. H. G. Stott, superintendent of motor power of the Interborough Rapid Transit Co., New York, has been retained as consulting engineer in connection with the large steam plant which the Buffalo General Electric Co. is building to supplement its hydro-electric energy from Niagara Falls. This new plant will embody many advanced features, including a steam pressure of 275 lbs. and an exceptionally high boiler rating.



Mr. A. D. Fishel has been appointed commercial manager of the Adams-Bagnell Electric Company, Cleveland. He formerly had charge of the Distributor Transformer Section of the Supply Department of the Westinghouse Electric & Manufacturing Company.



Mr. James B. Olsen, sales manager for the Habirshaw Wire Company for eighteen years, has been appointed general sales manager of the Habirshaw Electric Cable Company recently formed by the consolidation of the Habirshaw Wire Company, the Electric Cable Company and the Waterbury Company.



Mr. Cyrus S. Eaton, president of the Continental Gas & Electric Corporation, recently became a member of the banking firm of Otis & Co., Cleveland, Ohio, which firm has several branches throughout the States.

**Death & Company, Inc.**

Recently the firm of Deuth & Co., New York, has been completely reorganized under the name of Deuth & Company, Incorporated, and a large amount of additional capital secured.

The officers of the new organization are: President, Eugene J. Deuth, who was president of the company; secretary and treasurer, W. Dunbar McElhinny, who is also treasurer of the Equitable Building in New York City.

The directors of the new company are: George H. Dirkes, connected with the Equitable Building; Charles Le Barbier, formerly Assistant District Attorney of New York County; E. J. Deuth and W. D. McElhinny.

The company manufactures and imports incandescent lamps on a very large scale, having secured the output of two of the largest lamp factories in the country in addition to its own. The main offices and salesrooms occupy the entire eleventh floor of the Fifth National Bank Building, 131-133 East 23rd Street, New York City, and agencies are being established throughout the United States. Two large warehouses are maintained in New York City, in which a minimum stock of 200,000 lamps is kept. A number of supply stations have also been established in other cities, each carrying large stocks.



E. J. Deuth

The sales force is headed by Mr. E. R. May, assisted by Mr. Thomas Magiff. At the present time there are about twenty salesmen in New York City and surrounding territory.



**Portland, Ore., to Have Municipal Plant**

According to tentative plans, the city of Portland, Oregon, will install an electric lighting system. It is proposed to construct a hydro electric generating station on Bull Run River, in connection with an impounding dam which will soon be necessary for the conservation of the city's water supply. Approximately 4,000 hp. can be developed at a cost of \$200,000.



**Obituary**

Dr. Eric Gerard, director of the Montefiore Electrotechnical Institute at Liège, Belgium, and professor at the University of Liège, died in Paris, France, on March 27th. Dr. Gerard was one of the most prominent professors of electrical engineering in the world. He was born in Liège in 1856 and graduated from the School of Mines in that city in 1878, afterward going to Paris to complete his studies. He later occupied several positions in the School of Mines at Liège and in 1883 was made director of the Montefiore Electrotechnical Institute in that city, where he taught for thirty years. He represented Belgium at the International Electrical Congress of Chicago in 1893 and of Paris in 1900 and was also president of the Belgian Committee of the International Electrotechnical Commission. He was a very able writer, confining himself to technical subjects, and his "Lessons on Electricity in Magnetism" have been translated into many languages. He will be mourned by many friends in this country as well as in Europe.



Mr. Charles Fowler Baldwin, of Montclair, N. J., died in Pittsburgh, Pa., April 9th, aged 41 years. Mr. Baldwin was associated with the Western Electric Company for nineteen years, and served as chief engineer for that company in Antwerp and London.

Mr. William H. Capel, secretary of the New England Westinghouse Company, and the J. Stevens Arms & Tool Company, of Springfield, Mass., died suddenly on Sunday, April 23rd just after he had entered his automobile on his way home from church. The cause of his death was a cerebral hemorrhage.

Mr. Capel was born in New York City March 8th, 1867, and married Marie B. Bischoff March 4th, 1900. In April, 1899, he entered the employ of the Westinghouse Electric & Mfg. Company, holding several positions in the executive offices of this company in New York City, having been for several years past closely associated with Vice-President L. A. Osborne. On June 2, 1915, he was elected secretary of the above mentioned companies.

His geniality, generosity and wide sympathy won for him the esteem of everyone who came in contact with him.

Mr. Capel is survived by his wife and daughter.

\* \* \*

Dr. C. J. Woodbury died in Lynn, Mass., on March 20th. In his earlier years he made exhaustive studies of electric lighting, lubricating oils and measures for fire prevention, at which time he made regular contributions on these subjects to the journal issued by the National Electric Light Association. From 1894 until 1907 he was assistant engineer of the Bell Telephone Company. He received the John Scott medal for the preparation of insurance rules on electric lighting. He was born in Lynn in 1851 and graduated from the Massachusetts Institute of Technology in 1873. At the time of his death he held honorary degrees from Tufts, Union and Dartmouth colleges.

### Among the Associations

The annual meeting of the National Association of Manufacturers will be held on May 15, 16 and 17 at the Hotel Waldorf-Astoria, New York City. Local industrial conditions will be discussed in fifteen minute talks and export trade will be featured in an elaborate round-table discussion.

\* \* \*

The annual meeting of the Electrical Contractors of Texas will be held in Galveston on May 17 and 18.

\* \* \*

The Southwestern Electrical and Gas Association will hold its annual convention at Galveston, Texas, May 17-20. Secretary H. S. Cooper, 405 Slaughter Building, Dallas, Texas.

\* \* \*

The twenty-first annual convention of the International Association of Municipal Electricians will be held at Baltimore, Md., August 22 to 25. W. J. Canada, of the Bureau of Standards will represent the government. Dr. Charles P. Steinmetz will deliver an address.

The fourth annual meeting of the Society for Electrical Development was held in the Engineer Societies Building, New York City, on May 9th.

\* \* \*

The Missouri Association of Public Utilities will be held May 11-13 on board boat leaving St. Louis May 11. Secretary F. D. Beardslee, 315 No. Twelfth St., St. Louis, Mo.

\* \* \*

The sixth annual meeting of the Electric Power Club was held at Hot Springs, Va., on May 1, 2, 3 and 4, at the Homestead Hotel. Chas. Robbins read a paper on "Motor Ratings" on May 1st.

\* \* \*

Mr. C. A. Call, lately connected with the Advertising Department of the General Electric Company has been appointed manager of publicity for the Terry Steam Turbine Co., Hartford, Conn.

\* \* \*

Mr. W. H. Wood has transferred his services from the American Writing Co., Holyoke, Mass., as manager of the steam boiler plants, to the Electrical Department of the Baltimore & Ohio Railroad, having been appointed superintendent of power plants, with headquarters at Baltimore.

\* \* \*

The following officers were elected at the recently formed organization of the State of Washington Electrical Contractors and Dealers: President, W. H. Byers, of Nepage, McKenny & Company; vice-president, S. M. Jones, of John A. Roeblings Sons Company, and secretary-treasurer, Roy Worth, of the Pacific States Electric Company.

\* \* \*

The Electrical Dealers' and Contractors' Association of Ontario, Canada, will hold its second annual convention at Toronto, on June 5, 6 and 7th.

\* \* \*

The membership of the Cleveland (Ohio) Electrical League now numbers 1200, 702 names having been added in the recent membership campaign.

\* \* \*

"General Problems of Illumination Design" was the title of an address given by Dr. Charles P. Steinmetz on April 6th before the New York Section of the Illuminating Engineering Society.

\* \* \*

The annual convention of the Arkansas Association of Public Utility Operators will take place June 6-8 at Little Rock, Ark.

\* \* \*

National Electrical Contractors' Association of the United States will hold its annual convention at the Hotel McAlpin, New York City, July 18 to 22. G. H. Duffield, secretary, 41 Martin Building, Utica, N. Y.

## BAKELITE-DILECTO The perfect insulating material for high tension work.

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# BUSINESS OPPORTUNITIES

## Alabama

Birmingham.—The construction of a municipal electric light plant is contemplated, for which purpose the City will vote June 5th on \$500,000 bonds.

Birmingham.—The Birmingham Interurban Development Company recently capitalized with \$5,000 will build an electric railroad from Birmingham to the Warrior River and Jasper by way of Dora and Cordova. W. W. Shortridge, secretary.

Decatur.—City will construct an electric light plant and will vote on \$50,000 bond issue; plant to cost \$28,000, wiring, etc., about \$16,000.

Opelika.—The construction of a power-transmission system from the Goat Island hydro-electric plant to Opelika, 22 mi., is contemplated by the Columbus Power Co., of Columbus, Ga.; estimated cost \$80,000 to \$90,000.

## Arkansas

Bentonville.—City is having plans drawn for electric-light plant to cost approximately \$20,000.

Mountain Home.—The installation of a large plant is planned by the Mountain Home Electric Light Co., who anticipate supplying Cotter, 12 miles distant, and other towns with electrical service.

Tuckerman.—The installation of an electric light plant is being planned by the Citizens' Light & Power Company.

Warren.—The installation of an electric-light plant in Warren is under contemplation. L. J. Burbridge is interested.

## Arizona

Shumway.—R. C. Smith is contemplating the installation of an electric plant to supply electricity in the towns of Snowflake, Taylor and Shumway.

Tucson.—The construction of a central power and heating plant at the School of Mines, University of Arizona, is being planned. The estimated cost, including equipment, is \$95,000. R. S. King, Supt. of Construction.

## California

Fontana.—It is reported that the Fontana Power Company, recently capitalized at \$350,000, will develop a water power in the mountains to supply power in the Fontana district and adjacent territory.

Los Angeles.—A municipal electric distributing plant will be erected at St. John and Holly Streets; estimated cost \$60,000. Frederick L. Roehrig, architect.

San Pedro.—The installation of ornamental street lights on Sixth St. between Beacon and Pacific Avenues is being planned; a lamp every 120 feet and four lamps at each street intersection.

## Florida

Cocoa Grove.—The Cocoa Grove Public Utilities Company, recently capitalized at \$25,000, are planning the installation of an electric plant.

Lake Hamilton.—The Electric Co., E. C. Stuart, president, Bartow, Fla., has obtained franchise to build an electric light system.

Miami.—The Miami Traction Company is contemplating extending its lines. B. B. Tatum is president of the company.

Port St. Joe.—It is reported that plans are under consideration for equipping the Apalachicola Northern Railroad for electrical operation.

## Illinois

Bloomington.—The Bloomington & Normal Railway & Light Company will erect a 33,000-volt transmission line from Lexington to Chenoa, a distance of about nine miles, construct a substation in Lexington and rebuild the distribution in that village, to operate at 2,300 volts.

Dixon.—The Illinois Northern Utilities Company, of Dix-

on, is planning to install a 1,000-kw. turbine, 200 5-kw and 100 3-kw. 2300—220—110-volt transformers; 12 50-kw., 12 25-kw., 6 10-kw. and 6 5-kw., 13,200—2300-volt transformers and 1500 5-amp. meters and also 500 electric ranges.

Rockford.—The Rockford Electric Company contemplates installing a 6250-kw. turbo-generator set, a 1000-kw. motor-generator set, boilers having a combined rating of 1000 hp.; and have also under advisement additions to water-softening plant and extensions to distributing system.

## Indiana

Peru.—The City Council are considering plans to extend the electrical service of the municipal-light plant to Bunker Hill.

Richmond.—Bids will be called for on an ornamental lighting system for Main Street. The cost will be approximately \$11,000.

Rochester.—The Rochester Light, Heat & Power Co. contemplates the erection of a 4,600-volt single-phase transmission line to Fulton, a distance of six miles, using No. 6 bare copper wire. Chas. A. Davis, Supt.

## Iowa

Bloomfield.—Two 150-hp. or three 100-hp. boilers will probably be installed in the municipal electric light plant this summer. R. C. Bristow, City Treasurer.

Guttenberg.—The Hope Electric Light Company is contemplating the installation of a new 100-hp. boiler soon. Edmund E. Williams is manager.

Maquoketa.—The Maquoketa Light & Power Company has under advisement the installation of a feed water heater, stokers, a 100-kw. generator and engine, directly connected, and lightning arresters.

Perry.—The Iowa Railway & Light Company, who own the local electric light and heating plant will construct a new power plant here at an estimated cost of \$100,000. The power generated will also be transmitted over high tension lines to Rippey, Grand Junction, Dana, Paton, Bouton, Woodward, Coon Rapids and possibly other towns.

## Kansas

Harveyville.—The B. B. Fegan Company, of Junction City, has obtained a franchise to install an electric light plant here.

Kansas City.—It has been decided to extend the electric lighting system into the residential section not now served with electricity, for which purpose it is proposed to transfer \$20,000 of the earnings to the extension fund.

Preston.—The issuing of \$15,000 bonds has been authorized for the erection of an electric light plant.

Roseville.—A franchise has been granted to the B. B. Fegan Company of Junction City, to install an electric light plant here.

Yates Center.—The erection of a municipal electric-light plant and water-works system is being contemplated, for which purpose a bond issue of \$70,000 will be voted on.

## Kentucky

Cynthiana.—The construction of a municipal electric-light plant is under consideration. Address the mayor.

Horse Cave.—The Horse Cave Light & Ice Company has been incorporated with a capital of \$25,000 being an amalgamation of the Horse Cave Light Company and the Horse Cave Ice Company.

Lexington.—City is considering plans to install electric-light plant. J. W. Guyn, city engr.

Kuttawa.—The Cumberland Electric Co. has been incorporated

with a capital stock of \$3,500 by B. W. Doon, M. J. Beard, D. A. Doon and W. M. Bearn.

#### Louisiana

Glenmora.—An electric light plant will be built here at an approximate cost of \$12,000 by S. Farmbacker, of Baton Rouge, L. Livy and P. Joseph, who recently organized into a company.

West Monroe.—A proposal to issue \$45,000 in bonds to improve and make extensions to electric-lighting system, water-works, install filter plant and additional apparatus for fire protection will be submitted at an election on May 18th.

#### Maryland

Belair.—The Belair Electric Company is planning the construction of an 11-mile, 3-phase transmission system.

St. Michaels.—A municipal electric-light and power plant will be erected here in the near future. Address the mayor.

#### Massachusetts

Plymouth.—The Plymouth Electric Light Company will erect a three-phase, 22,000-volt transmission line to Middleboro, a distance of twelve miles. Bids are invited for the material required. E. P. Rowell is manager.

Worcester.—The Worcester Electric Light Company is contemplating extensive improvements, including additions to building, installation of a Westinghouse 20,000-kw., 13,200-volt turbine extensions to ornamental lighting system (175 6.6-amp. magnetic arc lamps) and additions to the 13,200-volt underground cable transmission system. F. H. Smith is assistant manager.

#### Minnesota

Hartland.—A bond issue has been authorized for the construction of a municipal electric lighting plant.

St. Paul.—The West Thomas Street Improvement Association is planning a new electric lighting system. J. P. Garvey, 1230 Thomas St. is president.

#### Mississippi

Baldwyn.—City recently voted \$10,000 bonds for electric-light improvements and water works system.

Goodman.—Plans for the construction of a municipal electric light plant to cost about \$5,000, are being prepared by Xavier A. Kramer, consulting engineer, of Magnolia.

#### Nebraska

Bancroft.—Bonds will be issued for the erection of a municipal electric-light plant.

Kearney.—Permission has been granted to the Kearney Water & Electric Power Company by the State Railway Commission to issue \$200,000 in bonds.

Omaha.—Elevators will be installed in the City Hall at an estimated cost of \$28,200. Address City Clerk.

Trenton.—A municipal electric-lighting plant will be constructed, for which \$8,500 bonds have been authorized.

#### New Jersey

Bayonne.—A committee has been appointed to obtain data for a private electric power plant to supply electricity for the proposed new street lighting system to be erected along Broadway. N. J. Steinberg, K. D. Brown, Frank Davis and Charles Grotzky are members of the committee.

Dover.—The Morris County Traction Company, of Morristown, contemplates installing a new rotary transformer equipment in its substation near Dover.

Jersey City.—The installation of a new street lighting system along Grove St. is being planned.

Long Branch.—The business section of this city is to have a new street lighting system. Ornamental standards carrying single lamps or three-lamp clusters will be used.

Trenton.—The Trenton Water Power Company have prepared plans for the construction of a hydroelectric power plant on the Assunpink Creek.

#### New York

Batavia.—Plans are being prepared for the rearrangements of the municipal electric-lighting plant by Chester & Fleming, of Pittsburgh, Pa.

East Aurora.—The installation of a new electric street lighting system is contemplated. Address Mayor Brotherhood.

Fulton.—The Fulton Light, Heat & Power Company has been granted permission by the Public Service Commission to issue \$49,000 in capital stock for improvements and extensions to its power plant and distributing system.

Lewiston.—The Sanborn-Pekin Electric Power Company will erect an electric lighting system here.

Rochester.—A new street lighting system on Main St. East to University Avenue is being planned.

#### North Carolina

High Point.—City contemplates installing electric generating plant. Address the mayor.

University.—J. B. McCrary Co., Engrs., Atlanta, Ga., will receive bids in June for lighting and heating plant for the University of North Carolina; approximate cost \$50,000.

Raleigh.—A White Way at an estimated cost of \$34,000 will be constructed by the city; magnetic arc type lamps on 1-light standards will be installed, also ornamental luminous arcs, 500-candle power, at 25-ft. radius. Jos. E. Pogue, chairman of White Way.

#### North Dakota

Forest City.—It is reported that an electric-lighting system will be installed here at an approximate cost of \$10,000. A. B. Field, I. W. Poole and others are interested.

New Rockford.—The installation of a municipal lighting plant is under consideration.

#### Ohio

Columbus.—The Columbus Railway, Light & Power Company announces that it will build a \$375,000 power plant near the Scioto River.

Dayton.—The Dayton Power & Light Company contemplates issuing \$1,250,000 in bonds to be used for a new electric power plant and improvements to its present system.

Dayton.—The construction of a new power plant is contemplated by the Cincinnati, Hamilton and Dayton Railway Company, which, together with the cost of other improvements, will involve an estimated expenditure of from \$50,000 to \$75,000.

Deshler.—The installation of a municipal electric light plant and water works system is under consideration.

Kent.—Plans are being prepared for the erection of a municipal electric light plant.

Reading.—Bids are invited for the completion of the new public school. Separate bids to be submitted for the different branches of the work, including the electrical work. Awards will be made on May 22. Plans and specifications are on file at the office of the architects, Garber & Woodward, Cincinnati.

Sidney.—The installation of a municipal electric lighting plant is contemplated.

Youngstown.—The Youngstown & Niles Railroad Company has made application to the State Utilities Commission for permission to issue \$100,500 in capital stock, the proceeds of which are to be used for the construction of an electric railway between Youngstown and Warren.

#### Oklahoma

Howe.—The construction of a municipal electric-light plant and water-works is under consideration, for which purpose the city will vote \$100,000 bonds.

Kusa.—Kusa Ice, Light & Power Co. has secured articles of incorporation, capital \$25,000, John G. Goshorn, of Henrietta, Okla.; Dan F. Seryey, of Iola, Kans., and Roscoe G. Clark, of Kansas City, Mo., being the incorporators.

New Wilson.—For an electric-light plant and water-works construction the city will issue \$25,000 bonds.

Verden.—The Chickasha Gas & Electric Co., Chickasha obtained franchise to supply electric lighting and will construct 3-phase, 6600-volt transmission line from Chickasha to Verdin.

#### Oregon

Baker.—It is reported that an electric railway from Pine, 15 miles long, and from Baker to Eagle Valley, approximately 75 miles, will be constructed. Alex. Allerdyce is interested.

Grant's Pass.—The construction of a hydro-electric generating plant on Fiddler's Gulch in the Kirby district, near Grant's Pass is under consideration. William H. Swalwell, of Everett, Wash.

### Pennsylvania

Millersburg.—Farley Gannett, consulting engineer, Harrisburg, has purchased the Millersburg Electric Light, Heat & Power Company. He will enlarge and improve the plant.

Marcus Hook.—The construction of a municipal electric light plant is being considered.

New Castle.—Contract for the construction of a new substation here has been awarded to the Stone & Webster Engineering Corporation, Boston, Mass., by the Mahoning & Shenango Railway & Light Company. Estimated cost of substation \$150,000.

New Brighton.—A new street lighting system for the borough is contemplated. H. C. Swoboda, consulting engineer, Empire Building, Pittsburgh, has been engaged to prepare plans.

### South Carolina

Ninety-Six.—A municipal electric-light plant will be erected, for which purpose city recently voted \$15,000 bonds. W. W. Gaines, mayor.

Saluda.—The Saluda Public Service Corporation has been capitalized with \$25,000, the incorporators being T. D. Fulmer and E. W. Abele. They will build an electric-light and power plant.

Summerton.—Plans are being made for the construction of a municipal electric light plant to replace the one burned some time ago.

### South Dakota

Clark.—The erection of a municipal electric-lighting plant is under consideration by the City Council.

Java.—A municipal electric-lighting system will be erected, for which bonds have been voted.

### Texas

Barstow.—An electric light plant will be installed by the Barstow Public Service Company; 100 hp. Tri-State Engineering Co., El Paso, Tex. engineer.

Lockhart.—An electric-light system, water works and ice plant will be constructed by the Citizens' Water, Light & Power Co. 100 kw. electric generating plant will be installed. Henry E. Elrod, Cons. Engr., 907 Southwestern Life Bldg., Dallas.

San Diego.—The San Diego Electric Co. has been organized to build an electric light plant. A site has already been purchased.

Shiner.—A municipal electric-light plant will be erected or purchased here, for which \$12,000 bonds have been voted.

Stockdale.—An electric-light plant will be installed here by G. A. Burris.

Victoria.—The construction of a municipal electric-light plant is under consideration. Address the mayor.

### Virginia

Mineral.—The installation of a municipal electric-light plant and water-works system is under consideration.

Richmond.—A \$50,000 bond issue is contemplated for the erection of a municipal electric-light plant.

### West Virginia

Mount Hope.—Application has been made for franchise to install an electric-light system by the Mount Hope Electric Power & Water Company.

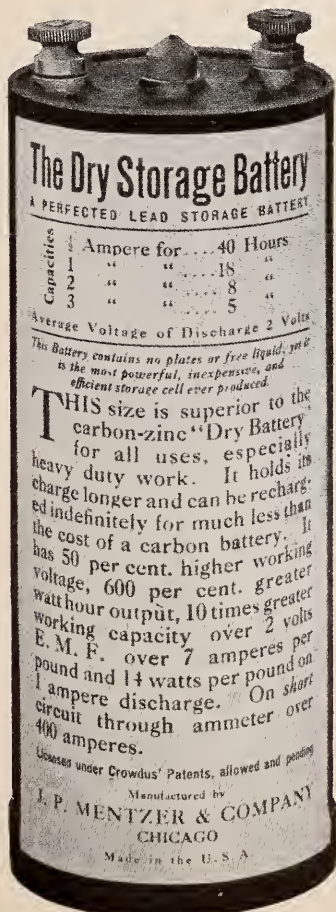
Wheeling.—Extensions and improvements to the city lighting system are being planned.

### Wisconsin

Lomira.—The power plant of the Lomira Electric Light & Power Company will be remodeled and a new generating equipment installed.

Ogema.—The installation of a municipal electric lighting system is under consideration.

Racine.—The Milwaukee Electric Railway & Light Company contemplates the erection of a boiler house, three stories high, on Lake Avenue and will install three boilers.



## 300 Times More Service than seven No. 6 Dry Cells is rendered by The Mentzer Dry Storage Battery

Yet the initial cost is only \$2.50, forty cents more than the seven old style batteries. To get this given amount of service from dry cells would cost \$630, whereas the Mentzer Dry Storage Battery performs this work for \$17.50, including recharging.

This important feature makes the Mentzer Dry Storage Battery

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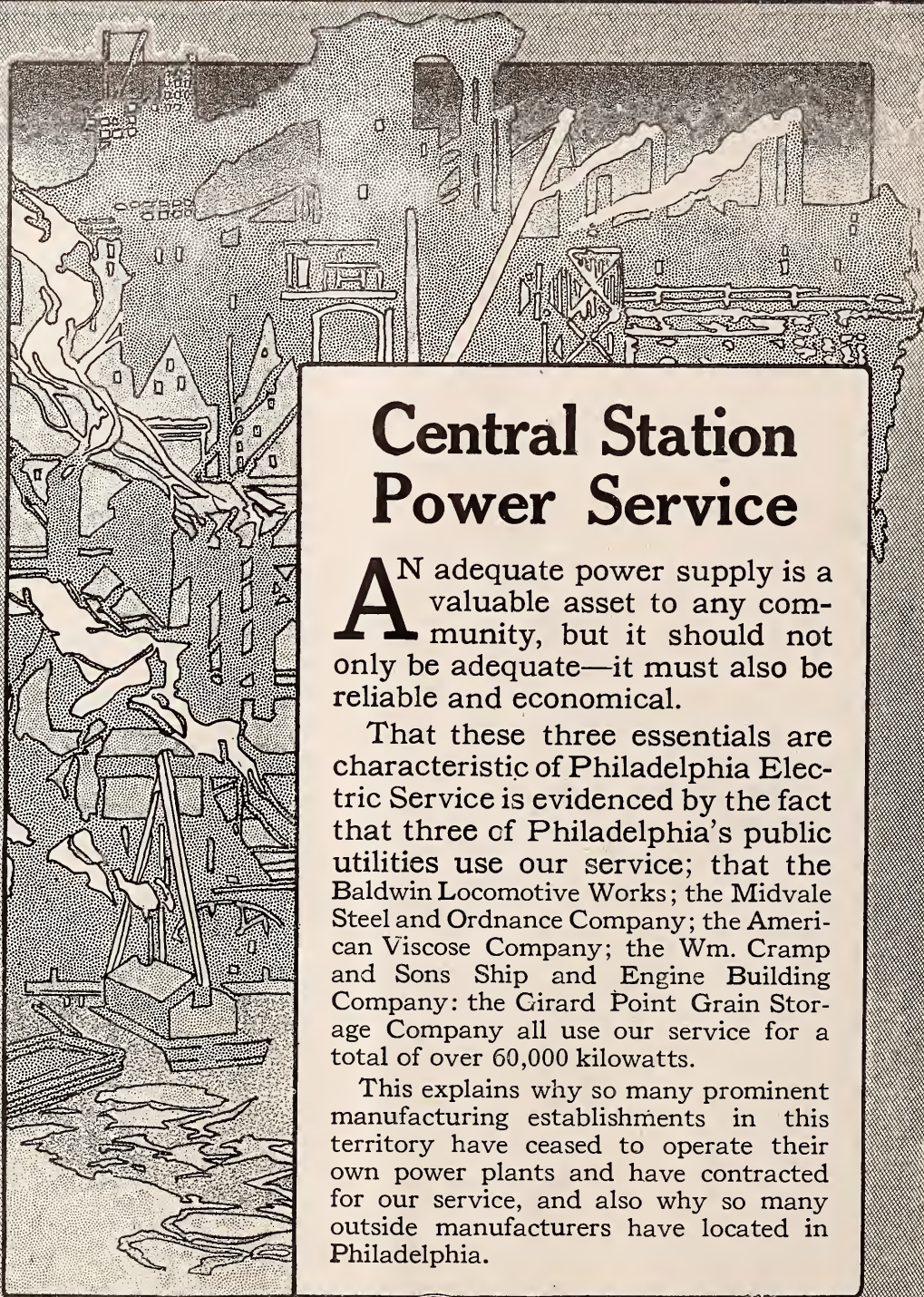
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Corn Exchange Bank Bldg.

CHICAGO, ILL.



## Central Station Power Service

**A**N adequate power supply is a valuable asset to any community, but it should not only be adequate—it must also be reliable and economical.

That these three essentials are characteristic of Philadelphia Electric Service is evidenced by the fact that three of Philadelphia's public utilities use our service; that the Baldwin Locomotive Works; the Midvale Steel and Ordnance Company; the American Viscose Company; the Wm. Cramp and Sons Ship and Engine Building Company; the Girard Point Grain Storage Company all use our service for a total of over 60,000 kilowatts.

This explains why so many prominent manufacturing establishments in this territory have ceased to operate their own power plants and have contracted for our service, and also why so many outside manufacturers have located in Philadelphia.

The PHILADELPHIA



ELECTRIC COMPANY



# ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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Vol. 48

JUNE, 1916

No. 6

## Electrical Equipment of the William Penn Hotel

Many Ways in Which Electricity Aids Service of Pittsburgh's New Hostelry

By Paul B. Findley

If we compare the present-day hotel with its predecessor of fifty years ago, we shall find, on going behind the mere externals of modern grandeur that the needs of our grandfathers for food and shelter were met almost as well as are our own. The chief improvement has been in those little niceties of service which are so well and unobtrusively done that they usually escape our attention. When we remember that these refinements have been added in the fact of constantly increasing difficulties of supervision, the result is all the more remarkable. The hotel which cares for 200 guests has been superseded by one which houses 2,000; the number of servants increases tenfold, and the distances also increase proportionally. "Service" requires quick communication and transportation, and that means "do it electrically."

The William Penn Hotel, in Pittsburgh, is one of the very best examples of the use of electricity in hotel service. The new hotel occupies a plot of ground 216 by 129 feet, being the block on William Penn Place from Sixth Avenue to Oliver Avenue. There are 24 floor levels from the second sub-basement to the machinery room on the nineteenth floor. Everywhere from the sump-pump fifty feet below, to the electric sign 250

feet above the sidewalk, the electrical way predominates.

To central station men the hotel's power and heat supply is of much interest. On account of the large amount of steam required in hotel service an isolated plant has been the usual source. After careful study arrangements were made with the Duquesne Light Company and its subsidiary, the Allegheny County Steam Heating Company, whereby these two corporation leased quarters in the basement of the hotel. This space, which has no communicating passages to the hotel, contains four 600 h. p.

boilers which burn natural gas, but also are equipped for burning coal. There is also an electric substation which includes three 250 kw. single phase transformers, 11,000 to 220 volt three-wire for lighting and three 250 kw. single-phase transformers, 11,000 to 2,200 volts, through which power is delivered to one or more of three 200 kw. motor-generator sets which deliver direct current at 220 volts three-wire for motors. The bus-bar and switch structures are built of concrete and asbestos lumber; their design presented a difficult problem as the space available was small. While the substation serves only the hotel at present, addi-



tional apparatus will soon be placed to care for a number of adjacent buildings.

As will be seen from the picture of the hotel, the floor plan above the nominal "first floor" is like the letter "E." From the house switchboard lighting and power feeders ascend two wire shafts located in the two wings. From the panel boxes on each floor conduits take the wires to the outlets. In the machine room in the second sub-basement there are, in addition to the main switchboard, pumps for water, vacuum-cleaning and refrigeration.

The first sub-basement contains locker-rooms and servants' dressing rooms. In the basement, which is but a few feet below the level of the William Penn way sidewalk are the bar, the mens' lounge and the

hotel is the kitchen. This is really a manufacturing plant in which quality of output and speed of service are paramount. In the William Penn Hotel there are three kitchens—the main on the mezzanine floor, the banquet on the 17th floor and the grill, adjacent to that room in the basement. There is also a small serving-kitchen connected with the servants' cafeteria on the 18th floor. All the equipment was designed and installed by the Bernard Gloekler Company, of Pittsburgh. Power-driven machines were equipped with 220 volt direct current motors of Westinghouse make, as follows:

Cake mixer, 2 h.p.; potato masher, 1 h.p.; dough mixer, 3 h.p.; puree machine,  $\frac{1}{2}$  h.p.; bread crumber,  $\frac{3}{4}$  h.p.; potato peeler, 2 h.p.; meat cutters,  $\frac{3}{4}$  h.p.; choppers, 1 h.p.; cheese grater,  $\frac{1}{2}$  h.p.; coffee mill,  $\frac{3}{4}$  h.p.; dish washers, 3 h.p.; grindstone, 1 h.p.; silver polishers, 3 h.p.; knife buffer, 1-20 h.p.; steel-knife polisher, 1 h.p.

Natural gas is used for the ranges and ovens, and high-pressure steam is used for soup-kettles, etc. Low pressure steam is used for warming-cabinets. Dishes are washed by being placed on edge in trays which run through a machine on an endless wood-block chain floor. They are squirted with hot soapy water and live steam and later rinsed with clean hot water. The heat absorbed is sufficient to dry them without toweling.

#### Refrigeration

The "backbone" of the refrigerating plant, which was installed complete by the Pennsylvania Engineering Company of Philadelphia, consists of two fifty-ton ice machines, each driven by a 90 h.p. motor, with speed adjustment from 225 to 450 r. p. m. The ammonia system is used. Drinking water is cooled by direct contact with the expanding gas; for ice cream making, brine at 0 deg. F. is used, circulated by duplicate reciprocating pumps driven by  $1\frac{1}{2}$  h.p. motors. The ice cream machines are of both the French and the dasher type, and are driven by 2 h.p. motors. For all other purposes brine at 10 deg. F. is used. There are a total of 62 refrigerators, divided into two systems—those up to the fifth floor and those above. For the lower system the duplicate centrifugal circulating pumps are driven by  $7\frac{1}{2}$  h.p., 1,100-2,200 r. p. m.; the upper system is cared for by duplicate reciprocating pumps driven by 1.5 h. p. 900-1800 r. p. m. motors. Ice for table and bar use is manufactured to the extent



*A Glimpse of the Main Lobby*

cafe. These are finished in the oak and brown leather of the Elizabethan period. The lobby on the main floor is Italian Renaissance, with black, dark green and gold, with gray rugs and green upholstery. To the left is the main restaurant, in Italian Renaissance and to the right the pearl gray and white Georgian dining room. The offices are at the rear under the mezzanine floor. Both restaurants on this floor are served from the main kitchen which occupies the mezzanine. The parlors and State Suite occupy the next floor, while from the "first" to the "sixteenth" floors are bedrooms. There is no "thirteenth" floor nor no "Room 13" on any floor. The seventeenth and eighteenth floors contain the ballroom, reception rooms and large private dining-rooms. On the nineteenth floor are the telephone exchange, tanks and elevator machinery.

Perhaps the most important single department of a

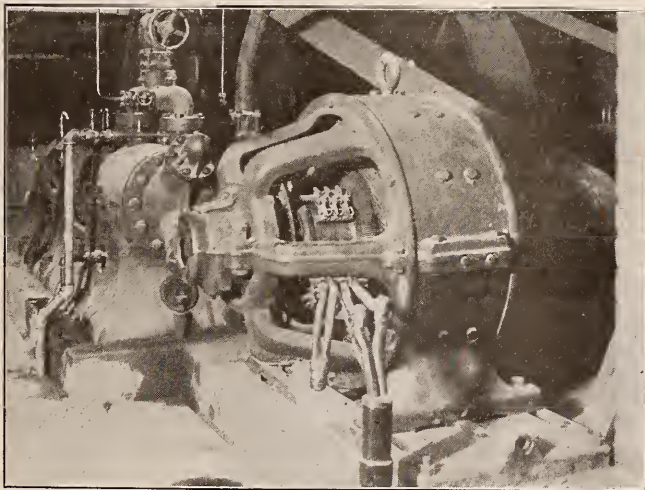
of 9,000 lbs. daily by a 10-ton plant using the raw-water system. A crusher, a shaver, and a cuber, each driven by a 2 h.p. motor prepare the ice for use.

### Pumping Machinery

All water for the hotel comes from the city mains and is filtered before use. The city pressure of 80 lbs. normally carries the water to the fifth floor; a centrifugal pump of 200 gal. per min. capacity against a head of 33 feet is held in reserve. It is driven by a 10 h. p. motor of 1970 r. p. m. For the upper floors there are two pumps, each of capacity for 350 gal. per-min. against a 317 ft. head. Each is driven by a 50 h.p. motor at 1,700 r.p.m. Water is heated to about 180 deg. F. by steam coils; a return-pipe system insures "no-waiting" for hot water. This service requires four centrifugal circulating pumps driven by 5 h.p. motors of which two are in reserve. The warm water from the ammonia condensers is pumped into this system.

Fire protection is supplied by two centrifugal pumps driven by 75 h.p., 1,700 r.p.m. motors. A 50,000 gallon tank on the 19th floor provides for emergencies; there is an automatic bell and lamp alarm for high and low water.

Compressed air at 30 lbs. for barber-shop, pneumatic tubes, sewage ejection, etc., is supplied by two compressors, each belted to a 25 to 35 h.p. adjustable-speed motor. Sewage is ejected automatically, and there is also an automatically-controlled sump-pump for removing engine-room waste-water. Automatic control-



*One of the motor-driven ammonia-pumps*

lers for all pumps were installed by the Sundh Electric Company of New York City.

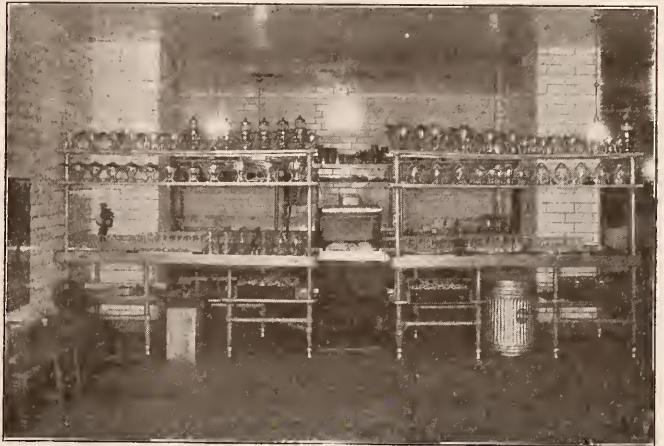
### Ventilation

To keep working-places cool and fresh and to prevent odors from penetrating to the public parts of the building, 28 blowers have been installed, principally on the 19th floor. The various motors have a speed adjustment of two to one, thus providing a large increase in the volume of air when needed. Certain

parts of the building receive washed and heated air through spray-type tempering rooms. Heating of guest-rooms is by low-pressure steam.

### Elevator Service

There are six main passenger elevators installed by the Otis Elevator Company. These are of the 1:1 ratio gearless traction type, capacity 2,500 lbs. They have a travel of 236 feet, and serve all floors from the



*A dish-washing machine and its racks*

basement to the eighteenth. The motors are 39 h.p. 240 volt, 58 r.p.m. The controllers are of the magnetic type and have overload and no-voltage protective relays, and protection from over-travel. Each car is equipped with the Otis electro-mechanical safety device. For service purposes there are two passenger elevators which have a travel of 258 feet, serving all floors. Electrically and mechanically they are practically identical with the others. Trunks are taken from the Oliver Avenue sidewalk to the storage level in the second sub-basement on an Otis winding-drum type elevator. This has a capacity of 3,300 lbs. and is moved at 350 feet per minute, by a 40 h.p. motor through worm-gear drive. An identical elevator on the Sixth Avenue side carries food supplies to the refrigerators and storage rooms. Freight of all sorts is handled by a traction-type elevator roped 2 to 1, which travels between all floors. It has a capacity of 3,300 lbs. at 450 feet per minute and is driven by a 43 h.p. motor.

### Electric Dumb-Waiters

One of the most interesting installations is the group of four electric dumbwaiters which run between the main kitchen and the service stations on various floors. These were installed by the Burdett-Rowntree Manufacturing Company and have a capacity of 200 lbs. at 300 feet per minute. Control is from one point only—the main kitchen. When the door in front of a car is closed, the operator presses a button which designates the floor to which the car is to go. The car starts and on its arrival a bell rings until the shaft door is opened. As long as it is open the car is immovable; as soon as it is closed the car returns automatically to the kitchen. Two of these cars run to the banquet

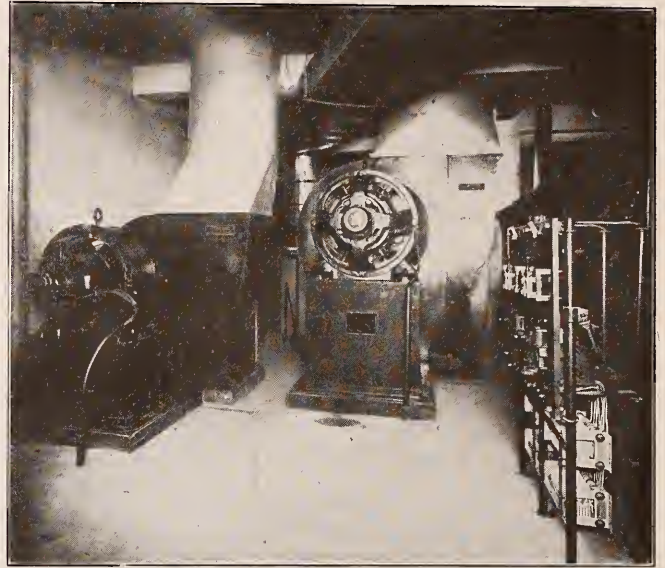
kitchen on the 17th floor. There are two similar dumb-waiters which run between the main kitchen and the store-rooms and butcher-shop in the basement. These have control-buttons at each end of their run.

#### Illumination

The lighting of any interior is an essential part of the scheme of interior decorations. In designing the fixtures for the main lobby and the Italian restaurant adjoining it, the makers, Edward F. Caldwell & Co., used direct lighting. This was on account of the dark ceiling and walls and the deeply paneled surface of the former, all of which reduced the light reflected to a small fraction of that produced. The general illumination of these rooms is from two large crystal chandeliers roughly spherical in outline, suspended well above the line of vision. Local illumination is given by pedestal, table and bracket lamps shaded in various ways. The Georgian dining room is illuminated in a similar way, as is the ballroom. The fixtures in the bedrooms are also for direct lighting, as it was felt that a more satisfactory illumination could be secured at less cost both for current and for maintenance than with semi-indirect lighting. In general, each room has a fixture carrying three arms close to the ceiling from which hang opal globes containing one 25-watt clear lamp. On each bed, a simple bracket is fastened to the high Georgian head-piece; this carries a 15-watt frosted lamp. Current is supplied through a cord and plug from an outlet in the base-board. Should the bed be taken down for storage, the plug is taken off the cord; a single screw releases the bracket, and it is wrapped up with the cord and plug for future use. A bracket arm on each side of the dressing-table mirror carries a frosted Style B candelabra lamp; the wires from each go to a junction box on the back of the dresser from whence a flexible cord. These fittings are also readily removed when necessary. On each writing-table is a small lamp with an opaque metal shade; glass below it allows light from the 15-watt clear lamp to be thrown directly on the writing surface.

The finish of the "standard" fixtures is dull gold. Other portable lamps are provided as the furnishings demand.

In each room additional outlets are provided to supply curling irons, fans, etc



*Ventilating Fans on the 19th Floor*

In the corridors of the guests' and public portions of the hotel are fixtures carrying an etched opal ball close to the ceiling. Each contains a 25-watt clear lamp. Emergency circuits are run direct from the main switch-board to sufficient lamps to make exit easy in case of fire; these lamps burn continuously, no switches being placed in the circuits. Although they are normally fed from the a.c. lighting buses, a relay is provided to connect them automatically to the d.c. power buses in case of a failure of the former source.

The service-quarters are lighted by single-lamp units consisting of ten-inch deep opal globes directly beneath the ceiling. Lamps of from 25 to 150 watts are used as the case demands.

*(To be Continued)*



*Pumps and Controllers in the Basement Machine Room*

# National Electric Light Association

## Thirty-ninth Convention

With an address by Mayor Thompson of Chicago, the thirty-ninth convention of the National Electric Light Association opened on Tuesday morning, May 23. In bidding the visitors welcome, Mr. Thompson spoke of the increasing part which electricity plays in modern life, due not only to the advance of the art but to the reductions in rates made by far-sighted utilities. Following mayor, President E. W. Lloyd delivered the annual address, in which he mentioned briefly the forward steps taken by the industry and the association during the year. In suggesting the lines of future progress, Mr. Lloyd mentioned the proposals as to the meetings of geographical sections with other societies, the addition to the association staff of rate and valuation experts to be at the service of members, and the possible change of name of the association to one which would be more expressive of its purposes.

The present status of the membership was given by Assistant Secretary Sewall, who reported the additions for the year to have been 120 Class A members, 3,579 Class B; 19 Class C; 27 Class D; 93 Class E; and 14 foreign members. The merger of the Electric Vehicle Association added 1,139 members, and the total now stands at 14,983.

Reports on other activities of the executive staff of the association occupied the balance of the session.

### First Technical and Hydroelectric Session

This session was held on Tuesday afternoon with Vice-President H. A. Wagner in the chair. After his outline of the past and future work of the section, Mr. C. D. Durfee presented the report of the committee on Meters. The discussion brought out various modifications in testing methods which would make savings in time and current consumption. Mr. E. R. Weeks then read a paper condemning the killing of animals by electricity as being needlessly painful. His opinion was supported by letters from Kennelley, Sprague, Mailloux, Steinmetz, Edison, and Elihu Thompson. The discussion on the report of the committee on Terminology developed a disfavor to the proposed list of illuminating terms as they did not correspond to those now in use by other organizations. A paper by D. W. Roper on lightning protection for transformers showed that where good grounds could not readily be obtained on account of soil conditions, the cost of protection by ordinary methods might easily become 25 per cent. of the cost of the apparatus.

### First Commercial Session

With Joseph F. Becker in the chair, the first report to the commercial section was that of the Committee on Publications. This suggested changes in the arrangement by which the printing and sales work should be handled by a publishing house, thus leaving the committee free of burdensome detail.

In the discussion of the report of the Wiring Committee the effect of the increased cost of wiring was commented on as tending to prohibit the use of electricity. The adoption of a universal type of attachment-plug was also favored. Mr. W. H. Blood gave a history of concentric wiring and a statement of the present situation regarding its use. He stated a sub-committee had prepared rules for the manufacture and installation of this type of wire and fittings. However, these rules are tentative, and there was no desire to enforce them, being

merely offered as a basis to work upon. Mr. R. S. Hale, in answer to questions on the anticipated reduction to be gained by use of concentric wiring, stated that average figures could not be given since the cost depended on the type of building in which the installation was to be made. He cited a number of installations in Boston that had come to his attention and gave the percentage cost reductions over conduit and knob-and-tube wiring.

The report of the Committee on Merchandising provoked a lively discussion concerning special sales of sea-



*The Association's New President:  
Herbert A. Wagner*

sonable devices and the necessity of maintaining such devices in order to keep them in service.

### First Accounting Session

The principal business transacted at this session was the receiving of reports on various phases of standardization of accounts. A resolution was adopted recommending that all public service commissions and other regulatory bodies having supervision of the accounts of public service companies, standardize as far as practicable their accounting schedules and form of annual report required from utilities.

### Second General Session

At this session Mr. W. W. Freeman presented the report of the Committee on Public Policy. President Lloyd occupied the chair.

### Second Commercial Section

The report of the Committee on Education showed that employees of 150 companies were taking the correspondence course for electrical salesmen. Of the 1082 subscribers, only about 65 per cent. are connected with commercial departments of central stations; the remainder are trying to familiarize themselves with the work for future use. It was recommended that a course be prepared on the fundamentals of electricity and magnetism for men not technically trained. The consensus of the discussion was that it takes men of great determination, assisted by co-operation from the central station companies, to complete the course. It is only necessary to have the men pay for at least a part of their course in order to appreciate its value. The offering and "promotion" of such courses will reveal men of unsuspected ability in central station forces.

Following the report of the Lamp Committee, which covered the general developments in incandescent lamps during the year, in particular of the development of a lamp for moving-picture machines, the discussion touched upon the desirability of the standardization of voltages and the elimination of carbon and gem lamps with a view to reducing the manufacturing costs. An investigation in Ohio showed the ease with which voltages of 110, 115, and 125 might be standardized in that State as 75 per cent. of the central stations and now use one or other of these voltages. The necessity for reducing glare by screening high-intensity lamps was touched upon.

### Second Accounting Session

The report of the Committee on Form of Annual Report brought out the necessity of standardizing the various schedules in order that they may be of real value to public service commissions, public service companies and the general public. Valuable suggestions by member companies brought out salient points of vital importance and in many instances show the seemingly unnecessary burden and expense a great many member companies must bear in order to furnish information required by their respective commissions, which information is apparently of little or no value. The aim of the Committee has been to simplify and standardize all schedules and submit for association approval a concise, concrete and standard form of annual report to be recommended to all public service commissions having control over electric utilities.

The methods of billing subscribers were discussed at length, especially devices for making a photographic or other record of meter readings. This method was favored at present for special cases only, such as demand-meters which are re-set monthly. The necessity for every possible saving was made evident by the enormous sum of \$10,500,000 expended each year for billing.

### Electric Range Session

The enthusiasm manifested at the meeting which took up the electric range situation was most striking. The committee's report emphasized need, in development plans, for advertising campaigns, for pushing of sales by the central stations, and for co-operation between the manufacturers and the central stations in the design, construction and the merchandising of electric ranges. Each central station will have to adopt the form of rate which seems best for its conditions. Household cooking and baking in restaurants, bake shops, etc., can be profitably handled on a three-cent rate; cooking in hotels, etc., requires a somewhat lower rate; water heating requires a

rate of one cent per kilowatt hour or less. Central stations must prepare to heat water electrically for a considerable number of their electric cooking customers. Present types of electric water heaters are efficient. Storage of hot water is generally very inefficient. A beginning only has been made in the solution of the water heating problem.

Mr. W. R. Putnam, of Salt Lake City, who presented the report, added that an investigation of electric cooking was made in a town of 8,000 population where about 42 electric ranges were installed. The average kilowatt-hour consumption per month was found to be 74.5 and the average price of the range installed \$90. A majority of the customers considered electric cooking cheaper than coal. The discussion called attention to the effectiveness of various advertising mediums, in particularly the Saturday afternoon and Sunday dailies. A co-operative plan by which the Union Electric Light & Power Company has agreed to absorb an amount up to 15, of the cost of any range installation made by contractors. This plan resulted in much activity being displayed by the electrical men in promoting the use of electric cooking.

### Third General Session

During the discussion of the report on Rate Research, the need for greater co-operation with the association was mentioned. President Lloyd stated that there was under consideration the plan of publishing as complete a compilation as possible of the rate, of electric light and power companies in cities of 40,000 population and over. This publication would be in loose-leaf form and would be revised every three months.

The report of the Committee on Constitution and By-Laws recommended amendment of the constitution to provide for the holding of meetings of geographic sections in conjunction with meetings of similar bodies in order to save time and travelling. Another change would allow, if the section chairman was unable to attend a meeting of the National Executive Committee, the might executive committee of the geographic section elect a representative, providing that no one representative, providing that no one representative thus elected would attend more than two meetings of the National Executive Committee. Another amendment would substitute for the word "income" of electric light and power companies the word "earnings" in computing association dues.

There was a general discussion of plans for increased activity and affiliation on the part of the sections, following which J. M. Wakeman, general manager of the Society for Electrical Development, gave a rapid survey of what had been accomplished by the Society with respect to Electrical Prosperity Week and the "Wire Your Home" campaign, and outlined some of the plans with regard to "America's Electrical Week" from December 2 to December 9.

### Second Technical Hydroelectric Session

On Wednesday afternoon this session discussed high-tension joints, in particular those on 19,000 and 25,000 volts made by the "Conducell" method. Federal legislation on water-powers was explained by Mr. Henry J. Pierce, who pointed out the need for more scientific legislation.

The proposed Electrical Safety Code drawn up by the Bureau of Standards came in for criticism as it was said to provide for construction which would never fail under any circumstances, and was too stringent to be practical. The electrical industry has been harried by excessive regulation in comparison to some more hazardous lines, and they should now receive the attention of government. Any increase in the cost of electrical construction must ultimately be borne by the public.

### First Electric Vehicle Session

At this meeting, also on Wednesday afternoon, after various reports had been received, Mr. Henry Salvat, of Chicago, read a paper on garage service. In this he stated that interference by the manufacturer of electric vehicles between owner and garage man had the result of irritating the owner and making him think that the electric vehicle is more delicate than the gasoline type. Then, too, he claimed that manufacturers discourage the attempts of the garage owner to sell supplies, taking away the profits of a by-product of the latter's service; also manufacturers do not give commissions on sales when leads are furnished by the garage owner. These tendencies do not exist in the relations with gasoline car manufacturers, the garage owner becomes discouraged with these conditions, together with small returns for electric-car service, and either the business is discontinued or the garage is converted to the care of gasoline cars exclusively, which, in turn, works to the detriment of the car owner and manufacturer.

Mr. Salvat mentioned the lack of newspaper and magazine "publicity" for electric cars.

### Second Electric Vehicle Session

This was held on Thursday morning, and included the presentation and discussion of reports on good roads, insurance, legislation, and the use of electric trucks in Federal and municipal transportation. Papers were read on the relation of tires to the efficiency of electric vehicles, on troubles of electric trucks, and on various industrial applications.

The last-mentioned paper gives an outline of the principal types in extensive use, the "electric stevedore" in lengths of 6 to 10 feet stated as having the most universal use. A short description is given of the electrical and mechanical features of this type. The various fields covered, the adaptations of the truck to local conditions and its possibilities are outlined and illustrated. The specific services for which the electric truck is applicable are so many that its increased use in large numbers is inevitable.

The advantages derived from a battery-service system are stated, and it is urged that service systems should cover not only battery maintenance but also chassis, body, tires, including painting as well as storage and washing. Experiences in connection with furnishing such service are given, together with advantage to the truck owner, and relations between central stations, manufacturers and garage owners in co-operating to give the service. The plan appeals strongly to the small user of trucks and aids in the sales and popularity of the electric vehicle.

### Third Commercial Section

The first item at this session, on Thursday morning, dealt with the work of the Power Sales Bureau, and recommended that its name be changed to Industrial Sales Bureau, and that it be divided into electrochemical, general power and railway, electric heating, and isolated plant subdivisions in order to prevent duplication of work. A paper by C. J. Carlsen on "Central-Station Service in the Manufacture of Ice," covered the subject in a general way, the object being to point out the great opportunities and possibilities for central-station service in this branch of industry as well as to present such practical working data as may be of value to prospective ice manufacturers and manufacturers of ice-making machinery and equipment, as well as to central-station interests.

The discussion developed the facts that as power can be saved more obviously where electric drive is used, closer supervision will be given to such economies. Advantages of the raw-water system was shown, as also the desirability of operating an ice-plant as a central-station

auxiliary. The committee on New Industrial Applications showed the necessity for co-operation between engineers and commercial men in the investigation of prospective customers' plants, and also that information as to processes, etc., be kept strictly secret. Industrial heating and its advantages were also discussed.

### Third Technical Session

A report and discussion on safety devices brought forward a new thin rubber glove which will stand 20,000 volts and yet does not impede the fingers. Attention was given to mechanical resuscitation devices and to the need for training of workmen in the prone-pressure method of resuscitation.

The phenomenal increase in size of steam turbines also came in for attention. The discussion of coal handling and the influence of moisture content on the fuel bill was of interest to steam-plant men. The Committee on Electrical Apparatus recommended a change of standard secondary voltages from 110 and 220 to 115 and 230. This, however, was opposed because of the desirability of having transformers interchangeable. A general discussion followed in which many points of interest were brought up.

### Third Accounting Session

Thursday morning's meeting opened with the presentation of a paper on "A Correspondence Course in Accounting" submitted by A. L. Holme and J. R. Wildman. This paper gave an outline of a course in accounting which it is proposed to give by correspondence to employees of member companies. This course is laid out for four years of which the first two are elementary, the third an intermediate and the fourth is an advanced course. The work of each year covers eight principal divisions. It was stated that, if 500 subscribers could be secured to take up this course, the annual cost per student would not be over \$15.

Discussion of this paper and election of officers consumed the rest of the session. The results of the election were as follows:

Chairman, J. L. Bailey, of Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; vice-chairman, Paul R. Jones, of H. L. Doherty & Company, New York City; treasurer, C. E. Calder, Dallas, Tex.; secretary, Frederick Schmitt, of New York Edison Company, New York City. Directors, J. H. Gulick, Chicago; R. W. Symes, Detroit; R. H. Ballard, Los Angeles; F. L. Hall, Providence; H. Spoehrer, St. Louis; W. E. Long, Philadelphia, and E. J. Allegaert, Newark.

### Fourth Commercial Section

Following the report of the Lighting Sales Bureau, Mr. Earle E. Whitehorn presented an excellent paper on "The way to make a Salesman." The qualifications which Mr. Whitehorn specified were:

- (1) good impression, principally a matter of clothes and face;
- (2) necessary general and special knowledge to secure the interest of the prospect;
- (3) personal contact, influence and acquaintance in the community;
- (4) ready command of all arguments and data of what he sells;
- (5) determination to secure the order at the first call, if at all possible;
- (6) self-confidence and willingness to take responsibility without calling in special assistance;
- (7) aggressiveness in developing new business on his own initiative;
- (8) maintenance of friendly relations with former customers and readiness to sell further service;
- (9) co-operation with electrical contractors, dealers and other electrical interests;
- (10) co-operation with his fellow salesmen.

*(Continued on page 64)*

# Equipment of Philadelphia Company's New Generating Station

(Continued from the May Issue)

The forebay, located at the face of the station wharf embodies recent practice in forebay construction for large generating stations, which includes motor-operated revolving screen for the elimination of small floating matter such as leaves, etc., together with heavy iron screens of "I" beam construction to prevent entrance of heavy ice or other floating matter. The feed water for steam boilers will be the pure distilled water of condensation from the condensers, with make-up water from the station's own filtration and purifiers.

## Largest Condensers Ever Built

The condensers are the largest ever built for stationary practice, and are of the two-pass, radial-flow, surface type, each containing 50,000 square feet of cooling surface. The tubes are one-inch diameter, No. 18 BW gauge, of a special composition found most suitable for local conditions. The unique design of this huge condenser demands attention:—its tubes are arranged eccentrically within the shell in circular rows, and the air is removed from the center in order to give the steam a minimum path of flow through the condenser tubes. By means of the counter-flow principle, the condensate is allowed to pass down over the hottest tubes, and is removed at a temperature within a few degrees of that of the exhaust steam. The circulating water to each condenser is supplied through tri-rotor centrifugal geared turbine-driven pumps. For each generating unit there is installed two of these pumps, with maximum capacity each of 37,500 gallons per minute. Besides, there is provided one additional pump of like type and capacity, as a spare unit coupled for emergency service to either condenser. The reduction gear used for these pumping outfits is of the well-known herringbone type with ratio of 9:1, the turbine operating at 2,880 revolutions per minute and the pump at 320 revolutions per minute. The injection water which is delivered to the condenser through a 48-inch pipe, enters at the bottom and discharges from the top, through a pipe of similar size, and the end of this discharge pipe is sealed so as to form a perfect syphon system. It is held that this arrangement of piping reduces the actual work performed by the circulating pumps to that required to overcome the friction of the tubes and piping.

## Centrifugal Pumps for Condensers

The condensate pumps are of the two-stage centrifugal type direct-connected to steam turbines; each generating unit is provided with two pumps, the capacity of which is 1,500 gallons per minute each. The water of condensation which passes through these pumps discharges directly into a "sweet water" tank from which it flows by gravity into a boiler feed-water heater of the open type. As a further precaution and a warning to the operating engineers in case of fail-

ure of the condensate pumps, the company's standard high-water alarm is connected to each condenser. This consists essentially of an electro-mechanical device which closes an alarm circuit when the water in the condenser base has reached a predetermined and abnormal level. The air pumps are the well-known Le Blanc type, direct-connected to steam turbines; these pumping outfits also are in duplicate, and are placed immediately below the condensers. The hurling or sealing water required is supplied by the circulating pumps and discharged directly into the discharge tunnel.

## Coal Elevators

The coal supply to the two generating stations is both by rail and river barge, ninety per cent. of the fuel now being delivered by water. In the case of water delivery, the unloading of the coal is done by means of one steam-driven, two-man tower and one electrically-operated one-man tower, with combined unloading, crushing and weighing capacity of three hundred tons per hour. From these towers at the face of the wharf, the coal is conveyed to the station by a motor-operated cable railway. The transfer cars of 3-ton capacity discharge into standard track hoppers, whence on motor-driven elevators the coal is raised to top of the boiler house where it is then distributed to the coal bunkers by means of motor-driven conveyors. The elevators in use at the present station are of the link-belt type, and are in duplicate, one elevator being placed at each end of the bunkers. The conveyors are of the reversible scraper type arranged with motor-drive to handle coal from either elevator. The elevators for the new station are of McCaslin design with overlapping buckets and gravity discharge, and the conveyors of the same character as those already installed in the present station.

## Steam Boilers

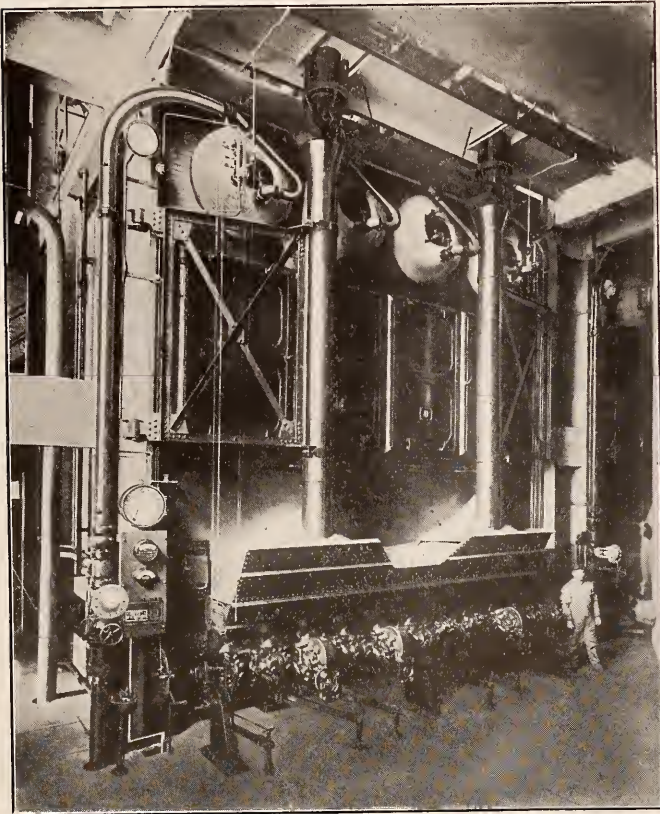
The station steam boiler equipment consists of 20 Babcock & Willcox water-tube boilers, each 32 tubes wide, 14 tubes high, and 20 feet long. There are 4 steam and water drums each 42-inch diameter by 22 feet, 3¼ inches long. The superheater is of the standard Babcock & Willcox type. The depth of furnace is 8 feet, 7½ inches, its width 19 feet, and height from floor line to lower row of boiler tubes measured at the front header 11 feet. Each boiler is guaranteed to evaporate 60,000 pounds of water per hour from a temperature of 160° F. to a pressure of 250 pounds per square inch and a maximum temperature of 600° F.; and each is furnished with recording steam flow meter, recording CO<sub>2</sub> meter and recording thermometers for flue gas temperature measurements. These boilers are set singly with 5-foot alleys between, and arranged in four rows of five boilers each. Two rows or ten boilers are piped to each of the two turbines.



Each row of five boilers is provided with one steel stack 12 feet diameter at top, 19 feet at base and extended to a height of 207 feet above the boiler room floor line, the location of stacks being directly above the boilers, and their support being the heavy structural work of the building.

**Coal Storage and Handling**

In the new station, there are two separate and distinct coal storage bunkers, capacity each 3,750 tons, and each bunker is divided longitudinally into four sections by fire-proof partitions to prevent the spread of any combustion which might occur. From these bunkers the coal flows by gravity to the stoker hoppers



One of the Twenty Steam Boilers

through coal feed pipes which are supplied with cut-off valves conveniently located beneath the bunkers; the lower half of the coal pipe is arranged to swing clear of the path of the boiler tubes to facilitate the cleaning of tubes or their removal.

**Stokers and Blowers**

Each boiler is equipped with one ten-retort, underfed, automatic stoker of the Taylor type with extension grate, the ashes dropping directly into an ash hopper located immediately below the furnace. For air supply to each furnace there is provided one multivane blower driven by a 60-horsepower Terry steam turbine through a reduction gear of the herringbone type. The turbine speed is 3,600 revolutions per minute reduced to 510 revolutions per minute at the fan. Each blower delivers 35,000 cubic feet of air per minute against a static pressure of 5 inches water in the

wind box. When operating under these conditions, the water rate guarantee of the turbine is not to exceed 28 pounds per brake-horse-power-hour. The stoker for each boiler is driven by a 10 h-p. 230 volt interpole motor having a speed adjustment from 400 to 1200 r.p.m. This provides great flexibility to care for variations in load. Current for these motors is generated by two 200 kw. 250 volt d. c. generators driven by Curtis turbines through reduction gear.

**Ash Handling System**

The ash-handling facilities are unique. From the ash hoppers, located directly beneath the furnaces as previously mentioned, the ashes are drawn off into a portable crusher mounted on a truck which runs on rails provided for emergency ash-carts. The crusher is driven by a 5 h-p 900 r.p.m. motor connected by flexible leads to a service outlet under each boiler. From the crusher the ashes fall into an intake opening in a 10-in. cast-iron pipe through which they are drawn into the ash-storage tank. This is of reinforced concrete and provided with air-tight doors. An exhaustor of the positive blower type creates suction sufficient to move 550 lbs. of ashes per minute. It is belted to a 100 h-p. 2400 volt induction motor. The exhaust is discharged into a muffler chamber. The storage tank has a capacity of about 15000 cubic feet, enough for 300 tons of ashes. From time to time the ashes are drawn off into dump-carts for removal.

**Phase-Converter Sets**

Mention should be made of the two phase-converter sets which are for use on the 25-cycle system. Regardless of which phase is the more heavily loaded, they will distribute a single-phase load of 12,000 kw. equally over the three phases for five minutes without undue heating. Each phase-converter also furnishes power for a 550 kva. voltage balancer which is both mechanically and electrically connected to it.

\* \* \*

**Turbo-Generator Efficiencies**

Some idea of the guaranteed steam consumption of turbo-generators may be had from the following table of offers made to the Municipal Electric Plant of Shanghai, China. The machines are of European make, except as noted.

Firm	Alternator	K.W.	Speed R.P.M.	Full Load Steam lbs. per kw.
Fraser and Chalmers	Vickers	5,000	3,000	13.0
Escher Wyss	Brown Boveri	5,000	3,000	12.62
Willans & Robinson	Siemens	do.	do.	12.85
Oerlikon	Oerlikon	do.	do.	12.78
Willans	Siemens	6,000	1,500	12.75
Westinghouse (U.S.A.)	Westinghouse	5,000	3,000	15.0
Oerlikon	Oerlikon	7,000	do.	12.71
Belliss	Vickers	do.	1,500	13.05
Brush Co.	Brush	6,000	do.	12.9
Howden & Co.	Vickers	7,500	do.	13.05
General Electric Co. (U.S.A.)	G. E. Co.	do.	do.	12.55
Dick Kerr	Dick Kerr	8,000	do.	13.1
Fraser & Chalmers	Vickers	10,000	do.	12.75
B. T. Houston Co.	B. T. H.	do.	do.	12.5
Willans	Siemens	do.	do.	12.55
Escher Wyss	Brown Boveri	do.	do.	12.65
Howden & Co.	Siemens	do.	do.	12.95
General Electric Co. (U.S.A.)	G. E. Co.	do.	do.	12.85
Oerlikon	Oerlikon	do.	do.	12.61
C. A. Parsons	Parsons	do.	do.	11.9
Westinghouse (U.S.A.)	Westinghouse	do.	do.	13.5
Richardsons-Westgarth	Siemens	do.	do.	12.5
Adamson	Siemens	do.	do.	12.8
Brush Co.	Brush	do.	do.	12.65

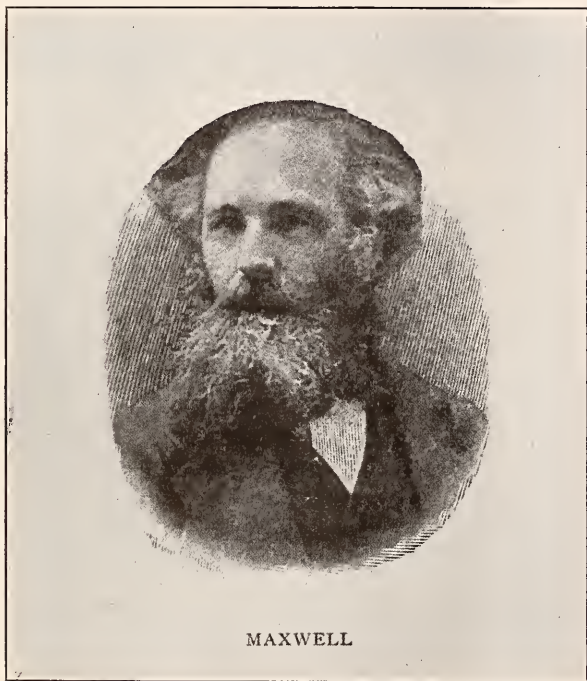
The cost of these machines, erected in Shanghai, varied from \$13.32 to \$19.55, the average being \$16.50 per kw. capacity. Most of the bids were in the near neighborhood of the average.

# Electrical Fathers

James Clerk Maxwell

As has been indicated in the previous articles of this series, the broad beam of electrical knowledge, that to-day enlightens the world, is the work of many lands. To it have contributed Italy with Galvani and Volta, France with Ampere and Coulomb, Germany with Ohm and Gauss, England with Gilbert and Faraday and our own country with Franklin and Henry.

Auld Scotland came in late, but when she did take a part, her famous sons, Clerk Maxwell and William Thomson (Lord Kelvin) gave to the sum of the world's store of electrical science contributions unsurpassed in brilliancy and usefulness. It is to the former of these two that men to-day owe much of their grasp on the great underlying facts of electricity and magnetism and it is with him that this sketch is concerned.



MAXWELL

Unlike most of the great men whose lives we have so far followed, James Clerk Maxwell, born at Edinboro, June 13, 1831, came of a distinguished and well-to-do family, that was amply able to give him every wordly advantage.

As a lad he was principally noted for his lively curiosity as to the reason of anything that attracted his attention. He was interested in the whence and whither of the winds, streams, clouds, water-pipes, bell-wires and so forth and his everlasting query was, "What's the go o' that?" His bent was for accurate knowledge and if any indefinite reply was given him, he would at once come back with, "But what's the particular go of it?" He was also a clever and industrious amateur experimenter, putting his questions directly to nature.

Studious, and well trained in the fine schools of the Scottish capitol, young Maxwell early showed his proficiency in mathematics, making his first original contribution to that science at fifteen, for in 1846, while he was still at the Edinboro Academy, its principal, Professor Forbes, read a paper before the Royal Society on "A Mechanical Method of Tracing Oval Curves," written by his youthful pupil. Shortly afterwards he entered the University where he was a star student in mathematics and physics, producing several papers of distinct value before he graduated there in 1850 at the age of nineteen. Fondness for his specialty led him to

Trinity College, Cambridge, where he took his doctor's degree in '54. The following year, he started on the series of electrical and magnetic studies which became the leading work of his life. The first fruit was the publication of an elaborate paper on the nature of Faraday's "lines of magnetic force." Maxwell was appointed professor of natural science at a small Scottish college in 1856, but his papers had given him a wide reputation and four years later he was called to King's College, London. Meanwhile he was continuing his efforts to translate electrical and magnetic phenomena into mathematical terms and with brilliant success. Essay after essay came from his hand, each bringing new illumination to bear on some phase of the subject.

From this he turned aside long enough to capture the Adams Astronomical prize for 1857 with a paper on "The Stability of the Motion of Saturn's Rings," in which he was able to prove conclusively that the rings must consist of a vast mass of separate small bodies and could not be rigid. This episode indicates the breadth of Maxwell's scientific training and his exceptional power to express complex physical facts in the language of mathematics and thus facilitate their comprehension and handling. He also devoted his attention to the study of colors and color effects and in 1861 was awarded the Royal Society's Rumford medal for his researches in this line. He furthermore made important discoveries in the field of optics, inventing a real-image stereoscope and proving the variations of the sensitiveness of different parts of the human retina.

Maxwell's great work in electrical and magnetic science consisted in gathering the vast store of experimental facts and observations on these subjects that had been accumulating so rapidly during the past hundred years and weaving them into a workable theory, mathematically demonstrable, by means of which much of the observed phenomena could be explained and the relations between them better understood. In this way he was able to go far beyond the experimenters of the past in that he was able to make predictions, based on his theory and its consequences, that certain things, then unproved, would be found in the future to be so. Since his time many of these predictions have been experimentally verified, and while the developments of later years have profoundly changed our ideas on some of the subjects of which Maxwell treated, we also know that his deductions in the main were correct, as far as they went.

Perhaps the most famous instance of this is in the case of invisible electromagnetic waves. It was Maxwell who first demonstrated that these effects travel through space in the form of transverse vibrations similar to those of light, but of much greater wave length, and at the same velocity as light. Faraday had guessed this and Hertz proved by experiment that Maxwell's conclusions were true. The whole science of radio telegraphy and telephony has sprung from these facts. His grand conception was this: that it is possible to account for all electric and magnetic action by supposing electricity and magnetism to be stresses and motions in a weightless material substance, the ether. As a consequence of this, he showed that the ratio of the two centimeter-gram-second systems of electrostatic and electromagnetic units is numerically equal to the velocity of light in free space expressed in centimeters per second, or 30,000,000,000—that is  $3 \times 10^{10}$  centimeters, or 186,000 miles, a second.

This achievement has well been called, "the first great step towards the true understanding of the nature of electricity and magnetism." It must, of course, be understood that Maxwell was far too wise to assert that he had actually conquered the secret. He very modestly and simply offered his theory as a possible explanation of these phenomena. It was

(Continued on page 73)

# EDITORIAL



The college graduate who lays aside his academic robes for overalls and jumper, or finds new companionship with his slide-rule in eight hours' continuous calculation, will hear many expressions of contempt for theory as opposed to practice. If he is over-loyal to his technical training he will take up the cudgels for theory, and stoutly maintain its superiority over the merely practical. If, however, wisdom is with him, he will be quiet and wait for practice to show its merits before he places every reliance upon it.

This so-called conflict between theory and practice is, of course, but a fiction of minds which do not understand the nature of theory. Before we can have any ideas about any object, we must first have the object, and then we must observe it—we must say something about it—that it is heavy, or rough, or cold. By those very words, we tie it up to some group of objects which we remember as heavy, rough or cold. We remember that objects whose weight is above a certain amount of their size have always sunk in water, and so we conclude that this object is likely to sink. At once we have a theory and when we use the object as a weight to drown a superfluous kitten, we have an application of theory to practice.

The discredit which attaches to the theoretical in many minds is due principally to lack of decent care in its application. People have jumped to conclusions, found them wrong, and blamed the theory rather than themselves. There are constants to be determined in every case; just *how* heavy was the stone in proportion to its size? If the constants are assumed incorrectly, the result will be far from the expectation.

Another sneer that is directed against the theoretical man is that he is too slow. In many cases a few lucky guesses will land the man of action at his goal ere the student has gotten fairly under way. In many other cases, the problem is so complex that a full-scale trial is necessary before any attempt at calculations can be made. But here a knowledge of the fundamental relations will at once suggest the limits of the test, and give the interpretation of its results.

The student who without talking of his methods, uses his knowledge of theory at every turn to guide him will find that his education will carry him far beyond his untrained fellow-workmen.

"The dignity of labor" is a phrase so familiar to American ears that we have long since given it a place far back in a dusty corner of our mental stock-shelf. So, those news dispatches have a strange sound which tell us that the English people are at last coming to realize this truth which has been the main-spring of our daily lives. For generations it has been the British habit to look upon war as something that could be paid for in gold. Expensive it might be, and the money might come grudgingly at times, but always the money came, and the war was carried on. But now the people of England are finding that war is no longer waged with gold, but with goods, and that for every man on the firing-line there must be one at home to keep him supplied with the materials of modern warfare. With so large a proportion of the former workers unavailable, it now devolves upon every able-bodied person, man or woman to contribute, not money, but personal labor in some field of material production. Women of rank are taking places at machine-tools, or at street-car controllers and men too old for active service are doing whatever they can in the denuded factories at home.

One aspect of this situation is of importance to us all. We have heard much talk of preparedness, and much of it has been to the point. But what we need is more productive capacity for munitions of war. With huge profits to be made, our manufacturers have strained every nerve to handle orders for unfamiliar goods. The change has consumed months, yet they had available all of our wonderful commercial machinery to carry out their purpose. Should a similar necessity coincide with a declaration of war, and the disarrangement of ordinary transportation which would accompany it, the delay would be all the more serious. Ordinary prudence demands that enough factories be kept always in a position to change instantly from their ordinary work to the production of military supplies. The necessary plans, instructions, templates, tools and raw material stocks should be always on hand and the force should know in a general way what the operations were. Of course it would be expensive, but it would mean protection against sending to war troops which had not enough ammunition for a single hard-fought battle. All our talk of "too proud to

fight" goes for naught to a potential foe who realizes very well that save under the present conditions our initial output of munitions would be less than one per cent. of our need in any respectable war.

At present the engineering societies are taking a census of the production capacities of our manufacturing plants for munitions. By present indications the response is going to be truly American in its willingness to co-operate. We urge on all our readers their duty as citizens to give the committee all the assistance in their power in this matter. We hope that from the immense amount of data collected there may emerge a scheme for tying together the war and navy departments with our industries, so that there may be no friction in time of stress.

What the scheme may be, we leave for the committee to determine, but one thing is evident. The heads of these two great departments must be no longer men chosen for political expediency, but for keen minds and broad business ability. Better might we trust a raw track-hand at the throttle than a politician in either of these secretaryships. The very idea that the government, with no economic pressure for low and still lower costs, can manufacture armor plate more cheaply than a private firm, is evidence of what political incapacity may think.

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### Billing Methods

One of the most discussed questions at gatherings of central-station men is that of billing methods. With 5,800,000 bills to be made out each month, the accounting experts throughout the country are always on the alert to cut even a small fraction of a cent from the units costs. Their efforts have been directed along several lines, but chiefly toward improving the "load-factor" of the meter-reading and billing forces and toward eliminating every step in the process which can be shown to be unnecessary.

The obvious cause of the poor load factor is one which affects all commercial organizations, small or large. Purchasers have become accustomed to receive statements of account on the first day of the month. This means that in addition to the regular flow of work through the bookkeepers' hands there is a "peak" lasting from about the twenty-fifth of the month until the bills are in the mails. Managers must require overtime work with its attendant disadvantages, or hold through the slack period a sufficient force to carry the peak load without extra work. The best methods of smoothing out the load curve seems to be the billing of customers in groups at various times during the month. By this method there will be no particular time at which the work is heavier than at any other; if the groups are properly proportioned the load on the force as a whole will be uniform. There will always be the necessity for as quick action as is practicable from the time the meters are read until the bills are in the mails to make the loss of interest on power furnished but not billed as small as possible.

In the cases where this device has been submitted to a referendum of patrons, the vote has been favorable to its adoption and it would seem that the resulting decrease in the "maximum demand" on the payers' purses should be appreciated. That in turn should accrue to the gain of the company, for a bill received later in the month should be paid more promptly, not having to compete with other bills for the payer's funds.

Of methods to "speed up" the various operations and eliminate lost motions there are as many as there are alert men in the field. Opportunities for reducing costs are so alluring that every large organization has a "Supervisor of Methods" whose duty it is to devise such short-cuts. One of the most promising devices is the combination of adding-machine and typewriter now being tried out by the Commonwealth Edison Company, of Chicago. The number of operations that can be performed on these machines in exceedingly quick time is surprising. Apparently the limiting condition will be the overhead charges on the machines as compared with the cost of the labor they replace.

At the recent convention of the N. E. L. A. an interesting report was made by the Committee on Customers Record, giving replies to a number of questions as to billing methods which were sent to central station members. In the next issue of "Electrical Age" this report and an abstract of the accompanying discussion will appear.



There are certain switchboard instruments which normally may indicate any value from zero to their full range. Ammeters and wattmeters should be so designed as to give a correct and legible reading at any point on their scale. In the conditions under which switchboard instruments operate, this is not difficult to reach, and these instruments may be said to have reached a point of entire adaptation to their service.

Voltmeters, however, are generally used to indicate not what the voltage actually is, but how far it has departed from its normal value. At the most the pointer swings over a very small arc which is limited by the regulation of the plant. In such a case it would be better to use, not an instrument reading from zero to say 150 for a 115-volt plant, but from 100 to 125. Thus the divisions would be six times as far apart, and any variation would be six times as apparent. The more accurate control possible with such an indicator should make the additional expense of the special calibration an item well worth its cost.

# Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

## The Mazda Lamp in a New Field

By A. R. Dennington

In the search for illuminants best suited for special purposes there has been a steady tendency toward efficiency, simplicity and ease of manipulation and control. Coupled with this there has been the desire, the strength of which is in a way measured by existing insurance rates rather than by altruistic motives, to reduce fire risks. The use of open flame lamps of all types is being curtailed and in their place sources of light partially or totally enclosed are receiving favor. Though the use of an enclosing globe does not entirely eliminate the danger of fire from the light source itself, it does so to some extent and make the use of enclosed light sources possible where the open type of illuminant would be prohibited. However, in lamps used in lens systems where the rays of light are brought to a focus the danger of igniting any combustible material is proportional to the heat rays focused without regard to whether or not the light source is enclosed. It is, therefore, well to keep in mind the fact that the use of an incandescent lamp in a motion picture machine, for example, does not eliminate the possibility of igniting the film if the latter should be stopped for any cause and the automatic fire shutter should fail to close. This point is brought out because of the prevalence of the idea that with an incandescent lamp there would be no danger of igniting the film.

### Incandescent Lamps in Projectors

The incandescent electric lamp has won recognition in most of the industrial lighting fields and has assumed importance in street lighting, especially in the larger sizes, which are successfully competing with the most efficient types of arc lamps. Another form of illumination, known as flood lighting, has also come into prominence since the advent of the concentrated filament Mazda lamp of high candlepower. This form of lighting is used to illuminate buildings or portions of buildings, bill boards, signs, water towers, etc. and is named from the fact that the source of light is placed in a fixture which reflects the rays to flood the object to be illuminated. Other successful applications of incandescent lamps which require that the light be accurately directed are automobile and locomotive head lights. In the realm of picture projection, however, up to the present time the incandescent lamp has not been able to compete with the arc except for small stereopticon lanterns used where the "throw" is short and the picture small. For large lecture halls where stereopticons are used, the calcium light or the arc has been found necessary, though recently very good effects have been obtained by the use of specially concentrated filament lamps of high wattage and candlepower. One difficulty in the use of the usual type of concentrated filament lamp is the tendency

for the image of parts of the filament to be visible on the screen, or if this is eliminated, the intensity may be reduced.

### Requirements for Motion-Picture Work

The projection of motion pictures has been done exclusively by arc lamps, as the conditions have been very exacting. It is necessary to focus the light rays from the source on the small area of the film, and since this small picture is greatly magnified on the screen, an extremely high intensity at the film is required. Since the intrinsic brilliancy of the arc crater is much greater than the intrinsic brilliancy of the filament of an incandescent lamp, it has been difficult to obtain the required intensity. However, since the advent of the Mazda lamp made up with large filament which will carry 20 amperes or more, it has been possible to increase the intrinsic brilliancy beyond what could heretofore be obtained and also to increase the energy which could be transformed into heat and light in the small area which could be effectively used with a condensing lens system. Since the filament must be arranged in a series of coils, the most practical form of light source is a square, filled as completely as possible by the coils, Fig. 1.



Fig. 1.—Nitrogen-filled Lamp for  
Motion Picture Projection

In focusing the lamp special care must be used to get the filament in the correct position with respect to the optical system and also to have the correct distance from the condensers to the aperture plate. Unless these conditions are fulfilled the screen may have iridescent streaks and be unsatisfactory for pictures. It has been found by experiment that a number of different adjustments can be made with fairly good results on the screen, but for the best uniform illumination the lamp filament must be very closely placed to a definite point which is constant for a given optical system. Because of the possibility of adjusting and maintaining an incandescent filament at the specified point, results can be obtained which are better than even a skillful operator can maintain with an arc which requires constant adjustment.

### The Corrugated Condenser

As the experimental stage in the application of incandescent electric lamps to motion picture projection is not past, it is to be expected that a number of different condenser systems will be exploited. At the present time the corrugated condenser system gives most promise of successfully competing with the standard systems used with arc lamps. The apparatus used is a single lens similar to a semaphore lantern lens, corrugated on one side and convex on the other side. The condenser is placed with the smooth convex side toward the lamp and the corrugated side toward the aperture plate of the projector, Fig. 2. The overall diameter of the condenser is 3.5 inches and it is designed to have conjugate foci of 2 inches and 5 inches with the source of light placed at the 2 inch focal point. With this arrangement the condenser picks up a large angle of light and owing to the concentric corrugations which in effect form a number of concentric condensers, the total thickness of glass and hence the total absorption is small. The condenser focuses the light rays in such a manner that a uniform screen free from iridescence is produced if the lamp and aperture plate are the correct distances from the condenser.

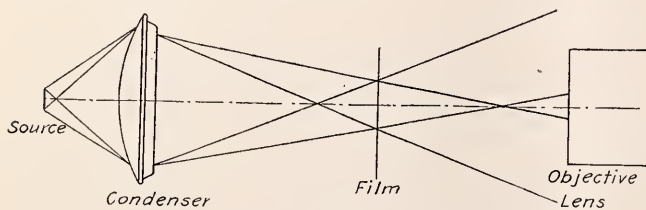


Fig. 2—Corrugated Condenser System

The main disadvantage of the corrugated condenser is due to its short focal length. The condenser and lamp housing must be brought to a distance of 5 inches from the aperture plate, and with some makes of machine when arranged to be hand driven, there is very little room for making adjustments or catching a loop. There is also considerable loss of light, due to reflection and dispersion from the edges of the corrugations. Since the face of the condenser toward the light source is convex the light rays striking the outer portions of the condenser are largely reflected. This effect operates to cut down the effective area of the condenser and is equivalent to reducing the solid angle of light picked up. Since the corrugated condenser focuses the rays at a comparatively sharp angle a projection lens of wide aperture is essential if all the available light on the film is to be projected to the screen. Where the "throw" is long the focal length of the projection lens may be so great that an appreciable portion of the light falls outside the lens and hence is lost.

### The Standard Plano Convex Condenser

With an incandescent lamp as a source of light the usual arrangement of plano-convex condensers, Fig. 3, can be used to get very good illumination of the screen and project pictures with excellent detail even in the deep shadows. As the plano-convex condensers are standard equipment on all motion picture apparatus it is of undoubted advantage to use them with incandescent lamps as a source of light if their use does not entail a loss of brightness or give other undesirable results on the screen. It has been found by trial that there is more danger of getting iridescent effects upon the screen with the plano-convex condenser system than with the corrugated condenser. However, as has been previously stated, it is possible, by careful adjustment of the light source with respect to the condensers, to get a screen which is practically free of iridescent streaks.

The screen when illuminated by an incandescent lamp has more of a yellowish tinge than when lighted by an arc. This is due to the fact that there are more red rays and fewer violet rays in the light from the tungsten filament than in the light from the arc. This difference in color is not objectionable and

gives a picture less tiring to the eyes of the audience than is obtained by the bluish white light of the arc. With the incandescent lamp, films tinted yellow or red show up very well, due to the large proportion of red rays in the light.

### Power Requirements

The Mazda lamps which have given excellent results in the projection of motion pictures require from 600 to 900 watts, the pressure at lamp terminals being in practically all cases about 30 volts and the current being 20 amperes in some cases, 25 amperes in others and in certain other lamps 30 amperes. The higher current lamps give higher screen illuminations in almost direct proportion to the watts required by the lamp. It may be safely stated that the screen illumination obtained from a 750 watt special Mazda lamp will approximate that from a 40-ampere direct-current arc. When the arc is perfectly trimmed it is possible to get a somewhat higher illumination than with the incandescent lamp but since the latter remains perfectly steady and constant while the arc varies more or less during the time a film is run, the effect produced is favorable to the Mazda lamp.

The Mazda lamp will operate perfectly on an alternating current circuit and hence requires only a transformer with several taps to give the proper voltage at the lamp. The power required is therefore only that supplied to the lamp plus the transformer losses which are so small as to be practically negligible. If the lamp is operated from a direct-current circuit of 110 volts there must be a rheostatic loss of more than twice the power required by the lamp or a motor generator set must be used to supply the pressure required at the lamp terminals. Hence, in the case of a direct-current supply the Mazda lamp is almost at an equal disadvantage with the arc, the only saving possible being due to the smaller current required by the incandescent lamp. The power saving is in this case about 25 per cent. to 50 per cent. over the arc for similar effects on the screen.

As the incandescent lamp will give as good results when operated on a 60-cycle alternating-current circuit as when operated on a direct-current circuit, it will meet a long felt want in the motion picture theaters which have been operating with alternating current arcs. The alternating current arc is inherently very much inferior to the direct-current arc because no crater is formed in one carbon, hence it is impossible to get as good

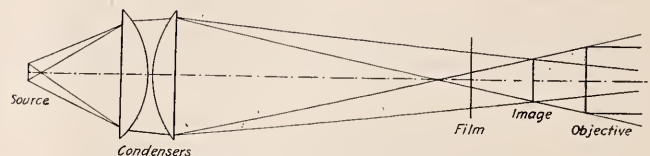


Fig. 3—Plano-Convex Condenser System

a source of light for the condensing system. Also, as the arc travels around on the carbon points and the intensity varies with the current value during each cycle it is impossible to maintain a uniform screen. The filament in the Mazda lamp used for projection purposes is larger and has sufficient thermal capacity to maintain an intensity essentially uniform. The author has had no experience with projector lamps on 25-cycle and 40-cycle circuits but it is evident that screen illumination free from flicker can be obtained with the Mazda lamps on any commercial frequency.

### Relative Costs for Lamps and Carbons

Exact data regarding the relative costs of arc lamp carbons and incandescent lamps for motion picture projection are not available at this time, owing to the incandescent lamp being in the experimental stage. The cost of carbons is variously estimated at from 6 cents to 9 cents per hour of operation of the machine. The cost of lamp renewals will probably not exceed these costs and may be less. Even if the lamp renewal cost equals or exceeds the carbon cost the advantage of economy of operation will still be with the incandescent lamp on account of the low power consumption.

## A New High-Tension Outdoor Disconnecting Switch

By Henry A. Davis

These switches described herein were built in the shops of the Hudson Valley Ry. Co., at Glens Falls, N. Y. They are absolutely sleet proof, and have given the best of satisfaction for upwards of two years, since their installation. Also, they are perfectly safe to operate. The following description is of the switches controlling three, three phase 22,000 volt, circuits at the Round Lake Sub-station at Round Lake, N. Y., this being the first installation. One circuit comes from the main generating station at Mechanicville, N. Y., one goes to the Ballston Lake Substation of the Schenectady Ry. Co., and the third circuit feeds other substations of the Hudson Valley Ry. Co.

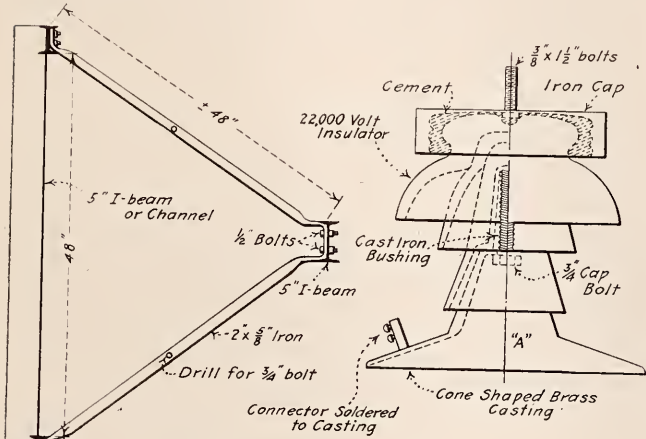


Fig. 1

Fig. 2

The frame for supporting these switches is built up of three five-inch I beams, supported in a triangle on wish-bone cross arms, fig 1., bolted to wooden poles, the lower I beam being about twelve feet from the ground. This frame is thoroughly grounded, making the operation safe in any kind of weather.

One side of the switch consists of a cone shaped brass casting, hung from the upper I beam by an ordinary 22,000 volt, three petticoat, pin type, insulator, with a cast iron cap cemented to the top (see "a" fig. 2) and a cast iron bushing,

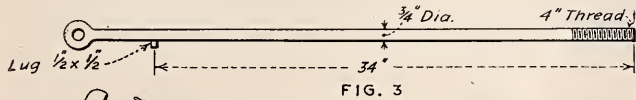


FIG. 3

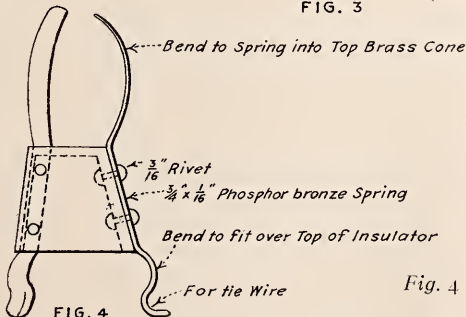


FIG. 4

Fig. 4

threaded for  $\frac{3}{4}$  in. std. cap bolt, led into the pin hole. The cement for fastening cap and insulator together was composed of 2 parts portland cement, and one part sand. The bushing was lead in as this was considered a stronger way of fastening.

Common screw connectors were soldered into the brass casting for connecting the line wires.

The other or movable member of the switch was mounted on a  $\frac{3}{4}$  in. rod, arranged to move vertically through holes

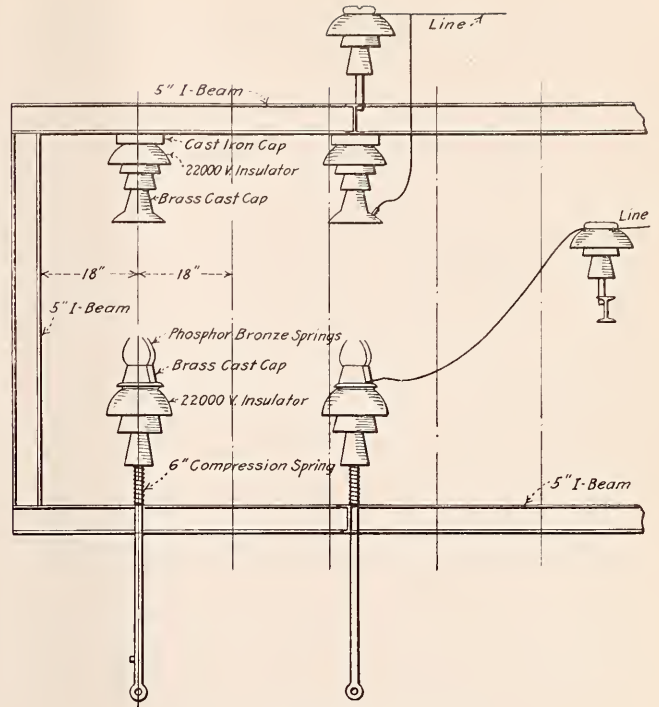
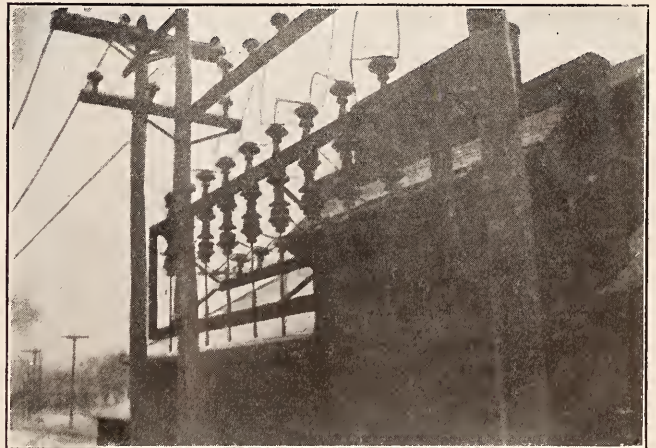


Fig. 5—Assembly of One Unit

in the flanges of the lower I beam. A lug on the rod passed through a slot in the side of the lower hole of the I beam and secured the switch in the upper or closed position by a half turn.

The movable element proper consists of a 22,000 volt pin type insulator, mounted on this rod by means of a  $\frac{3}{4}$  in. bushing, on top of which was mounted a small cone shaped brass casting (fig. 4) to which were riveted 3 phosphor bronze springs which were also tied to the insulator by a soft copper tie wire. Connection was made by a flexible cable extending to insulators mounted on the third I beam.

These switches are operated by means of a wooden rod about seven feet long with a cross handle on one end and a right angle hook of  $\frac{5}{8}$  in. round iron in the other end. To open the hook is inserted in the eye at the lower end of the rod, given a half turn to disengage the lug and the lower element dropped about 24 inches. A compression coil spring is placed on each rod between the lower I beam and the switch element to protect the insulator in case it should be dropped while being operated.



The Switch-group in Place

## A Useful Device for Busy Repair Men

By Kennedy G. Rockworth

All construction gangs, and nearly every wireman and erection engineer, carry with them dies, taps, and the holders for cutting screw threads. It is impossible to tell when these tools will not be required, whatever the job. This is especially true on emergency work on rheostats, the studs of various machines and instruments, bus supports, etc., for it may not be necessary to cut threads but only to run down them to remove a burr.

It often happens that the available space is so cramped and other apparatus so much in the way, in fact, this is usually found to be the case, that it is impossible to cut a thread in place, but instead the metal must be removed, placed in a vice on a bench and cut. After that it must be replaced before the job is finished. All this work must be done because of insufficient room for turning the die holder round. This is not only most annoying, but may be a very serious matter in cases of break down and emergency, where each minute a machine is out of service may be costly to both company and customer.

To overcome this, one man, while for many years on the road, installing electrical and hydraulic machinery for some of the large manufacturing companies, used a home-made tool that enabled him to do work in its place where others could not have done so, because of the limitations of space. To do this he made some dies from standard nuts, and in this way used a monkey wrench, spanner, or other form of wrench where a die holder or stock could not have been used. The first thing to do is to select a number of steel nuts, the ordinary hexagonal nut is the most convenient. Plug each nut with a piece of metal cut to the same number of threads per inch as the nut. Screw this plug into the nut so that on one side the two faces are flush. Now mark off four equidistant points on the circumference of the thread, and drill these out. The size of hole to employ depends upon the diameter of the thread, of course, and to some extent upon the metal to be cut. However, it is a safe guide to make these clearance holes, the object of which is to permit the escape of the metal as it is cut, about one-third the diameter of the main hole or thread. After this has been done remove the plug which was inserted to enable the drilling to be done. This plug may be removed by drilling out or by unscrewing. The next thing to do is to place the nut in a lathe and slightly taper the thread, as is done with the ordinary die. Clean the threads out, remove all burrs, and stamp the size, number of threads, etc., on the top of the nut, for easy reference when in a hurry. The nuts should now be hardened, the method employed depending upon the steel used. The hardening had best be done by a tool maker or properly equipped machine shop, all the other operations being carried out by any ordinary mechanic.

This form of die is very simple to make, and can be quickly done. Often it is possible to make such a tool on the job in less time than the machinery can be taken down, threaded and replaced. The chief advantage of this form of die over the ordinary one is that it requires no holder. All that is needed in this case is a monkey wrench or similar tool. Another advantage, and a very real one, in those classes of work where a man has to hurry from job to job, in different parts of the country, on a moment's call, is that the die is in one piece, hence it is not possible to get different dies having a different number of threads per inch interchanged, or the various parts lost. A whole set of these dies or nuts may be strung upon a wire and be safe and complete, whereas the other commercial types usually have to be carried around in a box with the holders.

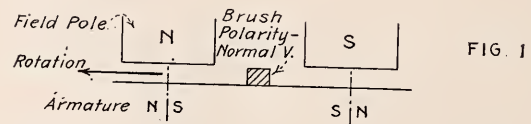
❖ ❖ ❖

A manufacturer of shoes reports that by the use of electric irons the average cost for repairing patent-leather shoes going through his plant was reduced from 2½ cents per pair manufactured to 1¼ cents. Based on his production, this means a daily saving of \$13.75.

## Reversing the Polarity of Rotary Converters

By Milton M. Flanders

Self excited rotary converters starting from the A. C. side as induction motors usually have a break-up switch connected in the field circuit, which is left open when starting to limit the voltage induced in the field turns. After the machine "locks" in synchronism as shown by a steady reading on the d.c. voltmeters, this switch is closed. The polarity on the d.c. side may not then be correct. To provide for this, the break up switch, or another field switch, is usually made reversing, so that the connections of the field may be reversed with respect to the d.c. brushes. If the polarity is wrong when this switch is closed in running position, the switch is quickly reversed and after a short interval of time again thrown to the running position when the d.c. polarity will usually be correct, the armature having slipped a pole with respect to the field.



With the field switch closed and the machine running in synchronism, the armature may be considered to have poles produced in it by the alternating current flowing in its windings. These armature poles reverse with the a.c. wave at about the middle of the field poles as indicated in Fig. 1, torque being developed by attraction and repulsion of poles as in any synchronous motor. The polarity of any given d.c. brush depends on which side of the alternating current wave it makes contact with, i. e., the positive or negative side. Since the machine is self exciting, any given field pole may build up either with a north or south polarity depending on the instantaneous polarity of the a.c. wave at the time the machine "locks in" since it is possible for any brush to be of a positive or negative polarity.

Now, when the machine is running in synchronism, if the field switch is reversed, the polarity of the field poles immediately reverses and the armature begins to slip backward to satisfy the laws of attraction and repulsion.

When the armature has slipped back one half pole with respect to the field, the brushes are commutating at the zero point of the a.c. wave and the field current and field magnetism become zero. If the armature continued to slip backward, the brushes on the d.c. side would reverse their original polarity since they would make contact with the a.c. wave

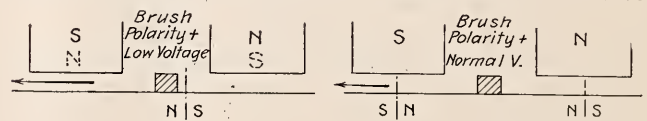


FIG. 2

FIG. 3

on the opposite side with respect to the first position. This cannot occur since the attraction and repulsion of armature and field poles would oppose the natural direction of rotation produced by the rotating field as shown by the dotted letters in Fig. 2. For the same reason the armature cannot return to its original position with respect to the field as the field polarity would then be as indicated by the full line letters in Fig. 2. In consequence the armature remains in magnetic stability, the reversal of the armature poles occurring nearly midway between the field poles. The losses of rotation tending to retard the armature, this reversal takes place nearer the trailing field pole as shown in Fig. 2 and as indicated by a small reading on the d.c. voltmeter. Some little time is required to establish this stability as when the field connections are first reversed, the armature oscillates back and forth in the magnetic field for a short time.



When the field switch is again placed in the running position, the armature tends to slip the remaining half pole, the field polarity builds up in the opposite direction to its original value and the machine operates as at first but with reversed polarity at the d.c. side, the laws of attraction and repulsion satisfying the normal rotation of the field as shown in Fig. 3. If this reversal of polarity does not take place, it may usually be attributed to performing the cycle of operations too rapidly or to making the reversals too slowly.

\* \* \*

### Moving Poles While in Service

By John F. Givens

In large cities it often happens that a pole must be removed and replaced by one having a greater height, more space or increased strength because of the limitation imposed by heavier load densities, etc. The work must be done without interrupting the supply to the customers, without endangering the apparatus or the lives of the men doing the work, and for as low a cost as feasible.

It is not difficult moving a pole when it carries one or two small circuits. It is a very different matter, however, when the pole carries two three-phase, 2300-volt circuits, three single-phase transformers of 25 kv.-a. or more, and three lightning arresters in addition to heavy secondary copper. To complicate matters imagine that a 100-pair telephone cable is strung along the same pole, and belongs to another company. Under the circumstances extreme care must be taken that the pole when being moved "off center" to make room for the new pole does not tipover due to the pull of the cables acting with the weight of the transformers; or that any of the conductors be broken. Current must be kept on the line at all times, of course. An interesting way of doing this job, that is economical of time, and is safe, is as follows:

Set pike poles to hold the pole that is in service. Dig the earth away around this pole, removing additional earth from the side to which the pole is to be moved until the other pole has been set in place. When sufficient earth has been taken out, and to the proper depth, lay two cross arms upon the earth, one each side of the pole and in such direction that they lie parallel to the path of travel of the pole in its movement. Over these cross arms place a roller, about six to ten inches in diameter. Many line gangs possess special rollers with "tommy holes" drilled in them. This roller is laid across the cross arms on the side of the pole nearest the direction of travel.

Now around the pole, and as low down as possible, fasten a chain, bringing the loose end up and slinging it round the roller, where it should be anchored. Men at the pike-poles must now stand ready to help balance the pole should any unexpected strains occur.

Two men stand at the roller, each with a pinch-bar in his hand. The one man inserts his bar into the roller and gives it a turn toward the new temporary position the pole is to take. When he has done this the other man places his bar in the roller and holds the roller in this position until the first man has taken a new position in the roller and given it one more turn. The one man does the turning, the other one keeping the roller in position each time. The men on the pike poles are meanwhile watching their end of the job carefully, while the foreman keeps his eyes upon the conductors, the slant of the pole and other important details.

By moving a pole this way the pole is lifted and at the same time moved over in the direction it is desired that it should go. All possibility of breaking conductors and of the pole overbalancing is obviated, provided proper care is taken. There is no need for any service interruptions whatsoever.

When this pole is in its new position the new pole is put in the hole formerly occupied by the old pole. It is raised and set. The transformers, cross arms, arresters, etc., are then transferred to the new pole from the old—a space of about two feet intervening. When this has been done the old pole is taken out

and the ground tamped down good and solid. In this way a difficult and dangerous job is made one of simplicity, safety and economy.

\* \* \*

### Cost of a Concrete Building

By W. P. Anderson, President, The Ferro Concrete Construction Co.

In many cases a property-owner, a superintendent, or an electrical engineer wishes to calculate roughly the cost of some proposed improvement before going to the trouble of calling in a building contractor for a formal estimate. In such cases it is well to have at hand some figures on the costs of reinforced concrete buildings, for that type of construction is being very generally used for light manufacturing, for car-sheds and for sub-stations. Many items in the cost of such buildings will vary, but we may take as a basis a plain structure, with no fancy exterior decorations, and as the principal items which go to make up the cost, such as, walls, windows, floors, floor finish, stairs, toilets and plumbing fixtures. The cost of excavation, heating, lighting and elevators is so dependent upon each particular building that these items are omitted from the estimate.

The assumed load on the floors is 150 lbs. per sq. ft. with column spacing about 18 ft. on centers and story heights about 12 ft. We may estimate the base cost on a building 50 by 50 ft. as about \$1.55 per sq. ft. of floor space. If the building is 50 by 100 ft. this price would be reduced to \$1.20. If 50 by 150 ft., it would be \$1.12, and if 50 by 200 ft. it would be \$1.07. In all these cases the building is assumed to be from four to ten stories high. A three-story building would cost somewhat more but the difference would be very slight. A two-story building would cost from 10 to 12 per cent. more than these figures, and a one-story building from 15 to 20 per cent. more. A decrease in the width of the building would increase the cost so that for a width of 25 ft. instead of 50 ft. the unit cost would be increased from 35 to 45 per cent. If, however, building widths are increased the costs would be correspondingly decreased.

The effect of increasing or decreasing the floor load depends on the height of the building. Obviously, there would be practically no change on a one-story building as the load comes directly on the ground. In a six-story building the decrease in cost for a 75-lb. load would be about twelve cents per square foot of floor space. This figure would also about equal the increase in cost if the live load was doubled.

The effect on the cost of varying the column spacing will not be great. Where columns are spaced about 15 ft. apart the cost will be about 6 per cent. greater than where columns are spaced 25 ft. apart both ways.

In giving these estimates of costs for reinforced concrete buildings allowance has been made for two stairways and one elevator tower for a building under 150 ft. in length, and two stairways and two elevator towers for great lengths. Two plumbing fixtures per floor are allowed for the first 5,000 sq. ft. No allowance is made for any interior partition work except that which would be necessary around stairs, elevator shafts and toilets. Of course, these estimates are based on plain factory buildings, and any attempt at decoration would naturally increase the cost.

The percentage of window area to wall area will have but little effect on the unit cost of the building. In figuring the estimates given a steel sash window with ordinary glass has been used. If wire glass should be found necessary the cost would be considerably more than for plain wall.

\* \* \*

A new subscriber gives his position as "Burglar". Perhaps he finds this a profitable side-line to his regular business of electrical contracting. "Electrical Age" tries to be of service to its readers but it disclaims any intention of running a series of articles on the theory and practice of house-robbery.

# Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

## Practical Calculation and Construction of Rheostats

By Norman G. Meade

There is probably no one piece of electrical apparatus that is used to a greater extent around a power plant than the rheostat. It may take the form of a motor starter, a field rheostat, a battery charging rheostat or a resistance for testing and other purposes. It is the purpose of this article to describe in a practical manner the calculation and construction of rheostats for power plant use from materials that can be easily obtained. Commercial resistances are frequently made up from alloys which have some advantages, but iron in the form of wire, ribbon, or netting can be made up into resistance units that will serve all practical requirements.

It is a well-known fact that currents of electricity flow through some substances more easily than through others, the relative ease of the passage of the current being termed conductance. In making calculations, its reciprocal, resistance, is universally used. A current of one ampere is maintained by an electromotive force of one volt through a resistance of one ohm. This is the familiar Ohm's law, which is expressed math-

ematically by the formula  $I = \frac{E}{R}$ , where  $I$  = current in amperes,  $E$  = potential difference in volts,  $R$  = resistance in ohms.

### A Wire-Netting Resistance

One of the cheapest forms of resistance to construct is made

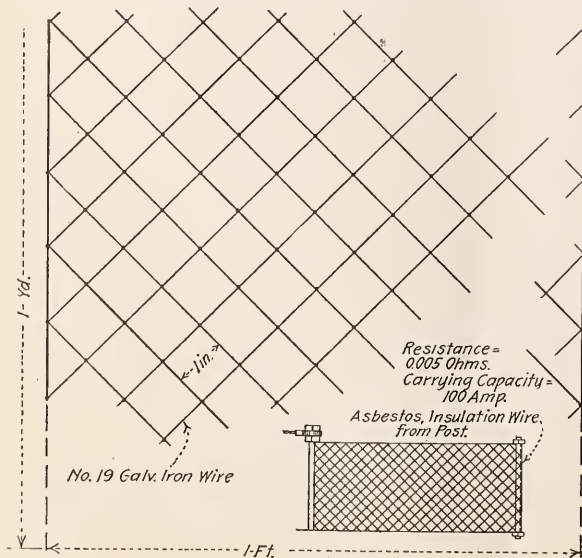


Fig. 1

up from wire netting and is shown in Figs. 1 and 2. This form of resistance is suitable for large carrying capacities and comparatively low resistance. Wire netting with a one-inch mesh,

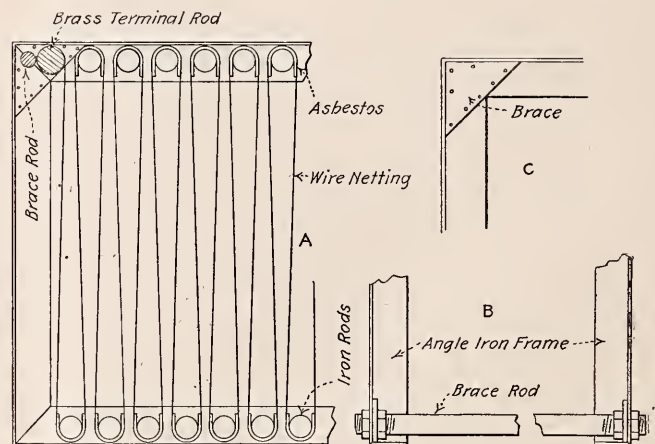


Fig. 2

made up from No. 19 galvanized iron wire, and one foot in width has a resistance of 0.005 ohms per yard and has a carrying capacity of 100 amperes. This form of rheostat is convenient for phantom loads, for use in connection with the electrical method of thawing frozen water pipes, etc. It is best constructed by supporting the netting on insulated iron rods secured to an angle iron frame as shown at A in Fig. 2. Strips of asbestos may be used over the rods for insulation. The first and last rods, however, should be made of brass or bronze to which the ends of the netting are secured by twisting the wire ends and soldering. These two rods should be insulated from the frame by fiber or porcelain bushings and provided with connection lugs as shown in Fig. 1. The netting must be "on the bias" as shown, otherwise the resistance and carrying capacity are much reduced. The iron rods, shown at C, Fig. 1, need not be insulated from the frame as the asbestos strips serve the purpose of insulating the wire netting. The manner of securing the corners of the angle-iron frame is shown at B and consists of a triangular-shaped piece of sheet iron riveted to the corners as indicated. The two sides of the frame are held together by a brace rod at each of the four corners as shown at C. The assembled unit should be protected from mechanical injury by fine-mesh wire netting.

Size of the frame will depend upon the resistance required and

its shape upon the place it is to be located. The calculations are simple, but the resistance must be such that no more than 100 amperes per foot of width will flow through the wire netting. Ohm's law states that  $I = E \div R$  and  $R = E \div I$ , therefore for a 110-volt circuit and a current of 100 amperes the resistance should be equal to  $R = 110 \div 100 = 1.1$  ohms. Then 1.1 divided by the resistance of the wire netting per yard,  $1.1 \div 0.005 = 22$  yards or 66 feet, the required length. Netting of varying widths may be used to secure various resistances and carrying capacities. Thus 22 yards of netting 2 feet wide has a carrying capacity of 200 amperes, but the resistance will be but half of the netting one foot in width, or  $1.1 \div 2 = 0.55$  ohms. This illustrates the principle that the current varies inversely as the resistance. Now let it be assumed that the resistance is to be used on a 220-volt circuit and have the same carrying capacity,

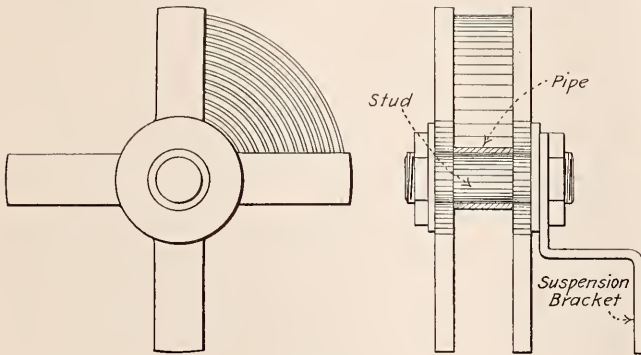


Fig. 3

that is, 100 amperes, the netting to be one foot wide. The resistance must be  $R = E \div I = 220 \div 100 = 2.2$  ohms. Now as  $I = E \div R$  it will be seen that double the length of netting must be used for 220-volt circuits in comparison for the length required for 110-volt circuits, or 44 yards will be required instead of 22 yards, in order to limit the current to 100 amperes.

**Sheet Iron Spiral Resistances**

Sheet iron ribbon wound in the form of a spiral and insulated with asbestos forms a hardy and convenient resistance unit. The ribbon may be sheared from large sheets of metal. The form for holding the coil is composed of two sheet iron spiders separated by a section of pipe and held together by a stud, and provided with a supporting bracket, as shown in Fig. 3. The ribbon is shown for only one quadrant of the spool. The resistance ribbon may be calculated by figuring the sectional area in comparison to that of wire. For example, if the wire has a sectional area of 0.25 in., the ribbon must be of such thickness and width that the product of the two dimensions will equal 0.25 in.

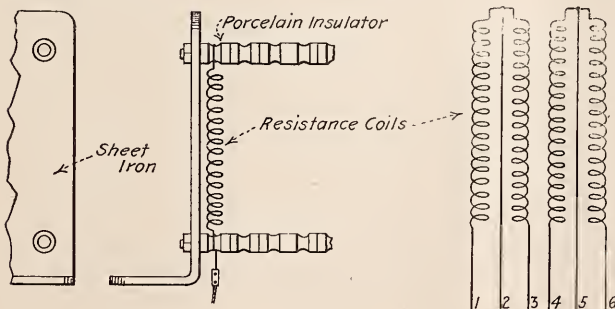


Fig. 4

**Open Wire Coils**

One of the most common forms of resistance units consists of wire wound into coils and supported in various ways. Wires larger than No. 6 B & S gage are difficult to wind in spiral form and wires smaller than No. 21 B & S gage must be wound on an insulated core. To obtain larger carrying capacity than

that of No. 6 wire, several coils must be connected in multiple. A convenient form of construction for a coil rheostat is shown in Fig. 4 and consists of two sheet iron end pieces connected by four corner rods over which porcelain insulators are placed. The wire coils are stretched from one rod to another and the various units connected by lead wires to contacts or switches as shown at the right-hand side. It will be noted that various combinations and capacities may be secured by connecting the various sections in series or in multiple

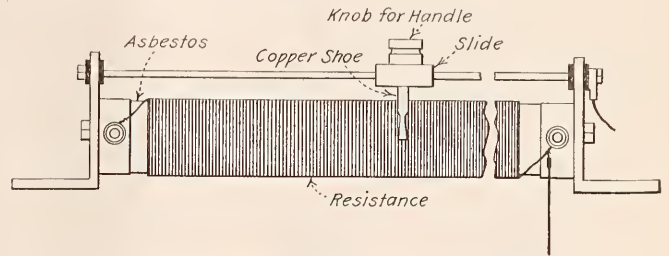


Fig. 5

**"Slide-wire" Resistances**

Another form of resistance, Fig. 5, consists of end pieces supporting an iron pipe with caps. The pipe is covered with asbestos and the resistance wire is wound with the screw-cutting motion of a lathe. A small space is left between the convolutions. The end pieces support an iron or brass rod, insulated from the frame, on which a metal slide with brushes bearing on the resistance wire, is free to be moved backward and forward. Any resistance from the maximum to the minimum of the coil can be secured by the adjustment of the slide.

**Carbon Compression Type Resistances**

Figure 6 illustrates a carbon rheostat which consists of an angle iron frame, a stationary and a movable iron plate, a screw provided with a suitable handle, and a quantity of arc lamp

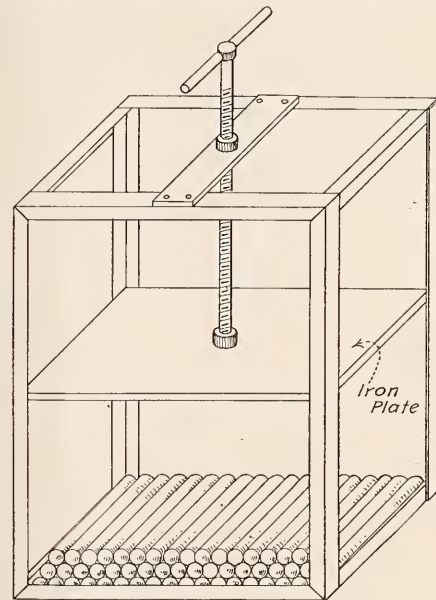


Fig. 6

carbons from which the copper coating has been removed by soaking in a bath of weak sulphuric acid.

The bottom side and the four upright sides of the frame should be filled with sheet asbestos or similar insulating material and the carbons laid in horizontally as shown in the bottom of the box of the diagram. Carbon will carry about 125 amperes per square inch and the resistance may be roughly varied over wide ranges by changing the height of the carbon pile. The fine adjustment of the resistance is obtained by varying the tension on the upper plate by means of the screw and handle. One

lead is connected to the upper plate and one lead to the lower plate.

When any kind of resistance elements are to be enclosed, 0.5 to one square inch should be allowed per watt dissipated by the resistance. With good ventilation and about one square inch per watt the temperature of the resistance will not rise above about 100 deg. C. (212 deg. F.) if the calculations have been properly made.

**Shunts for Series Fields**

Series-field shunts for direct-current, compound-wound generators and motors are compactly made up from one or more sheets of resistance ribbon shaped in the form of a grid as shown in Fig. 7. The turns are separated by insulating blocks and are held tightly in place by wire bands. Suitable copper terminals are riveted and soldered to the ends of the ribbon.

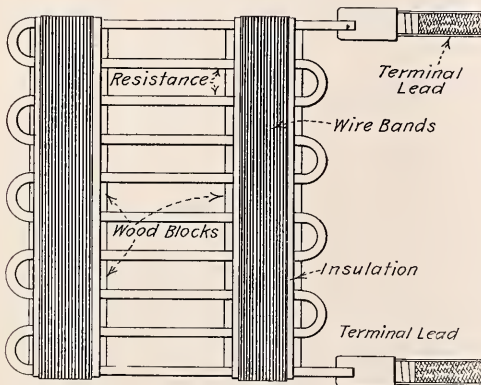


Fig. 7

**Liquid Resistances**

Liquid rheostats are convenient for high resistances. For small currents amalgamated zinc electrodes submerged in a weak solution of zinc sulphate are suitable. Liquid rheostats are especially adapted to the absorption of large amounts of power and are frequently used as an artificial load when testing newly

erected generators, or as temporary starters for large motors. Adjustments are continuous but the plates must be externally conducted with a switch to cut out the resistance entirely. There is no special importance attached to the selection of the electrode material but it is essential that it be a good conductor and if it is intended for permanent use, that it should not be attacked by the liquid. For sulphuric acid solutions, lead or carbon plates are used, copper is used with copper sulphate solutions but iron is most frequently employed. The current density in the electrodes should not exceed one ampere per square inch of material. The voltage and the necessary quantity of liquid to radiate the heat will determine the solution. For voltages under 1,000 pure water is seldom used. For lower voltages salt or sulphuric acid is added to the water to increase the conductivity. At a density of one ampere per square inch of electrode, water gives a drop in electromotive force of from 2,500 to 3,000 volts for each inch of gap between electrodes. A ten per cent. solution of sulphuric acid and water has more than five times the conductivity of copper sulphate and water. For each horsepower absorbed continuously in a liquid rheostat, from 400 to 800 cubic inches of solution should be provided. For motors about 20 cubic inches should be used for starting and about 60 cubic inches for running.

Liquid rheostats can be made up in many forms. Fig. 8 shows a simple and inexpensive design consisting of a barrel on a platform with an upright support for a crank and pulley for raising and lowering one of the concentric metal cylinders forming the electrodes. The stationary metal cylinder is connected to one lead and the movable electrode to the other lead. At least four wood strips should be attached to the inside of the stationary electrode and extending some distance above it, to guide the movable electrode. Care must be taken that the attaching screws do not pass through the wood. Maximum current will flow when one cylinder is enclosed by the other, as at this point the resistance is reduced to a minimum. An equally satisfactory arrangement employs a small manhole-cover in the bottom and a similar cover suspended by chains attached at three points and converging to a rope which passes up to the pulley.

**Calculation of a Rheostat**

To illustrate the calculations of a metallic resistance assume that it is desired to make a resistance for an arc lamp rated at 80 volts and 5 amperes at the arc. The lamp is to burn on a 110-volt circuit. Sufficient resistance must be provided to provide for a drop of  $110 - 80 = 30$  volts. Resistance of the arc by ohm's law  $= E \div I = 80 \div 5 = 16$  ohms. Then the resistance required for the 30-volt drop will be,  $R = 30 \div 5 = 6$  ohms. As electromotive force varies directly with the resistance this can be solved by the simple proportion 80 volts : 30 volts :: 16 ohms : x ohms,  $x = 6$  ohms. For iron wire about 250 circular mils per ampere should be allowed. Then  $250 \times 5 = 1250$  circular mils, the required size of wire, which corresponds nearly to a No. 18 wire. Iron wire of this size (EBB) has a resistance of 140.8 ohms per mile or  $140.8 \div 5280 = 0.026$  ohms per foot. The required resistance is 6 ohms, then  $6 \div 0.026 = 230$  feet approximately. If the wire is wound on a 1/2-inch mandrel the length per turn will be 0.16 feet. There will be approximately 9 turns to the inch, or  $0.16 \times 9 = 1.44$  feet per inch. 230 feet divided by 1.44 equals the required length of the finished coil in inches = 159 or approximately 13.2 feet. The maximum length of a coil of No. 18 wire wound on a 1/2 inch mandrel should be about 12 inches so that 13 coils can be connected in series to meet the requirements. Resistances for any purpose are similarly figured.



"Preparedness" is being not only preached by practiced on the drill ground by employees of the Union Electric Light and Power Company of St. Louis. Uniforms are furnished by the company and rifles by the United States Government. General Manager A. C. Einstein is sponsor of the movement.

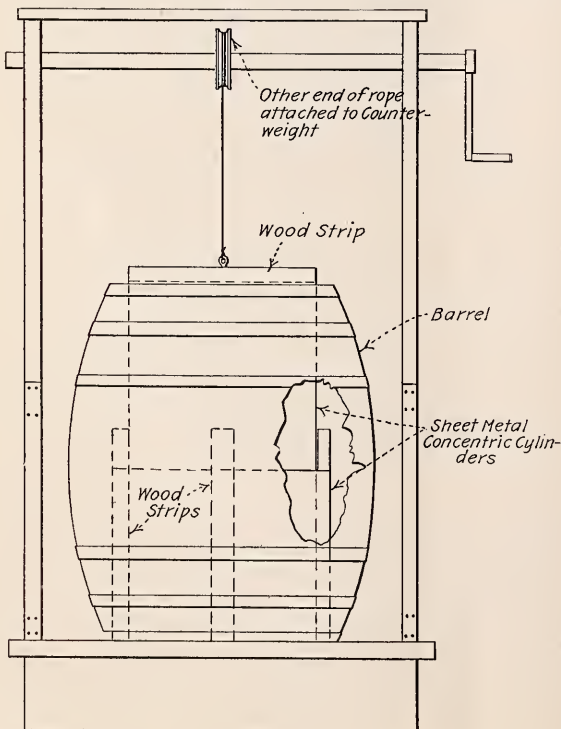
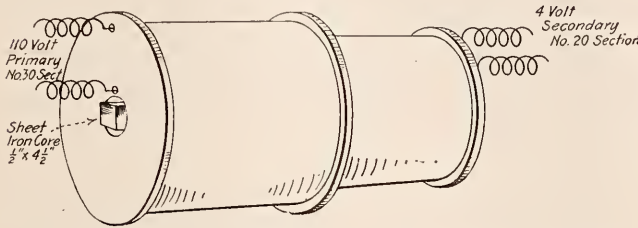


Fig. 8

### Unsatisfactory Bell Ringing Transformer

A transformer for ringing bells, fed from 110-volt, 60-cycle alternating-current and designed to give four volts on secondary side has been made according to sketch given below.

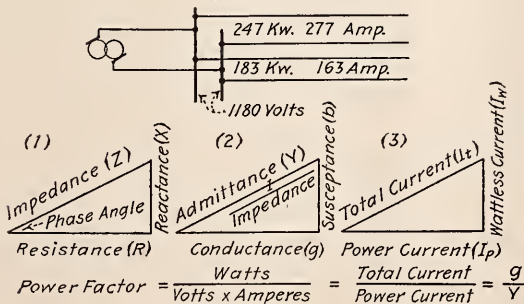
When in operation, however, there is an annoying variation in the sound of the buzzer which is quite different to the effect given when operating the same buzzer with a 4-volt dry cell. Can you suggest what the trouble is and how it can be remedied?  
C. K.



Answering C. K.'s query about the unsatisfactory performance of his bell transformer, the trouble would appear to be due to voltage variation in the buzzer circuit. The design of the transformer is inherently bad; due to the large air-gap in the magnetic circuit, and the small cross-section of the iron, the magnetic flux will be small. Hence there will be a large no-load current in the primary winding. As the secondary is placed against the end of the primary, the leakage between the two will be large. When current is drawn from the secondary, its voltage will drop considerably, and this variation in voltage may be the cause of the trouble. The remedy is to re-wind the transformer, using a core about an inch square made of soft iron wires whose ends project from the coils enough for them to be bent around and interlaced. The secondary should be wound over the primary, not beside it.  
M. S. McK.

### A Problem in Alternating Currents

Question: A small single-phase plant supplies power at 1180 volts to two sets of feeders. The first receives 247 kw. and the second 183 kw. The current supplied to the first is 274 amps. and to the second 163 amperes. (a) what is the equivalent admittance of the first load; (b) what is the equivalent conductance of the same; (c) what is the equivalent susceptance of the same; (d) what is the equivalent conductance of both loads; (e) what is the total equivalent susceptance of both loads; (f) what is the total equivalent admittance of both loads; (g) what is the total current supplied by the plant; (h) at what power factor is the plant operating?



The circuit drawing shows the operation conditions, and reference to the drawings will make clear the formulas used. All triangles are similar right triangles i. e., all angles are equal, hence the ratio of any two sides is the same for all.

Since  $I = \frac{E}{Z}$ , and  $Y = \frac{I}{E}$ ,  $Y = \frac{I}{E}$ , or for circuit No. 1,

$$\text{Admittance } Y = \frac{277}{1180} = .2348$$

$$\text{Power Factor } Pf = \frac{247000}{1180 \times 277} = .729$$

$$\text{Conductance } (g) Y \times Pf = .2348 \times .729 = .1713$$

$$\text{Susceptance } (b) = \sqrt{Y^2 - g^2} = .161$$

By the definition of conductance,  $I_p = E g = 1180 \times .1713 = 202$  amps and by the definition of susceptance,  $I_w = E b = 1180 \times .161 = 190$  amps.

For circuit No. 2,  $Pf = .951$ .

Power component of current  $I_p = I_t \cdot Pf = 155$  amps.

Wattless component of current,  $I_w = \sqrt{I_t^2 - I_p^2} = 50.5$  amps.

To find the total current flowing in the generator circuit, we add the power and wattless currents separately, then take the square root of the sum of their squares:

Power component,  $202 + 155 = 357$  amp.

Wattless comp.,  $190 + 50.5 = 240.5$  amp.

Total current  $= \sqrt{357^2 + 240.5^2} = 431$  amp.

Then power Factor of plant as a whole  $= \frac{I_w}{I_t} = \frac{357}{431} = .828$ , and

Conductance  $g = \frac{I_p}{E} = \frac{357}{1180} = .305$  Susceptance  $b = \frac{I_w}{E} = .204$

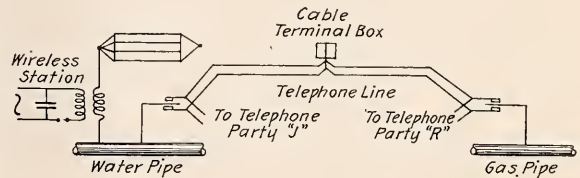
Admittance  $Y = \sqrt{g^2 + b^2} = .367$

\* \* \*

### A Case of Interference

By J. P. Armstrong

The wire-chief of a large city telephone exchange received one day a complaint from a subscriber that his line was so noisy he could not use it. There was no doubt of the fact; while they were talking there was a roar like a klaxon horn, which made hearing impossible. But the wire chief recognized the dots and dashes of the wireless code and knew at once what he had to solve.



The line tested clear of grounds, and the records showed it to be a party line with two telephones connected. The aerial lines from the cable terminal ran for some little distance in opposite directions to the subscribers' premises. Inspection showed that there was no direct leakage from the wireless telegraph aerials into the system, but that the wireless station and one of the telephone lightning arresters were grounded to the same street gas main, while the other arvester was connected to an entirely different pipe-line. On the supposition that the 60-cycle high-tension current of the wireless station, in seeking a better ground connection, was flowing from one pipe to another through the telephone line, the wire-chief disconnected one of the telephone grounds and immediately the noise ceased.

Electrically, what was happening is shown in the diagram. With every half-wave of the high-frequency side of the wireless set, the aerials were charged positively or negatively with respect to the ground. The charging current, amounting to

several amperes, was impeded by one or more high-resistance joints and so a small part of it jumped the air gap in both protectors on its way to ground in the distant water-main.

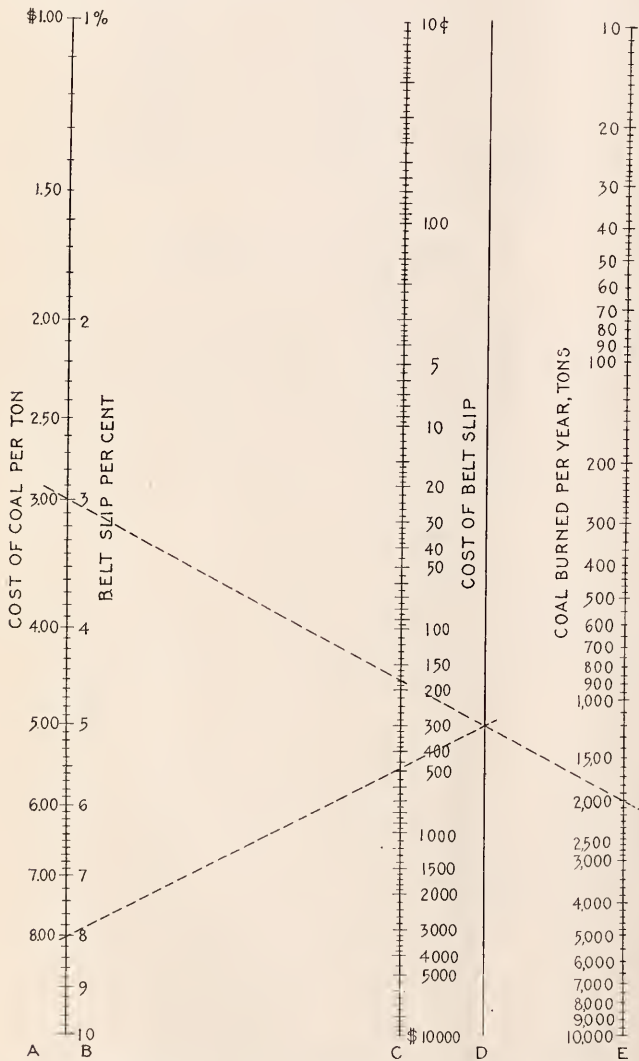
The remedy was to connect the wireless station's ground to the water system, and both telephone grounds to the gas system, when the trouble disappeared.

\* \* \*

### The Cost of Slipping Belts

By W. F. Schaphorst

In every plant, no matter how completely motorized, there are belt drives. This is due to the fact that existing plants have been changed from belt and line shaft drives, and have used the cheapest means of connecting motors to their old machinery. Moreover, belts drives give an element of flexibility which is desirable in certain cases. The disadvantage of belt drive is the ever-present slip, with its waste of power and wear on the belt. Only careful maintenance can avoid this, but how few men will give it! There is nothing to show up a slip of a few per cent, but it all comes out of the coal pile and a careless maintainer can waste a lot of money in a year. Just how expensive a slip can be is evident by the example worked out below.



Let us assume that all the power used passes through a belt from engine to generator, and from motors to machines, and that there is 2% slip at each pulley. As there are four pulleys through which each watt must pass, there is a total loss of 8%.

Let us further assume that 2000 tons of coal are burned

per year in this factory, and that the cost of the coal is \$3.00 per ton. What is the cost of the belt slip per year? First join the \$3.00 (column A) with this 2,000 tons (column E). Note the point of intersection in column D. Now join that point of intersection with the 8% slip (column B). The resulting cost is found at the intersection with column C and is \$480 per year.

These figures are not exaggerated in order to make them emphatic. \$480 per year is a serious enough loss to attract the attention of any factory or mill superintendent. There should be no slip at all. Slip is usually easy to stop. If it cannot be stopped there is something wrong with the design of the drive and alteration should be made.

To compute the loss under other conditions, any straight edge may be used, but the best form is one made by drawing a line with a sharp point on a transparent celluloid triangle. The line makes close contact with the paper, and there is no annoying refraction as is the case at the edge of such a ruler.

\* \* \*

### An Illustration of the Advantage of Similar Motors

The advantage of using motors made by the same manufacturers can hardly be better demonstrated than by the following example. The cap of the oil well at the pulley end of the shaft, by some mishap, got between the bearing housing and the armature winding, completely destroying the latter. It was a 4-horse power, 220-volt, d.c. motor driving a small isolated laundry. The repair shop was asked to supply a motor while the damaged motor was being repaired. The best that could be done was to furnish a 3 horse power motor of the same type and make. The damaged motor was mounted on a platform so close to the ceiling that a chain fall could not be used to lower it, and the laundry machinery was so arranged that the extra motor could not be set on the floor and belted to the line shaft. As the two motor frames and armature appeared to be about the same size the three horse power armature was tried in the 4 horse power frame and it fit perfectly. The speed of the line shaft was reduced by putting a smaller pulley on the three horse power armature so that it could not be overloaded. The working day of the laundry men was increased about three-quarters of an hour. The load was carried in this manner for two weeks without the slightest difficulty.

R. L. Hervey.

\* \* \*

### A Novel Signalling Device

Our motor-driven railroad turn table is located about 200 yds. from the power house. As we have only one engineer we are obliged to shut down at the noon hour, and if an engine has to be moved, the engineer must be notified to keep the plant running. I connected a lamp to the ground and a single pole switch between lamp and line wire in the cab on the turn table. When power is wanted a few minutes at noon to finish work the operator turns the switch which throws a light ground on one wire. The ground lamp on the board in power house lights and remains until the work is completed when the operator throws switch off, which notifies the engineer that work is finished. The engineer always looks at the switch-board before he shuts down. Another ground on the lines of course would interfere but this has happened only once in a year, in which case the operator notified the engineer verbally.

\* \* \*

### Heating Steel Tires by Electricity

One of the automobile manufacturers is now using electricity to heat the steel truck tires that must be expanded before being shrunk on wooden wheels. The tires are placed in an annular steel tub which is part of a transformer, the tires becoming secondary, and they are brought uniformly to a red heat in about three minutes. These tires are about ten inches wide by one-half inch thick and 36 inches in diameter.

# Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

## An Example of Profitable Co-operation

By George Carson

No matter how prosperous a community gets, there are nearly always vacant stores.

These stores are a big liability from every standpoint. They mean loss to the owner, who is paying taxes, insurance and other overhead expenses without any revenue; they mean loss to the central station, which is missing business it might logically expect to be handling; and it gives the town a black eye, because a vacant store is a sign of failure, actual or potential.

Any plan which will help, in the first place, to make vacant stores look less unattractive, and in the second place will make them productive and in the third place will develop their capacity lantern. The reason people say that the location is dead is because you've created that impression by keeping the building dark. There's no chance to rent it unless it is lighted."

So, in spite of the fact that the costs pertaining to the property were already exceedingly burdensome, the owner decided, after making arrangements with the real estate agent to handle the proposition, to permit it to be illuminated after dark, provided the expense was not prohibitive. So the task of the agent was to get the lighting company interested in making a special rate for earnings, is a good plan.

That is the sort of stunt which was recently worked in an Ohio Valley city, and because it has suggestions which are applicable to every other community, it is being described here.

The building in question is a big four-story mercantile structure on the corner of an important thoroughfare in a city of 250,000. The intersection, as a matter of fact, is one of the two most important in the city. The traffic is heavy, and the value of the property is high, accordingly. The building itself was erected only a few years ago, and represents an investment of about \$75,000.

### A Building Hard to Rent

Until recently it had been a white elephant in the hands of the owner, who was beginning to get tired of paying all of the fixed charges with never a red cent return. But one tenant had occupied the structure—a clothing merchant—and he had failed in six months, leaving among his other liabilities an item of unpaid rent. So that at the time referred to the owner was beginning to feel that he had plucked the largest and juiciest lemon in the whole broad field of real estate investments.

About that time he was solicited by a young real estate man, who thought he could rent the property. The real estate man, as Montague Glass would call him, is a bright young man with a good sense of publicity values. After dickering with the owner for a time, the latter inquired:

"What would you do first of all in order to rent that building?"

"I'd light it up," was the quick reply. "It's so dark on that corner now that you're likely to fall down if you haven't got a for current. He interviewed the commercial manager of the company, presented his proposition, and ended thus:

"The normal revenue to your company from that building, if it was rented, is \$200 a month, based on the consumption of

current by the former tenant. Therefore the longer it is not in use, the longer you are losing that \$200 of business. It's as much a selling problem for you as it is for me. Why not co-operate with me in order to help get that space into use, making it productive to you and to the owner of the property?"

The commercial agent can see through the hole in the proverbial mill-stone, and after pondering the suggestion, he admitted that there was something in what had been said.

"We would certainly like to see the building rented," he admitted, "and we are willing to do something to assist in bringing that about. Now, if you will give us the use of the display windows, we will keep them lighted without cost to you."

### Making Use of the Display Windows

The agent willingly agreed to this, and the commercial manager promptly began looking about for a means to use the windows. These ran around the building on both sides, of course, offering 150 feet for display purposes. Here was an exceptional opportunity for somebody to take advantage of. The central station man, after considering the subject from all angles, decided that the people who could make most profitable use of the space were the local dealers. Most of them had stores off the main thoroughfare, and it was likely that displaying some of their goods would help to get sales, and in this way still further increase the consumption of electric current.

The commercial manager selected three dealers. One was putting on an electric toaster campaign; another had a washing-machine which he was advertising in the newspapers, and the third was in the electric sign business, and of course had plenty of display material which could be used to feature that department. When they were offered 50 feet apiece for use in the promotion of their business, they fell over themselves accepting the offer. The only conditions was that they provide the lamps.

### How the Situation Was Lined Up

The owner put in as his stake the use of his building;

The central station furnished the current;

The dealers provided the lamps and made the displays.

Each was giving something, but nobody was assuming all of the expense, and the possible results to each one of the three interests were so much greater than the investment that the proposition looked mighty attractive all around. The dealers probably got the best of it, because window display space on a down-town street in a big city is valuable, the average drug-store with less than a 10-foot frontage frequently selling its windows for \$50 apiece per week. So the dealers were getting at least that much value out of the display facilities, at a cost represented only by the possible expense of lamp maintenance and the labor of transporting and setting up their displays.

It is always pleasant to be able to record the success of a good idea, and this one went big, as the vaudeville people have a habit of saying. The dealers got a lot of inquiries for electrical goods, and the real estate man did not have to lose any time before being able to work on prospects for the building.

In fact, as soon as the windows were lighted up, the agent was asked what was going on. He replied frankly that it was a publicity plan, pure and simple, and that all that was desired was to let the public know that the building was on the map, and that it was available for renting purposes.

A real estate man only needs prospects to get business, and thirty days after the stunt was put on, the leading piano concern of the city signed a lease. This, remember, was after the building had been vacant for two years. Good merchandising skill, plus the right kind of publicity—electric lighting—had done in one month what other methods had failed to accomplish in twenty-four. And the central station is going to realize on its investment in current much sooner than it would have developed revenue had it not been willing to co-operate in this way.

**How the Scheme Worked**

"The plan was a big success," said the commercial manager in discussing the details of the proposition, which attracted considerable attention in electrical circles in that city. "We are impressed more than ever with the fact that every vacant building, especially a business building, is a loss to us, because it might be made to produce a revenue in the form of the consumption of electric current. That the central station is interested in lending its facilities to secure the rental of these buildings seems to me to be apparent.

"We are now considering offering special inducements to owners and agents to use current in the illumination of vacant stores, in the way that we did with the structure we have been discussing, provided that we get the use of the windows. We can always arrange some sort of business-getting exhibit, and in this way co-operate with the electrical dealers, most of whom can use all of the advertising space they can get. Such a plan kills two birds with one stone, inasmuch as it helps us to sell current through renting the building and also through promoting the sale of electrical appliances of various kinds. In addition, of course, it builds good-will with the owners of the buildings and with the dealers, a factor which is too important to be overlooked."

Meanwhile, the real estate man who put over the big deal has been so enthused over the possibilities that he has since purchased a number of transparent electric signs advertising his firm, for use in the windows of other vacant stores. He has found these to be inquiry-getters.



**Meter Reading by the Consumer**

One of the sources of annoyance in the meter department of every central-station company is the customer who is "out" when the meter-reader calls. At least one more trip must be made to pick up this reading, and usually it will be a long trip, for all the other meters in the vicinity will have been read at the regular time. A method of avoiding the expense of a second trip has been used by a number of companies with

Folio \_\_\_\_\_ 191 \_\_\_\_  
 Our meter reader called \_\_\_\_\_ to read your meter No. \_\_\_\_\_, but was unable to gain admission. Will you please mark on the dial below the exact position of the hands on your meter, and promptly mail this card. The index as reported by you will be used for rendering your bill this month.



The above represents position of hands \_\_\_\_\_ 191 \_\_\_\_

If you prefer to have the reading taken by us, kindly advise date and hour we may call  
 You may read my meter on \_\_\_\_\_ 191 \_\_\_\_ at \_\_\_\_\_ M.

From \_\_\_\_\_  
 Address \_\_\_\_\_

Electric Company also makes use of this method. They find that errors, accidental or otherwise, are made occasionally, so that they do not send a card to the same customer twice in succession. At the time of the second reading any error can readily be adjusted without offense. The information on how to read

**HOW TO READ YOUR METER.**

You undoubtedly verify your household bills, making sure that you receive the goods for which you pay. This Company is anxious that you should check your electric bills. The illustration shows the dials upon your electric meter. Each division of the right-hand dial represents one kilowatt hour. To read this dial, take the figure that the hand passed last. In the illustration it is 3. Read the next dial to the left. In the illustration it reads 2. Likewise read the other dials to the left, which read in the illustration 4 and 6 respectively. If you will read your meter in the same manner it will give you the reading of your meter in kilowatt hours. Subtract from this figure the index of your last bill and the difference will be the kilowatt hours used between the two dates.

NARRAGANSETT ELECTRIC LIGHTING CO.  
 Courtesy "Edison Sales Builder"

meters is of value to subscribers of a cautious turn of mind who want to be sure they are not being overcharged. To the average person, an integrating wattmeter seems hopelessly incomprehensible, and any device which may show him that it can readily be understood will make him feel that he is at least not utterly dependent on the word of the meter-reader.



**The Sales Value of Illumination**

At one of the monthly meetings of the Louisville Gas & Electric Company, Mr. Emile Pilpel told an interested audience of some of the methods he uses for increasing the connected load in show windows and interior store lighting. Mr. Pilpel stated that it was a difficult matter for him to say how a salesman should approach a prospective customer in his district, for every different class of business man has to be handled so differently. As an illustration he described approaching an old lady who ran a little shop on one of the streets out of the line of traffic where eggs and butter were sold. The shop was illuminated very dimly with carbon lamps. He spent some time trying to persuade the old lady to substitute large nitrogen lamps to replace the small carbon units, but was unable to convince her that the increased illumination would have sufficient sales value to justify the expenditure. Therefore he got her permission to try a little experiment. He placed one case of eggs on the sidewalk at one side of the entrance over which he hung a carbon lamp and put a sign over the eggs reading "Fresh Eggs—25c per Dozen." On the other side of the doorway he placed another case of the same eggs over which he hung a bright nitrogen lamp and a sign reading "Fresh Laid Eggs—27c per Dozen." Then he stood in the background and watched the proceedings, and every one who came near walked over to the bright light and bought the eggs labeled "Fresh Laid Eggs" and paying for them at the rate of 27c per dozen. During the evening the old lady sold out that entire stock and none had been sold out of the other one. By this demonstration he convinced his customer of the sales value of illumination.



**Bringing Patrons to Display Room**

A means of increasing the good-will of the community for his company, as well as bringing patrons into closer touch has been developed by Manager Coffy, of the Everett, Washington, Gas Company. It is a plan which is even more applicable to the sale of electrical devices for household use, for it will draw especial attention to the cleanliness and coolness of electric cooking. Says Mr. Coffy:

"A large percentage of the patrons of a gas company never visit the office, as they settle their monthly accounts by check through the mail. This class of patrons generally includes the company's best customers and those financially able to keep the most modern and up-to-date appliances. If it were possible to place before these customers in a favorable way the latest designs in gas ranges as well as water heaters, both automatic and tank, and small appliances, there is no doubt but that a gratify-

success. A return postal card, printed as shown in the illustrations, is mailed to the customer when the meter-man turns in his report. According to the Narragansett Lighting Company, of Providence, R. I., about 57 per cent. of the cards bring replies. For these there is but the cost of clerical labor, printing and postage, the total of which is very much less than that of sending a man to read the meter. The New York & Queens



ing number could be sold. As a means of overcoming this situation we have been offering part of the space in the front of our office, including one show window, to various churches for holding sales of food stuffs. Since starting this five weeks ago there has been a sale every Saturday with from two to eight women in attendance besides the number of buyers who come through advertising given the sale through the press and pulpit. Through this means we are getting people in our office who have not been there for years and when once in will almost invariably look over the various appliances we have on display. An excellent example of the value of these sales occurred last Thursday when the ladies of Trinity Episcopal Church held a sale of hot cross buns for Good Friday. One of the members of the congregation came in with her husband and almost before making her purchase of buns became enthusiastic over a \$40.00 range with enamel trimmings and glass oven doors. This couple was in the office but a short time but before leaving signed an application order for the range. Besides the value of this plant as a sale stimulator it is also of extreme value in securing the good will of all those with whom we thus have a chance to come in contact. It has been somewhat difficult to get this started as the churches could not understand why we were willing to do so much for them. At the present time we believe that as soon as the churches understand the proposition we will have the space engaged for weeks ahead. Besides giving such space as they need for their sale we connect a gas range in the window for their cooking and donate the gas they require."

\* \* \*

### Snappy Phrases for Window Cards

The vast number of advertisements which nowadays seek to capture the potential buyer's attention have made it necessary to use every artifice of the showman to gain a hearing. For window displays the element which really carries the sales-message home is the show-card. If it bears a catchy phrase, its chances of being read are all the better. For live dealers who want to make their windows pull in trade, these phrases, worked up by the Society for Electrical Development will have a very timely value:

- A cool feature for a hot day. (Fans)
- A breezy thing for a hot day. (Fans)
- A daily advantage. (The Wired Home)
- Built to do business. (Motor)
- Comfort suggests them. (Fan or Range)
- Cost is trifling. (Wiring)
- Be good to your eyes. (Lighting)
- Cooking comfort at small cost. (Appliances)
- A touch and there's heat—another touch—gone, Clean—Simple—Safe. (Electric Range)
- Start the summer right. (Electric Fan or Range)
- Simple in construction—always ready. (Washer)
- The thing for spring cleaning. (Electric Cleaner)
- Made of the best materials, put together by people who know how. (General)
- Very easy to own. (Appliance on deferred payments)
- Worth while in warm weather. (Range; Fans, etc.)
- Your money is simply on deposit here until you are perfectly pleased. (General)
- Sure it's warm, but here's the remedy. (Fans)
- Cool things for torrid days. (Fans)
- The foundation of a comfortable home is electric service. Rich, clear—fragrant coffee—the real "starter" for the day's work. (Percolator)

\* \* \*

### U. S. Mail for Lamp Deliveries

The problem of delivering lamps to consumers is one of importance to every central station which sells them. Usually the profit on the transaction is small or entirely absent, so that it is necessary to make every possible economy in order not to

show a loss. By the use of a corrugated paper mailing-case the Rochester Railway & Light Company, of Rochester, N. Y., has been able to make deliveries by parcel post in a most satisfactory manner. The case is made of a single piece of double-back corrugated paper board, of the weight called "parcels post stock." It is seamed with gummed tape and the ends are left open. Three sizes are used, all of which are 6 in. high and 11 $\frac{7}{8}$  in. long, the dimensions of the standard lamp carton. The sizes are 3, 6, and 9 in. wide accommodating respectively one, two, and three cartons. The cases may be wrapped in paper or merely tied with twine. No printing appears on the case.

Pre-canceled stamps are used to save unnecessary handling by the postal clerks and the jar of the cancelling operation. The post office has co-operated most heartily in securing prompt and safe delivery, and the losses from breakage has been negligible. On an average, 6,500 lamps per month are delivered in this manner.

This would seem to be an excellent method for all who have lamp-deliveries to make. Such cases can be made by any manufacturer of cardboard boxes; an average figure for those used in Rochester is \$25.00, \$35.00 and \$50.00 for the sizes given. At slight additional cost advertising matter may be printed on the cases, or some design similar to that used on Mazda lamp cartons.

\* \* \*

### The Monthly Window-Display Suggestion



This display used by the New York Edison Company, takes advantage of timely interest in Flag Day

\* \* \*

### Novel Use for Electric Air Heater

The St. Marks Hospital of Salt Lake City Utah, has a set of four dumb waiters running from the basement to the first, second and third floors carrying food from the kitchen to the various wards. Great difficulty was encountered in keeping the food warm from the time it left the kitchen until it arrived at its destination.

Mr. Chadron, general manager of the hospital, gave the problem careful study and finally designed and had built several portable wagons. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air tight. A Western Electric Navy Type Air Heater is mounted on the bottom of the wagon with a cord and plug attachment capable of being connected ten feet from the wagon. An hour before each meal the various heaters are connected to a source of electric current so that at meal time the interiors of the wagon are satisfactorily heated.

After the wagons are loaded with the trays of food, the heaters are disconnected and the whole contrivance is placed on the elevator and raised to its destination where the heater is again connected to a source of current supply and remains so until the last tray is removed.

The new system is in constant operation and it is found to work perfectly—the food is served to the patients quite as warm and palatable as when it left the kitchen range. The installation has been the object of favorable comment in hospital circles.

\* \* \*

### Louisville Housewiring Records Again Broken

During a single week solicitors of the Louisville Gas & Electric Company, secured contracts for wiring 131 already built houses, the largest number ever secured by the company in any one week. This makes a total of 1,229 housewiring contracts secured by the company's solicitors, since the first of the year, covering an expenditure by the public of more than \$38,000 for this class of work. These figures cover only orders taken by the company's own solicitors and do not include the large number taken by the many electrical contractors of Louisville individually.

\* \* \*

### Northern Idaho Co.'s Appliance Campaign

Complete report covering a seven-day appliance campaign in the Sandpoint, Idaho, division of the Northern Idaho & Montana Power Company shows sales of 229 household electric appliances with a total kilowatt demand of 120.4 kilowatts, including 89 flatirons, 91 utility grills, 19 electric percolators, 4 twin glowler radiators, 2 electric ranges and 28 other appliances. These results were secured by four house to house salesmen, whose calls were heralded by small newspaper advertisements and printed circulars. Prospects were secured for 15 electric ranges. Two new residence electric customers were obtained and the school board at Newport, Washington, was interested in installing 12 electric disc stoves in the High School's Domestic Science Department. Approximately one-fourth of the residence customers in the territory canvassed purchased appliances.

A similar effort conducted in the Kalispell, Montana, division was responsible for the sale of 274 lamp socket appliances and one electric range.

\* \* \*

Following the lead of White Plains, N. J., the electric light poles of Wallingford, Conn., will as far as possible be hidden this summer by climbing roses.

### A Pertinent Demonstration

The Denver Gas & Electric Light Company is conducting an aggressive campaign for electric trucks. A demonstration that could not be surpassed was recently made by accident. A Denver manufacturer who owns two gasoline trucks recently moved his plant. On the day that he intended moving, both gasoline trucks went dead because oil for the cylinders had been forgotten. In consequence the manufacturer asked for electric truck demonstration, and one or more sales seem probable. As expressed by one of the salesmen, "This demonstration brought out the point that if you want to operate a gas truck with any success, you have to buy brains to drive it."

\* \* \*

### Chicago Telephone Co. Flies Illuminated Flag

Visitors to the N. E. L. A. Convention who were within sight of the Telephone Building on West Washington Street after nightfall noted with interest the fine appearance of the company's illumination of "Old Glory." A 30 by 15½ foot silk flag, more than 300 feet above the street was lighted by four projectors containing 250-watt stereopticon lamps, and two containing 500-watt lamps. Each night a man adjusts the projectors and lights the necessary number for the particular position in which the flag happens to be flying that night. Ordinarily four lamps are used. The total cost of the installation was about \$165, for materials, as the design and construction was handled by the telephone company's staff.

\* \* \*

### Electrical Requirements of Large Cities

According to some data collected by Mr. H. E. M. Kensit of the Canadian Waterpower Commission the following are the figures as to the electric requirements of twenty large American and Canadian cities. These figures comprise all sources of public supply, including the transportation items. They are for the year 1914.

A study of this table shows that Winnipeg, Atlanta and Vancouver are the three cities using most power generation per capita, while Philadelphia is the lowest, using only half as much as Columbus, which is next on the list.

Why should Philadelphia make such a poor showing? Is it not because it has the highest percentage of unwired houses? And doesn't this follow because it is an older city? It would look as if the present campaign for wiring the unwired houses should have particularly good results in Philadelphia.

	Estimated Population	Connected Load in Kilowatts		Peak Load in Kilowatts		Output-Generated in Kilowatt-hours	
		Total	per Cap.	Total	per Cap.	Total	per Cap.
Atlanta	199,740	88,000	.44	44,326	.22	145,684,803	730
Buffalo	457,900	137,872	.31	67,424	.147	302,220,107	660
Chicago	2,436,000	852,000	.35	344,500	.142	1,280,962,600	527
Columbus, O.	213,900	49,309	.23	19,471	.091	70,283,250	329
Detroit	583,000			87,800	.15	329,395,900	565
Louisville	232,350	97,000	.41	28,200	.122	100,692,219	433
Milwaukee	420,000			46,924	.112	170,889,000	406
Minneapolis & St. Paul	601,900	144,778	.24	91,655	.152	270,168,475	450
Nashville & Chattanooga	179,500	60,843	.338	20,200	.113	71,401,500	398
Philadelphia	1,671,000	202,086	.121	82,078	.49	272,711,745	165
Pittsburgh	572,000			71,000	.124	316,500,000	553
Portland, Ore.	314,000			47,775	.152	199,166,000	634
Providence	249,000	82,060	.330	39,700	.16	113,286,600	455
Rochester	248,000	68,177	.274	29,813	.12	123,850,785	500
St. Louis	740,000			92,176	.125	319,151,753	430
Toledo	187,250	60,315	.322	23,965	.128	91,996,426	491
Montreal	570,500	222,000	.384	65,000	.113	300,000,000	520
Toronto	468,000	178,677	.382	64,664	.137	250,240,500	535
Vancouver	186,400	61,290	.33	34,300	.184	124,884,565	668
Winnipeg	226,000	136,000	.60	43,300	.191	167,765,000	740

# The Care of the Feet

By J. F. Duncan

**L**EANING heavily on the desk which bore his log-sheet. Big Bill, the watch engineer, shifted his weight from one foot to the other. His eyes wandered from the switchboard clock to the door through which his "relief" would come, and he wondered if there ever had been a "trick" as long as his. He wasn't tired—but how his shoes hurt him! Nothing looked as good to him as the chair in the corner and the window sill which fairly invited his aching feet.

"Yes, they looked fine in the store, and they're still in good shape, but why didn't I have sense enough to get a pair I could work in?"

That is a question many and many an electrical man has asked himself—particularly at the end of a hot day when his feet have swelled till they have made otherwise bearable shoes bind like a straight-jacket. No man can do the sort of work the boss likes if his feet keep his tongue on the verge of profanity every minute, and many a bit of carelessness can be traced to ill-conditioned feet.

Yet most cases of aching feet are cured without difficulty, and more easily prevented, if the structure of the foot is thoroughly understood. Fig. 1 shows the skeleton of the right foot seen from the outside. If a mechanic were to make a model of the foot from metal, it would look something like Fig. 2. The framework, instead of being bones, is of sheet-steel, while the springs serve in place of tendons. As the leg moves forward and back, the springs "A" and "D" are extended and released. At the conclusion of a stride in walking the front of the foot is bent up, and when the foot is put down again, the heel strikes first. The jar is taken up principally by the extension of "A" as the toes come to the ground, and later by "B" and "C" when the whole foot is on the ground.

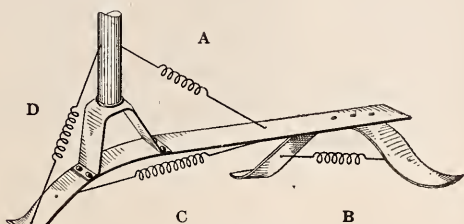


Fig. 2

What happens to a man with "flat feet" is at once evident. As the two arches are flattened, the strain on "B" and "C" is increased, until they fail entirely. The jar of each step is then received directly by the leg-bones and transmitted up to the body. But the greatest discomfort comes as the stride continues and the weight is thrown forward to the ball of the foot. The tendons represented by "B" and "C" are entirely unable to bear the strain, and they allow the bones to be distorted from their normal places. To secure relief from the pain which follows, the victim "toes out," or walks on the sides of his feet, only to make matters worse. Often the aching and swelling makes walking almost impossible.

The remedy for this condition is obvious when the cause is known. Two things produce "flat-foot"—wrong use of the foot in walking or standing, and improper shoes. It must not be thought that much use will harm the feet. They were meant to

support the body, and if given a chance will do so uncomplainingly. But they must be allowed to do so in their own way. They should always point "straight ahead," for thus the weight of the body is carried directly above the distributing arch. If "toeing-out" is practised, the weight is thrown off-center, and unnatural strains are set up. In standing, the knees should be stiff, and the weight equally distributed between both feet.

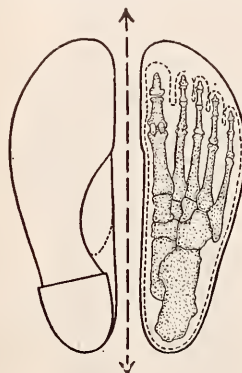


Fig. 3

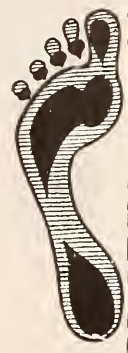


Fig. 4

Shoes may offend in several ways. Fig. 3 shows a normal foot in a normal shoe. The bones are here in their proper positions, but if the toe of the shoe swings toward the outside, or is too pointed, the whole foot is forced out of line, to the discomfort of its owner. Fig. 4 shows the great increase in bearing area which results with increase in load. Were the sole of the shoe of ample width, this would be of decided advantage, for it would reduce the unit pressure on the foot. With many shoes, however, there is reasonable comfort only when the foot is off the ground.

To no class is the condition of the feet of such vital importance as to our military and naval forces. After careful tests, the United States Government has laid down the following standards for shoes, abstracted by "Safety" as follows:

1. Material—Medium weight; uppers soft and yielding, to give sufficient thickness and strength. The soles should be single and flexible, yet tough leather.
2. Soles should agree with the print of your foot bearing the weight of the body with space in front of toes.
3. Heel—Broad, long, flat, low and solid.
4. Toe Cap—An extra thickness of pliable leather, no stiff box with hard sharp edges.
5. Permanent water-proofing is bad. A little oil on the upper surface is sufficient.
6. Construction—No arch supports; no folds of leather or seams over the ankle tendons. A light half-bellows tongue. Perfectly smooth interior. Large eyelets (no hooks).
7. Fit—Snug and comfortable, preventing shifting and the working of the heel up and down, yet allowing room for expansion of foot resulting from work. Length of sole at least one-half an inch greater than length of foot bearing body. Toes allowed to lie straight, flat and easy, especially the great toe, which should not be pressed against the others.

Shoes which correspond to these specifications are illustrated in Fig. 5. They disprove the idea in many minds that shoes to be comfortable must necessarily be clumsy. As a matter of fact the heavy soles and wide toes usually associated with working shoes are entirely unnecessary. The time is past when an elec-

trical man must sacrifice either appearance or comfort when he picks a pair of shoes.

If, however, the mischief has already been done, and the arches of the foot have been broken down, the best remedy is to have a metal arch support fitted by an expert. If his services cannot be secured, the supports may be fitted by bending them to conform to the shape of the foot when it is resting free of load. Massage morning and night is of benefit. As the tendons



Fig. 5

recover their powers, a less rigid support should be substituted. A cure will require from one to six months.

Rubber heels are very desirable, especially for central-station men who move about all day on hard floors. Some shoes are said by their makers to be good insulators from ground. What ever they may be at first, they eventually lose their protective quality through wear, and unless they are regularly tested, they will give a false sense of security which is a real menace. For protection around live circuits, rubber gloves and overshoes worn for no other purpose are alone worth using.



Shoes for Dress Wear Need Not Be Uncomfortable

It will be noted that Section 5 discourages the use of waterproofing. This is because of the application of sufficient oil or grease to render the leather really watertight will close its pores to the perspiration of the feet. Men who wear rubber boots know from experience how soon socks become wet and how the skin is softened by continual dampness. Ventilation is of particular importance to men whose perspiration is excessive or offensive. For this the remedy is absolute cleanliness. The feet should be washed thoroughly each day in warm water, then

rinsed with cold water, and dusted with any good foot-powder. Tan shoes are especially affected by perspiration, and careful attention may make a direct saving in money.

The wearing of tight shoes is responsible also for skin diseases of the feet. In most cases of corns or bunions a competent chiropodist should be seen, but incipient corns can be treated, first of all, by the removal of the cause—the shoe which presses on that spot—and the application of one of the standard corn-removing salves. The necessity for scrupulous cleanliness and the difficulty of securing it make treatment by the knife a source of great danger from infection. Cutting corns with a razor is as foolhardy a thing as is ever attempted.

Cold feet also are due to tight shoes, to lack of cleanliness, and to low vitality. The extreme case, frost-bite, calls for the conventional treatment of *gentle* rubbing with snow, lest the frozen tissues be broken up. Where the feet have been frozen for any length of time there is great danger that the blood may not start to circulate. The rubbing should continue for some time, and the frozen parts should be watched carefully for a day or two to detect any darkening, the symptom of gangrene.

In conclusion, it may be remarked that like every other part of our bodies, our feet will serve our every need if we treat them right. As long as we keep them clean, and do not hamper them by tight shoes, they will carry us through the longest day's work with ease and when the whistle blows, we can walk home with a feeling of superiority over the men who somehow are always so tired that they wait for the car.

\* \* \*

### Engineers March for Preparedness



Engineers were prominent among the 125,000 marchers in New York on May 13. This group includes Peter Cooper Hewitt, Thomas A. Edison, W. L. Saunders, and Hudson Maxim.

(Photo by Paul Thompson)

\* \* \*

Under the bulletin-glass of the system-operator or on the sliding leaf of the office-man's desk may well appear these maxims of the elder Baron Rothschild:

- Bear troubles patiently.
- Maintain your integrity as a sacred thing.
- Employ your time well.
- Be polite to everybody.
- Make no useless acquaintances.
- Never try to appear more than what you really are.
- Never tell business lies.
- Do not reckon upon chance.
- Refuse to be discouraged.
- Then work hard, and you are certain to succeed.

\* \* \*

"\$1,890 for Two Bottles"—Newspaper Headline.  
How many had he had before?

**Personal**

Harold Winthrop Buck, president-elect of the American Institute of Electrical Engineers, was born in 1873, and graduated from Yale in 1894. After receiving his E.E. degree from Columbia in 1895 he went to the General Electric Company's apprentice course at Schenectady. There he assisted in the development of a process for the manufacture of carborundum and later was assistant engineer in the lighting department.

In 1900 Mr. Buck became electrical engineer of the Niagara Falls Power Company, and in 1908 he came to New York as a consulting engineer in the generation, transmission, and distribution of electrical energy. He has had much to do with the development of the suspension type of strain insulator. His firm is Viele, Blackwell & Buck.

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Mr. John B. Sebring, Pittsburgh representative of the Ward Leonard Electric Company, has moved his offices to 901 Park Building. Mr. G. H. Armstrong has joined the Sebring organization.

\* \* \*

Mr. J. Ed. Erickson has joined the sales organization of The Packard Electric Company, of Warren, Ohio, and will cover the territory formerly in charge of Mr. Benjamin Smith. Mr. Erickson has specialized on motor car power plants and central station practice.

\* \* \*

Mr. D. A. Casey, who has been connected with the Westinghouse Electric & Mfg. Co. for the past six years as a machinery salesman in the Pittsburgh District, has resigned and organized the Service Supply & Equipment Company, with offices in the Fulton Building, Pittsburgh, Pa. The company will act as sales agent for machinery and supplies through the Pittsburgh district.

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O. E. Thomas, 626 Washington Bldg., Los Angeles, has been appointed district sales manager of The Terry Steam Turbine Co. for a territory covering Arizona and the southern portions of California and Nevada.

\* \* \*

Grattan Kerans, who for four and a half years was associate editor of "The Jovian," official organ of the Jovian Order, on June 1, returned to the editorial staff of the St. Louis "Post-Dispatch."

\* \* \*

**Obituary**

William Stanley, of Great Barrington, Mass., died on May 14, 1916. Mr. Stanley was a pioneer in electrical invention, and was the fourth recipient of the Edison Medal, for the creative work he did in developing the transformer and alternating-current systems. Mr. Stanley was born in Brooklyn, N. Y., November 22, 1858, and was educated at Williston Academy. After a short stay at Yale College he entered the electroplating business in New York City. Soon he entered the service of Hiram Maxim in the United States Electric Lighting Company. When Mr. Maxim gave up this venture. Mr. Stanley joined, for a short time, the staff of assistants about Dr. Edward Weston, the distinguished physicist and engineer. Later, in 1882, Stanley started a small laboratory of his own in Englewood, N. J.

In the spring of 1885 Mr. Stanley, then working for George Westinghouse in Pittsburgh, made his first "converter," now called "transformer," and operated it at the Pittsburgh shops for a few days. During the summer and early fall of 1885, although too ill to work steadily, he gave every moment possible to the perfection of his pet scheme, the devising of a system of electrical distribution that would greatly increase the distance over which electric energy could be conveyed. It was during this period of illness and before he was able to return to work that Mr. Stanley worked out the methods that have since been employed in the alternating-current system.



*William Stanley*

The first plant was erected by Mr. Stanley during the following year at Great Garrington, Mass., as a result of which the Westinghouse Electric Company began the manufacture of alternating current apparatus.

Later he devised several new kinds of alternating-current generators and two new kinds of alternating-current motors. In 1888 Mr. Stanley built the first induction wattmeter, an instrument that is used for measuring energy wherever alternating-current is employed.

In 1890 the Stanley Electric Manufacturing Company at Pittsfield, Mass., was organized by Stanley and his associates, Mr. J. F. Kelly, and Mr. C. C. Chesney. Their initials gave the famous "S.K.C. System" its name. Mr. Stanley has also invented and patented many devices and methods that have entered into the electrical product of the times. Recently he devoted a great deal of attention to thermal problems, in particular to the development of the electric range.

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Enos M. Barton, one of the founders of the Western Electric Company and for twenty years its president, died at his southern home in Biloxi, Miss., on May 3, 1916, at the age of seventy-two years. Since his retirement from the presidency of the Company, in 1908, he had been chairman of its board of directors.

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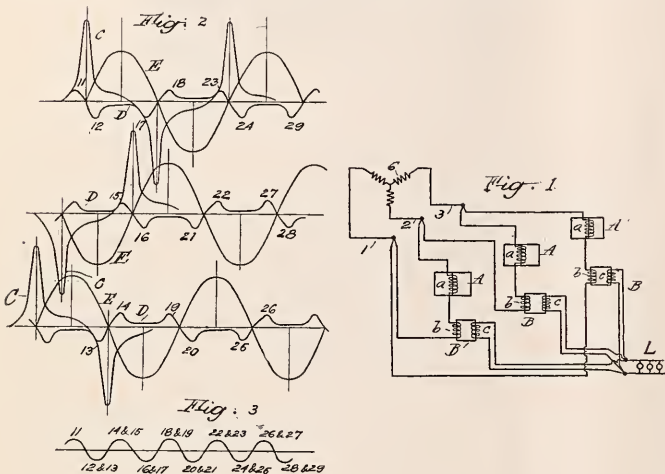
Professor Lucien Ira Blake died at Boston, Massachusetts, on May 4. Born in 1854, he studied under Hertz and Helmholtz at Berlin, receiving the degree of Ph.D. in 1883. From 1884 to 1887 he was professor of physics and electrical engineering at Rose Polytechnic Institute, and from 1887 to 1906 occupied a similar chair at the University of Kansas. In 1889 he began experimental work which led to the discovery of the now widely used submarine bell signalling device. Professor Blake also did important work in the development of the electrostatic ore separator.

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Henry Floy, electrical engineer and expert on valuations, died suddenly at his residence in New York City on May 5. He was a graduate of Cornell University in the Class of 1891, from which he entered the employ of the Westinghouse Electric & Manufacturing Company rising from engineering apprentice to manager of the company's Minneapolis office. In 1898 he resigned, and took up consulting work in New York, in which he remained until his death. Mr. Floy is the author of a number of volumes whose material is drawn from his own observation. Among these are "Valuation of Public Utility Properties," "Value for Rate-Making," and "High Tension Underground Electric Cables."

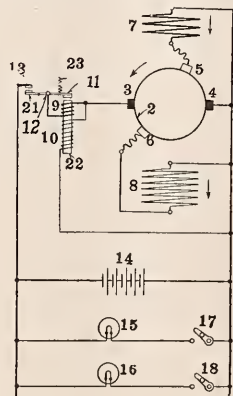
## Recent Electrical Patents of Interest

**Means for Changing the Frequency of Alternating Currents.**—Where a periodicity of twenty-five cycles per second is employed it is often desirable, for the purpose of feeding lighting circuits, etc., to obtain currents of higher frequency. According to a patent issued on April 25th, 1916, to Mr. Alfred M. Taylor, of Kings Heath, England, he provides an improved method of accomplishing this result by means of stationary transformers and choking coils. In Fig. 1, a choking coil with a saturated core A is connected in series with a primary of a transformer B, a coil A and transformer B being connected across each phase of a three-phase circuit. The transformer secondaries are connected in par-



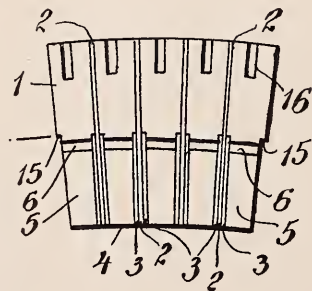
allel to the lighting circuit. The result of this arrangement is that the sinusoidal E. M. F. of the generator is deformed. In Fig. 2 the current and voltages of the respective transformer primaries are indicated, the sign curve E representing the E. M. F. supplied from the mains, curve C, the circuit in the primary, and curve D, the resultant E. M. F. in the primary. The combination of these in the lighting circuit is indicated by the curve of Fig. 3, the frequency of this circuit being triple that of the original source. Patent No. 1,180,800.

**Dynamo Electric Machine.**—It is desirable in many instances, notably on automobiles and in car lighting systems, wherein a generator operates in conjunction with a storage battery, that the generator should have a practically constant output regardless of generator speed. Auxiliary commutator brushes have been employed to limit the output, but it has not been kept constant. According to a patent to Mr. V. A. Fynn, of St. Louis, Mo., issued on May 16th, 1916, the regulation of the generator to constant output is attained by the use of auxiliary brushes in an apparatus as illustrated in the cut. The generator winding 7 is a low resistance shunt, while winding 8 is a high resistance shunt. The voltages across these windings vary with the speed and load and they are so proportioned that excitation of winding 7 is at first greater than that of 8. For the direction of rotation and magnetic flux as indicated, the voltage across winding 7 will diminish and that of winding 8 will increase with increase in speed or load. Under these circumstances, the proportion of



the total magnetization supplied by winding 7 will be great at low speed and the reverse is true of winding 8, with the result that the current output will not drop as fast with increasing speed as with winding 7 alone. By adjusting the auxiliary brush 5, the regulation due to the drooping excitation of winding can be governed and the rising due to the winding 8 can be independently adjusted by the brush 6. The fact that the two magnetizations can be independently adjusted makes it possible to secure a practically constant current output regardless of speed and also to vary the output curve within very wide limits. Patent No. 1,183,000.

**Commutator.**—In the manufacture of commutators it has been found that, after the assembly, the boring out of the interior sometimes forms burrs which carry across from one commutator bar to the next thereby connecting the same.



This difficulty is sought to be avoided in a patent to Mr. Bilton E. Thompson, of Ridgeway, Pa. His expedient is to make the insulation between the bars thicker adjacent the point of boring than at parts remote therefrom. The scheme is clearly shown in the cut. Patent No. 1,183,253.

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### A Substitute for Sulphuric Acid

An interesting development of a new product to meet an economic need is that of "nitre cake" as a substitute for sulphuric acid. This is a product consisting of 78 per cent. sodium acid sulphate, and 18 per cent. sodium sulphate. A hot saturated solution contains the acid equivalent of an 18 per cent. solution of sulphuric acid. This is satisfactory for many of the uses to which ordinary sulphuric acid is put, such as the removal of oxide and scale from iron and steel, and cleaning ("pickling") of these metals before galvanizing. Its use will release sulphuric acid for many processes in which "nitre cake" will not answer, with a resultant lowering of price for the more sought-for acid.

\* \* \*

### New Apparatus for Brockton, Mass.

A new substation in Brockton will soon be erected by the Edison Electric Illuminating Co., of Brockton, Mass., at a cost of about \$100,000. Upon completion of the new station, which will be equipped for alternating-current service, the existing substation, which is equipped for alternating and direct-current service will be used entirely for direct-current service. The new building will be designed for an ultimate capacity of 9,000 kw., the present transformer equipment to be installed totaling 3,500 kw. By the addition of a 750-kw. motor generator set the output of the direct current substation will be increased. Improvements, including the installation of a 10,000-kw. General Electric turbo-generator set, two 600-hp. Edgemoor boilers, equipped with Taylor automatic stokers, Wheeler Condensing & Engineering Company's condensing apparatus, and switchboard equipment, will be made to the East Bridgewater generating plant. The Stone & Webster Engineering Corp., of Boston, has the contract for the work.

### Recent Books

POLE AND TOWER LINES FOR ELECTRIC POWER TRANSMISSION, by R. D. Coombs, New York: McGraw-Hill Book Co., \$2.50 net.

The design construction of a transmission line is an engineering feat of no mean importance, embodying as it does the placing of foundations of some sort in ground of widely varying character, and the erection thereon of a superstructure which must bear severe stresses. The comparatively recent development of lines other than the wooden-pole leads of the telephone and telegraph companies is no doubt the cause for the lack of authoritative data on the subject. From his long acquaintance with transmission-line problems, Mr. Coombs is well qualified to speak.

The book has several points of merit. It sticks closely to the construction of the line, leaving electrical properties for other works. The author never loses sight of the fact that the cheapness of a line does not depend on reducing its first cost, nor on making its operating cost low, but on the proper balancing of the two. He is not dogmatic upon mooted points, such as line crossings, but gives the opinions of both sides fairly. The tables of construction data are of much interest not only to the man who has a similar line to build, but to the profession as a whole. Tables of wire-data are also of value for quick reference.

\* \* \*

THE ELECTRICAL CONTRACTOR by Louis W. Moxey, Jr., New York City: McGraw-Hill Book Company, \$1.50 net.

Mr. Moxey's book is one which should be read by every man who does electrical contracting work, whether as owner or workman. Probably one of the greatest causes of business failures in the electrical trade is the lack of knowledge of cost-keeping methods, and the necessity for such records of past performance. The testimony of an obviously successful man as to his dependence on full and accurate records should carry weight with his readers.

It is unfortunate that more has not been said about systems of book-keeping, especially simpler systems for the smaller shops. Owners of these shops, however, can devise their own system, bearing in mind Mr. Moxey's principles. The tables of construction costs are good, and for them alone the book should have a place in every contractor's office, as well as in every engineer's library.

\* \* \*

### New Power Plants

A \$300,000 hydro-electric plant on Tyger River, 16 miles south of Spartanburg, will be built by the Interborough Power Co., Spartanburg, S. C., developing 4,000 electrical horsepower for transmission. In order to generate electricity for transmission to Cliffside and other cotton-mill cities of Rutherford county, the Broad River Hydro-Electric Power Co., Cliffside, N. C., incorporated with \$500,000 capital will build a hydro-electric plant at Haynes Shoals, on Main Broad River.

\* \* \*

By the completion of the addition to the power house of the Mahoning & Shenango Railway & Light Company at Lowellville, Ohio, the capacity of the three generating stations of the Mahoning and Shenango system has been doubled. Batteries of 600 hp. Babcock & Wilcox boilers, with provision for the installation of additional boilers of the same type, comprises the new steam generating equipment. In order to serve the boilers, a new engine-driven fan of 60,000 cu. ft. per minute capacity was installed. The boilers are fed by centrifugal pump, operated by steam turbine, having a capacity of 1,000 gal. per minute, and have mechanical stokers. The new electric generating equipment consists of one 18,750-kva. General Electric turbo-generator unit, with condenser and auxiliary apparatus. The new generator has

its own exciter unit, which may be driven by a turbine as well as an induction motor. All the essentials, both in generating and transmission equipment, have been duplicated. An outdoor transformer and switching station is being erected south of the new building. The contract for the work was given to the Stone & Webster Engineering Corporation, of Boston, Mass.

\* \* \*

Preparatory work on the construction of a large hydroelectric power development has been begun by the Rochester Railway & Light Co., of Rochester, N. Y. The construction of a large horseshoe tunnel from the dam above the Middle Falls under the river to the eastern base of the Lower Falls, a distance of 1550 feet will be included in the work contemplated. The cost of the work is estimated at \$750,000. The elimination of station 15 on the west bank of the river at Middle Falls and station 5 on the east bank at the foot of the Lower Falls will be a result of the tunnel. Where station 5 now stands at the Lower Falls, a new power house 130 ft. by 70 ft. will be erected. Turbines of 16,000 hp. each will be installed at present, and later a third turbine of the same capacity will be installed.

\* \* \*

Contracts have been awarded and work is now under way for improvements to The Arkansas Light & Power Company's local system, at Marianna, Ark., including the construction of a new power house to be equipped with one 75-kw. and one 100-kw. belted unit (from old power house); one new 300-kva. General Electric generator (directly connected), one Allis Chalmers Corliss engine, one new feeder panel and one new generator panel to be added to General Electric switchboard; setting boilers in steel settings; rebuilding distribution system; electrically - driven centrifugal pumps are to be installed at the water plant which is now operated by the Arkansas Company.

\* \* \*

The commissioners of Phillips County, Dodson, Mont., are planning for the installation of an electric light plant and water system to cost about \$35,000.

\* \* \*

\$1,000,000 has been appropriated by the city of Minneapolis, Minn., to double the capacity of the present water filtration plant and to install a water softening plant. The replacing of two steam driven pumps at the Camden station with electrically driven pumps with a capacity of \$25,000,000 gallons per day is a contemplated improvement. The equipment in the extension to the filtration plant will be operated by electricity in addition to the new pumps. The Minneapolis Division of the Northern States Power Company supplies the energy for operating the water works.

\* \* \*

An offer to purchase the municipal electric lighting system and furnish electrical services in Burlington Junction, Mo., was made to the Town Council by the Maryville Electric Light & Power Company. The company will erect a transmission line from Pickering, the present terminus of the line, and supply electricity from the Maryland plant if it is taken over. Farmers along the line will also be served.

\* \* \*

Properties on Placer Creek, near Wallace, Idaho, will be immediately equipped for electrical operation by the Washington Water Power Company of Spokane. According to reports further operations are to be instituted and several mines are to be equipped in the near future by the power company.

\* \* \*

E. V. Buchanan, General Manager and Philip Pockock, Chairman, as a committee have been authorized by the Public Utilities Commission, of London, Ont., to engage an architect to prepare plans for a hydro electric sales building with offices above to cost \$75,000.

# N. E. L. A. Convention Report

(Continued from page 31)

There was an animated discussion of highway lighting following the report of the committee on that subject. Methods of inducing cities to use better systems were given amongst them those of trial installations for comparative purposes, and getting merchants to pay for the installation of "White-Way" fixtures.

An illustrated lecture by Mr. W. A. Durgin showed that lower prices and more efficient lamps would force the lighting load into the by-product class unless measures be taken to secure the adoption of higher intensities, indirect or semi-direct systems, and color control of lighting. Mr. Durgin's remarks were effectively illustrated by actual tests of various arrangements of illuminants and intensities of illumination.

## Third Electric Vehicle Session

The joint report on Operating Records, Garages, and Rates, submitted Thursday afternoon included four curves. The first showed the daily operating cost of commercial electric vehicles for different carrying capacities, as proved normal under the varieties of service this type of vehicle is employed. The second graph gave an indication of the energy consumed in charging batteries in public garages or where groups of vehicle are employed. A second copy of this graph was given, and it was requested that operators record their individual experiences on it, and forward the graph to the committee. The third graph was a method of obtaining the approximate number of commercial electric vehicles that can be garaged on various quantities of garage floor space. A chart showing an analysis of the cost of garaging commercial electric vehicles furnished a comprehensive list of all the elements to be considered. Costs for the elements were given, these being normal in large cities, which, because probably the maximum to be required, are variable.

H. A. Wagoner spoke at length on the necessity for co-operation between the manufacturer of electric vehicles and the central station, saying that the margin of profit and the commission allowed to agents were so low in comparison with gasoline cars that the latter had received more "pushing" in the market.

President Lloyd also addressed the newly-formed section, expressing his pleasure over the affiliation of the vehicle men. P. D. Wagoner told of the merits of a battery-service plan for vehicles, reference being made to an establishment which maintains over 200 cars. In answer to a question, Mr. Wagoner said that "dead mileage" under this plan was not great.

The election of officers for the following year resulted as follows: Chairman, E. S. Mansfield, Boston, Mass.; vice-chairman, G. B. Foster, Chicago, Ill.; treasurer, H. M. Edwards, New York City; secretary, A. Jackson Marshall, New York City; executive committee: W. H. Johnson, Philadelphia, Pa.; Arthur Williams, New York City; Frank W. Smith, New York City; P. D. Wagoner, New York City; Charles Blizard, Philadelphia, Pa.; J. W. Frueauff, Denver, Colo.; G. A. Freeman, Chicago; Charles A. Ward, New York City; H. G. Thompson, East Orange, N. J.; E. P. Chalfant, Detroit, Mich.; James H. McGraw, New York City; H. H. Suydam, Toledo, O.

## Fourth Technical Session

At this meeting, the report of the Committee on Power Supply for the Electrification of Steam Roads was read. The discussion included a paper on the same subject presented by Frederick Darlington. The desirability of

railroad load as increasing the diversity-factor and as a means of publicity was shown. If the Commonwealth Edison Company supplied all the power used in Chicago the maximum demand would be about 800,000 kilowatts, and of this the steam railroads would use but 15 per cent., while the manufacturing concerns would require about twice as much. It is thus evident that it is more important to get all manufacturing business, after which the railroad business will come as a matter of course. Some of the advantages of electric power to the railroads were mentioned. The following officers were elected: Chairman, R. J. McClelland; vice-chairmen, P. M. Downing, J. T. Hutchings, Farley Osgood, Charles Ruffner; executive committee, O. B. Coldwell, Thomas Sproule, I. E. Moulthrop. Stuart Wilder; secretary and treasurer, S. A. Sewall.

The session then adjourned.

## Fifth Commercial Section

This session was devoted principally to thermal applications of electricity. There was discussion of a paper on "The Resistance Heater as a Load Builder" and also on electric furnaces. The latter have a power-factor of .87 to .98 and an annual load-factor of 35 to 60 per cent. For high-grade products this method is superior to the converter process, and it can compete with the open-hearth process. In discussing the report on electric spot-welding it was said that this type of load on account of its violent fluctuations and poor load factor required special devices, such as a motor-generator set with heavy fly-wheel, or a dummy-reactance to be cut in as the welding-load was cut out.

The defects of gas-engine power make it unsuitable, in members' opinions, in comparison to electric power, even when natural gas at 30 cents per 1,000 cubic feet is to be had.

## Company Section Session

At these sessions membership problems were discussed. In a great many instances the straw bosses and foremen in companies have used their position as a club to coerce many of their employees to join the company section, with the result that the coal passers and men of all ranks who are not equipped to receive any benefit from this membership have become members.

Men should not be kept out on account of their low rank, but on the other hand they should not be solicited. The importance of vigorous and attractive programs to hold membership was also urged.

## Sixth Commercial Session

This was devoted to an illustrated lecture on industrial and yard lighting, being the report of the committee on that subject. A number of miscellaneous matters were brought up, and the annual election of officers was held. The result:

Chairman, E. A. Edkins, Chicago; vice-chairman, C. J. Russell, Philadelphia, Pa.; vice-chairman, J. G. Learned, Chicago; secretary, F. D. Beardslee, St. Louis; members of the Executive Committee to fill vacancies, F. H. Gale, Schenectady, N. Y.; Henry Harris, Pittsburgh, Pa.; T. F. Kelly, Dayton, O.; H. R. King, New York City; M. S. Seelman, Jr., Brooklyn, N. Y., and R. H. Tilman, Baltimore, Md.

## Fourth General Session

This was the final session of the convention, President Lloyd being in the chair. The Doherty gold medal for the best paper read before a company section was award-



ed to B. H. Blaisdell of the Manila, P. I., section, and was entitled "The Power Plant Department's Part." The Harriet Billings medal, founded by Arthur Williams, was awarded to G. J. Leibman, of the Brooklyn Edison Company, for a paper entitled "Reviving Unused Subsidiaries." The special prize of \$25.00 given by H. F. Frasse, was awarded to G. R. Jones, of the Public Service Company of Northern Illinois, for a paper entitled "The Utilization of Waste Material." Mr. Frasse has asked the officers of the association to announce four prizes for the coming year with the provision that at least eight papers must be entered in competition.

Mr. Ell C. Bennett, mercury of the Jovian Order, then outlined plans for closer co-operation between the two bodies. Secretary Martin read the report on memorials in which he referred particularly to James I. Ayer, William Stanley, Emil Rathenau, Enos M. Barton, J. A. Hill, Louis Duncan, Henry Floy, J. C. Manley and G. R. Stetson as among the notable men who had passed beyond during the year. Previously mentioned changes in the constitution were made, and the words "operating revenues" were substituted for "earnings" in figuring members' dues. Resolutions of thanks were given to all who had made the success of the convention, and contributed to the enjoyment of its delegates. The support of electrical men was asked in contributions toward the fund for illuminating the Statue of Liberty in New York Harbor. The New York *World* has charge of the fund.

The Committee on Nominations presented the following recommendations for officers for the ensuing year, and the secretary was instructed to cast the ballot. The officers are therefore as follows:

President, H. A. Wagner, Baltimore, Md.

Vice-presidents, W. F. Wells, Brooklyn, N. Y.; R. S. Orr, Pittsburgh, Pa.; R. H. Ballard, Los Angeles, Cal.; Alex Dow, Detroit, Mich.

Treasurer, W. T. Atkins, Boston, Mass.

Executive Committee, M. R. Bump, M. J. Insull, W. H. Johnson.

\* \* \*

## Two Recent Street-Lighting Contracts

The proposal of the Salem Electric Lighting Company, of Salem, Mass., for street lighting which provides for 50 6.5-amp. magnetic arc lamps mounted on ornamental posts in the business section and 1133 nitrogen filled incandescent lamps of 400 cp., 250 cp. and 50 cp. to be erected throughout the city, has been recommended to the City Council for acceptance by the special committee on street lighting. The contract is for a period of five years.

A contract for lighting the streets of the city of Knoxville, Tenn., for a period of ten years, has been given to the Knoxville Railway, Light & Power Company by the City of Knoxville. The company is to supply not less than 60 arc lamps and as many small incandescents as the city may order under the terms of the contract. To maintain the ornamental lighting system on Gay Street from Hill to Jackson Avenues, Market Street, from Clinch to Wall Avenues, Vine Avenue from Gay to Central Streets and on Wall, Union and Clinch Avenues from Gay to Market Streets, the contract provides that the company shall supply the electricity without charge. On each of the 94 iron trolley wire poles on Gay Street one 300-cp. lamp will be placed. The five-lamp cluster posts on Gay Street will be placed on Market Street, where the contract provides for 24 standards. The estimated cost of the installation of the ornamental lamps is between \$8,000 and \$10,000 which will be paid by the city.

## Legal Notes

The legality of the provision of the electric-sign ordinance requiring that electric signs must be kept lighted on both sides from dusk until 10 o'clock P. M. at least six nights of the week was upheld by the Municipal Court in Louisville, Ky. Actions were brought against ten alleged offenders by the city building inspector, and the court held them all guilty, assessing a fine of \$10 in each case. All of the fines but one, however, were suspended.

\* \* \*

The Illinois Public Utilities Commission has approved of the continuous meter reading system proposed by the Western United Gas & Electric Company for use in various Illinois cities in which it operates. Under the old system the company read its meters and rendered bills at the first of each month, necessitating the employment of a large number of meter readers who necessarily were idle part of the time. Under the new system the meter readers will make the rounds, reading each meter at regular periods a month apart, but not necessarily at the end of the month. Forty thousand postcards, explaining the new plan and asking for approval or disapproval by return mail were mailed out to consumers. The company filed with the commission 7,000 replies, in asking approval, practically all of which were favorable to the new system.

\* \* \*

Authority was granted to a utility to discontinue completely its street railway operation in the city of Lincoln by the commission in the case of the Lincoln St. Railway. The company proved its case by showing continued operating losses. The commission held that the company should not be compelled to continue the further operation of an unprofitable street car business, which it has been adequately demonstrated is not patronized sufficiently by the public of the city of Lincoln to be self sustaining.

\* \* \*

The Maine Public Utilities Commission in its first annual report just published, in discussing rates offered to isolated plants to induce them to shut down their plant and take central station service, states that service rendered to these customers should not be understood as constituting a special rate, and should only be permitted where the admitted or proved facts clearly indicate, first that the business of the customers cannot be secured at regular rates, and second, that it is in the interest of the general public to permit the company to secure the business of a particular customer and others who may be similarly situated. The commission says; "Whatever the circumstances or necessities may require the company and this commission to do, the service performed should be in accordance with a schedule filed with the commission, open to all, and any contracts thereunder should be for as short a term as possible, to the end that as time goes on and the business of the company increases, the benefit resulting from this low rate to large consumers may be reflected in lower rates to the smaller consumer.

\* \* \*

The Appellate Court of Indiana (111 N. E. 198) holds that an employer must use ordinary care to provide his employees with a reasonably safe place to work and this rule also applies to a line of poles and wires on which a lineman is required to work. The employee assumes risks incidental to the service, and where a lineman was repairing wires from the top of a freight car, the roof of which he knew to be uneven, he assumed the risk from the defect. The lineman cannot rely on his employer for inspection should he know that there is no independent system of inspection, but must make the necessary tests of safety for himself. On the other hand, if the employer provides a system of inspection, the employee does not assume risks which are not obvious to the ordinary use of the senses and which would have been discovered by an inspection. If the contract requires the lineman to make an inspection, he cannot recover for injuries resulting from his failure properly to inspect. An employee assumes the obvious risks of his calling.

# New Products And How to Use Them

**A Monthly Review of New Apparatus, Equipment and Specialities of Known Value**

## A Meter-Reading Camera

A camera, known as the "Factograph," which photographs meter dials is the latest development in photography as applied to the electrical industry.

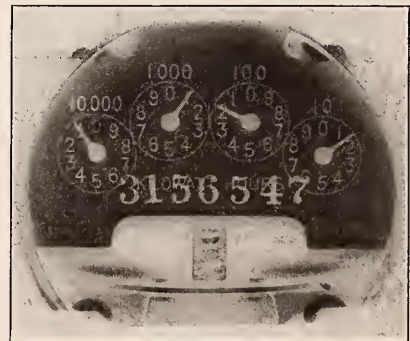
The camera measures  $4\frac{1}{4} \times 5\frac{3}{4} \times 12$  inches; is made from selected mahogany specially treated to stand severe moisture; is equipped with a high grade anastigmat lens working at f.6.3 and a simple automatic shutter controlled by the operator, making exposures with varying speeds as fast as one-fifth second. The light is furnished by two four cell dry batteries stored in either side of the camera, supplying current to four 3.8-volt tungsten miniature lamps. By pressing a small button that is located just below the exposure lever the lights may be turned on, converting the camera in a "flasher" for locating meters or finding one's way through dark cellars.

The reading is made by placing the front of the camera against the meter dial and pressing downward on the exposure lever. This action automatically turns on the light, opens and closes the shutter and turns off the light. The shutter with each exposure automatically locks until the film for the next exposure is wound into place. This prevents the possibility of a double exposure; that is, the superimposing of one exposure upon another. Likewise there are no blanks for the film cannot be wound off until the exposure has been made. Winding reel and exposure lever are mutually interlocking, thus eliminating the possibility of error from forgetting to turn the key or from turning the key before the exposure has been made.

The exposure is recorded upon a special sensitive emulsion coated on a paper support and by a reversing feature in the camera a positive reading is obtained direct from development,

the whole field force. After winding on racks the films are immersed in the developing tanks where they remain for two minutes, and after development are rinsed and then immersed in the fixing tank. After fixing and a short rinsing they are slipped in wall racks for drying. When dry they are respooled and ready for the bookkeepers.

The operations of developing, fixing and rinsing being all done on the one rack, greatly simplifies the operation which in quantity is all done in about three minutes to each roll. As all developing can be most economically done at night, no expense is necessary in the way of dark room equipment, as any blue print room or other room with large sink affords the necessary facilities. Identification of the meter is obtained by stamping on the outside of the glass dial either the account or meter number or consumer's name.



*A specimen record*

The prices of camera and supplies are:

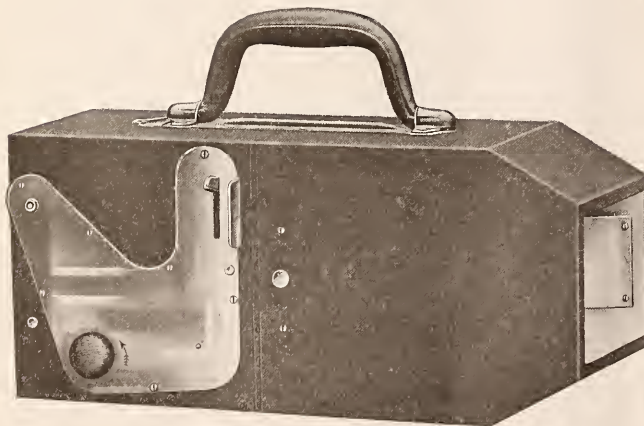
Camera complete with lens, shutter, batteries and lamps..	\$28.50
Film in spools of 75 readings per spool, packed in cartons of 50 spools, five cartons in a case: per carton, 50 spools .....	12.50
Developing powder, each package sufficient for one gallon of developer.....per package .....	.45
Fixing powder, each package sufficient for one gallon of fixing solution.....per package .....	.25
Dry batteries .....each .....	.30

\* \* \*

## A Battery-Charging Set

Every garage operator and automobile owner has experienced the need of a convenient means for charging small storage batteries, such as are used to-day on practically all up-to-date gasoline cars for starting, lighting and ignition service. Launch owners, too, have experienced the same need.

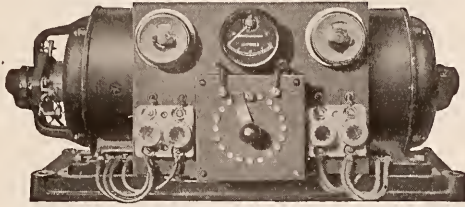
For economically charging these small storage batteries, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is marketing an equipment shown in the illustration. This simple, compact motor-generator can be connected to the most commonly found lighting circuits, namely 110 or 220-volt, 60-cycle, alternating-current or 115 or 230-volt direct-current. The motor generator takes its power from the line and generates direct current at a voltage slightly higher than that of the battery.



which does away with any necessity of making prints from the exposures. The exposures are  $1\frac{1}{2} \times 2\frac{1}{8}$  inches and are spooled in the familiar day light loading cartridge form with 75 exposures to each roll. When the last exposure has been made the shutter by a special cut in the film, remains locked until the film is wound off and a new spool has been inserted.

The development is the simplest part of the whole operation and any one of the meter readers can do the developing for

The panel and the charging set are supplied completely wired ready for operation, which is extremely simple. The motor is first connected to the supply circuit and then started by means of a snap switch. The battery is connected to the generator terminals and the ampere charging rate adjusted by means of the field rheostat to the value shown on the battery name plate. The charging is continued according to the method recommended by the battery manufacturer. As the generator is shunt wound, its



voltage increases as the ampere load decreases. That is as the battery approaches a charged condition the potential of the generator automatically rises to the higher value required for finishing the charge. This voltage characteristic is a great advantage where lead batteries are to be charged because it permits the operator to give the battery an equalizing or long period low rate charge which prolongs the life of the lead battery.

The Westinghouse charging equipment includes a motor-generator and a charging panel with the necessary controlling rheostat, meter, switches and fuses. The meter shows the ampere charging rate which can be adjusted by the rheostat. Snap switches and fuses control both the motor, and generator, conforming to all the requirements of the National Board of Fire Underwriters. The outfit is so simple and compact that it is easily installed and operated.



### A New Pulmotor

The manufacturers of the Pulmotor, a device for producing artificial respiration, have recently placed on the market their Type B machine. This machine is much more readily portable, as it weighs but 12 lbs. in its compact carrying case. It may also be used where no supply of compressed oxygen is available, ordinary air being forced into the patient's lungs by a



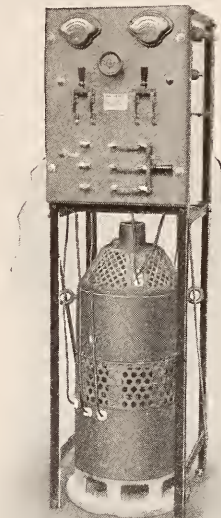
hand-pump. In action, the rubber mask is fastened over the patient's face, and the operator by manipulation of the control-lever first admits air into the lungs, then exhausts it. The essential part of the device is the control valve, for which the makers claim that it has few working parts, that wear is almost negligible, and that there are no adjustments to be made. Included in the valve casting are gauges showing the amount of pressure and vacuum produced, and the instructions include a table of the proper values to use in various cases.

The particular value of this machine lies in its ease of transportation and in the fact that there is no danger of the oxygen tank being found exhausted at a critical moment. Where, however, oxygen is available it may readily be used, a tank being connected in place of the pump. The operator, by watching the gauges can at once tell when the patient begins to breathe, by the fluttering of the indicators. He can then time his motion of the valve to assist the patient's efforts. The price of the apparatus as shown is \$115.00 f.o.b. factory.



### Motor-Operator For Projection Work

A new vertical motor generator set for moving picture theatres is designed to meet the conditions for this service, namely, provide a machine of compact design, taking up a minimum floor space, that can be installed in a booth, that is free from vibration and noiseless, requires practically no maintenance and is of sufficient capacity to enable two lamps to burn at the same time during a period of dissolving. These machines are built in 50 ampere capacity for continuous service, 100 ampere intermittent service and are all tested 120 amperes before shipment. They are motor generator sets with the induction motor mounted in the lower frame and wound for either single, two or three phase service; a large opening is provided between the motor and generator covered by a perforated metal plate in which the air is forced out by a fan mounted on the shaft between the a.c. motor and the d.c. generator. Hess-Bright ball bearings are used and the lower bearing is a thrust and radial bearing. The



d.c. generator is the bi-polar interpole type. The object in making it bi-polar is to give a large space so that there would be room to clean up a commutator and put in brushes without taking the machine apart, besides more ventilating space is available. The machines are built with fixed point of commutation so that brush holders cannot be moved from their neutral point.

When operating a single lamp, the compound winding is cut out and the machines runs as a shunt wound generator rated at 55 volts and normal 50 amperes. However, there is a sufficient range in the field rheostat to obtain 70 to 80 amperes as a shunt machine for intermittent service. During the period of dissolving, the compound winding is cut in and also two fixed grid iron resistance, one in each lamp circuit. The compound winding raises the voltage of the machine to 75 volts to compensate for the 25 volts drop in the grid iron resistance and limits the flow of current in each lamp to 50 amperes so that the two lamps can be burned without affecting the light.

These machines are designed to limit the starting current to

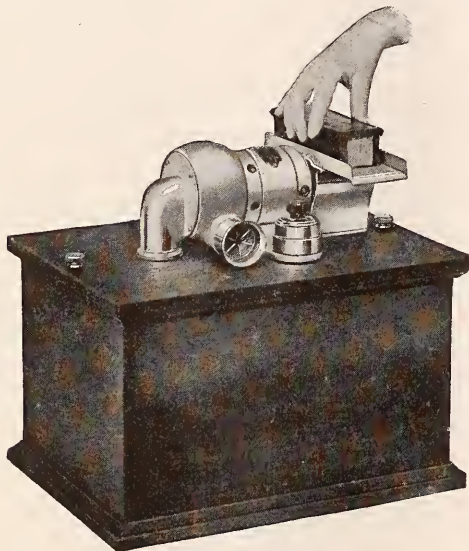
34 amperes on single-phase and 20 amperes on two-phase so that a 60-ampere fuse is always necessary and the feed wires can be of smaller size than for some other types of machines, which require exceptionally large starting current. The efficiency as a shunt machine is 68 per cent. Power factor is 80 per cent. and the rise in temperature, full load for 24 hours 40 degrees and when carrying the 100 amperes intermittently over fifteen minutes, the rise will not exceed 45 degrees on any part of the machine.

\* \* \*

### A New Eraser Cleaner

For years school people have been endeavoring to find a satisfactory method of removing chalk from blackboard erasers. An electric company has brought out and is putting on the market a specially designed cleaner that meets the requirements of the school which has electric current.

This outfit is, in fact, a small sized vacuum cleaner plant. Suction is produced by a 1/25 hp. Universal motor that operates on direct or alternating-current. The outfit not only removes chalk by means of strong suction, but it also has a power driven



bristle brush that brushes the surface of the eraser to be cleaned. No chalk escapes into the room. It is all drawn into the box and the air is filtered through a fine muslin separator.

All metal parts of the outfit are nickel plated, and the cabinet work is of hardwood, mahogany finish. The outfit comes complete with ten feet reinforced portable cord, and attachment plug. The cleaner may be operated from any convenient socket.

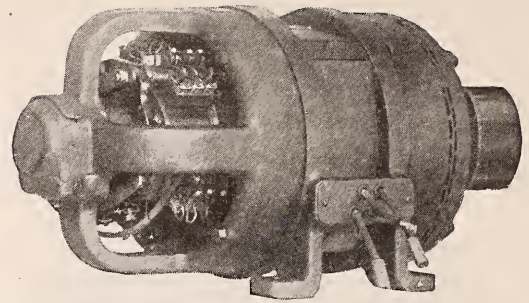
This is an excellent opportunity for electrical dealers as the cleaning of erasers by hand is a dirty and disagreeable task of which up-to-date school principals should be glad to relieve their employees. The ease of operation will make it possible to have clean erasers always at hand, and the resulting improvement in the appearance of the blackboards is a good talking-point. The manufacturers are guaranteeing the cleaner for one year and are prepared to send one on trial.

\* \* \*

### Repulsion-Induction Motor

A new line of motors of the so-called repulsion-induction type, which is provided with a simple and accessible short-circuiting device has lately been brought out by a western manufacturer.

These motors start as repulsion motors and after reaching a certain speed become induction motors. The manufacturers claim an unusually small number of parts for these machines. The distinctive features are the brushes and a short-circuiting ring of movable segments surrounded by a collar. At starting, the centrifugal forces causes the segments to

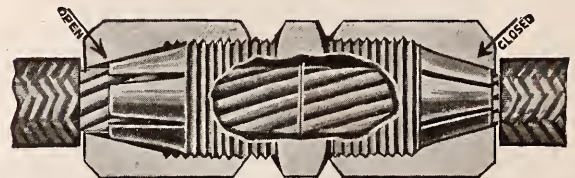
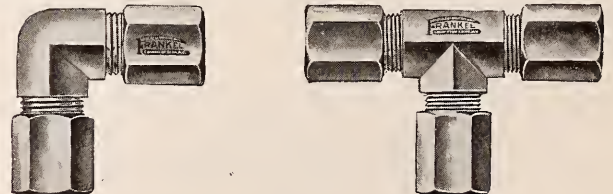


fly against the collar, thus short circuiting the commutator and relieving the brushes. The motors are designed to start under 100 per cent overload with two and one-half times full-load current. They have a capacity of 100 per cent. overload for short periods and are readily connected for operation on either 120 or 240 volt circuits.

\* \* \*

### A New Wire-Connector

The accompanying illustration shows several types of a new wire-connector. The phantom view in the center shows the principle of the connector and how the design has permitted the use of a very few parts to make a rigid connection. This simple construction, it is claimed, reduces the liability of the connector getting out of order and in ad-



dition provides a connection that is strong mechanically and electrically. The company is also manufacturing a line of connectors for panel boards to replace soldered terminal lugs for front and back connections.

\* \* \*

### A Combination Automobile Lamp

The use of a separate "trouble lamp" on automobiles equipped with electric lighting systems is obviated by this combined dash and trouble lamp. Ordinarily it serves to illuminate the meters and other appliances, but when the need arises it may be re-



moved from its socket and connected to an extension cord which is in turn connected with the socket. The cord is regularly furnished ten feet long and provided with the necessary fittings for attachment to lamp and socket.

### Pole Top Gin

This pole top gin was especially designed to meet certain demands in the erection of steel cross arms now used so generally on wood pole transmission lines. The original application was limited to this small field of construction, but it has since been found that it can be used on all line work where weights of any kind must be lifted and supported on wood poles, and it is meeting with considerable favor from linemen in all kinds of work.

It consists of a main base fitted with four spurs and a chain and a lever for clamping it to the pole. Tackle can be suspended from the arms at the top. To attach the pole gin the line-



man jabs the lower spurs into the pole as he would a spear, then the top of the channel is thrust towards the pole, and the upper supports sink into the wood. In this position the gin will "stay put" while the handle is opened and the chain carried around the pole and linked into the catch. The handle is then closed causing the chain to bite into the pole. In its closed position, the handle is self locked. If the chain is too loose and does not bite into the pole firmly enough, the handle is opened, the chain disengaged from the catch and lengthened out one link and pushed up at the back of the pole. This virtually acts so as to shorten the chain when the handle is closed again. The chain takes a firm hold and the gin is ready for use.

As the load is placed on it the lower spurs bite into the pole further and become firmly placed. This is an especially attractive feature, and that is the simplicity and ease of attachment to and detachment from the pole regardless of the load to be carried, the gin is readily attached, and there is no danger of it slipping loose. When the work is finished it can be readily and instantly detached although it may have carried its maximum load.

As designed, the present gin can safely carry a load of 1,500 pounds and if necessary 2,000 pounds in emergency. This capacity is ample, therefore to handle the usual loads that are placed on the pole. As an example of this, it may be noted that a 25 kv-a. transformer weighs about 1,700 pounds and a 10 kw. transformer about 1,000 pounds, both of which weights come within the capacity of the present design. Steel cross arms weighing from 40 to 120 pounds, of course are very easily handled.

In all line work, it will relieve the lineman of heavy lifting and give the ground man more work. This results therefore, in a greater efficiency of the line gang.

\* \* \*

### A Kitchen Power Plant

One of the obstacles to the use of electric power in the kitchen is the great variety of devices which are found essential by the housewife. None of them are used enough in a small family to justify the purchase of a separate motor for each, yet in the aggregate they would furnish many hours' use for a single motor. The problem of adapting a removable motor drive to a great variety of machines has been ingeniously solved by the "kitchen power unit" illustrated. The "unit" is so constructed that without any reconstruction it will drive such apparatus as bread mixer, meat grinder, coffee or spice mills, ice cream freezer, raisin seeder, cherry pitter, potato slicer, cake mixer, or egg whip. The driving arm may be raised or lowered to suit any height of appliance. There is a horizontal as well as a vertical drive. The drive shafts are equipped with a chuck and crank. The chuck is used where the handle of the appliance can be easily taken off while the crank is used where the handle of the appliance cannot be removed. The shelf is for supporting appliances which have table clamps. There are holding hooks



provided to hold appliances in position while being driven. The motor is  $\frac{1}{2}$  hp. and is furnished for both direct and alternating in all voltages and frequencies. The "unit" is finished in dark maroon while the shafts are either nickel-plated or polished steel. Attachments are furnished for buffing and grinding wheels.

\* \* \*

### Automatic Re-Closing Circuit Braker

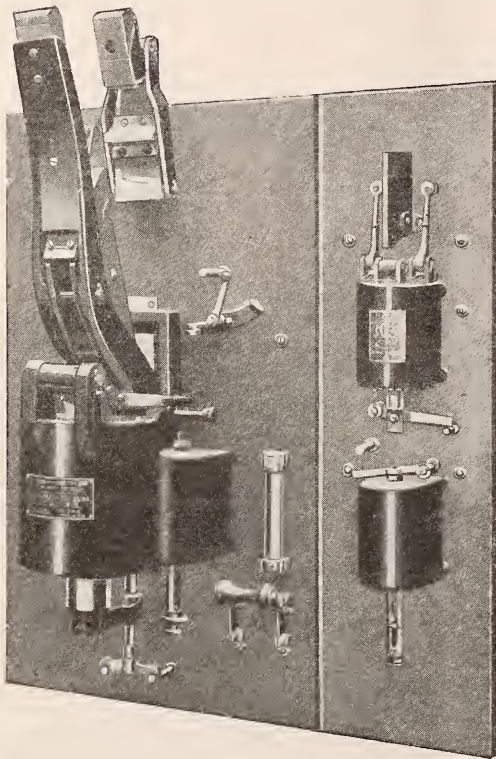
A new type of relay, designed for operating with automatic re-closing circuit-breakers has recently been brought out by a western company, interested in the development of this type of circuit breaker.

The standard form of automatic reclosing circuit-breaker is designed to control the entire current input on the circuit and will not operate satisfactorily in a feeder circuit where such feeder is supplying current to a load circuit which is also supplied by current at other points.

This new feeder circuit relay is designed especially to operate with circuit breakers connected in a circuit supplying current to a net-work of distribution. The accompanying cut shows feeder circuit relay operating in conjunction with a 1,200 ampere Type D. automatic reclosing circuit breaker.

The special feature of this relay being that it has a potential adjustment whereby breaker may be set to reclose at any voltage from 50 per cent. normal to full voltage on load

side of breaker. Should the breaker open due to an excessive load, breaker will reclose at the expiration of a short time interval provided the voltage on the load side of breaker is not excessively low; should the voltage be excessively low so that breaker would immediately open were it to reclose, the potential adjustment may be set so that breaker will not reclose until voltage has risen to a safe value but the instant the voltage does reach the allowable value, breaker will automatically reclose. Should a short circuit occur the breaker will of course remain open until short circuit has been removed.



Another feature of this relay is that it enables breaker to be used on a network where a number of feeders are supplying current to a common load or it may be used on an independent circuit, where breakers control the entire current input to the load. When used in either connection, breaker will operate entirely automatically and will reclose only when line conditions are right and no short circuit exists.

The dead load adjustment is provided with the breaker whereby breaker will reclose on any predetermined amount of load, such as lights, self starting motors, etc., but will not reclose on actual short circuit of low resistance. This combination of feeder circuit relay and circuit breaker is especially suitable for the protection of rotary converters or generator sets in small sub-stations supplying current to mines, street railways, mills, etc., where the switch-board attendant has other duties to perform besides looking after circuit breaker.

The potential adjustment on relay furnishes a certain means of having breaker closed only when proper voltage relations exist between the generator protected and the load circuit. This eliminates the necessity of having a volt meter or other means of indicating proper voltage for operator to close breaker, it also eliminates the human factor in operating the breaker, thus making the operation more certain to occur at the proper time.

\* \* \*

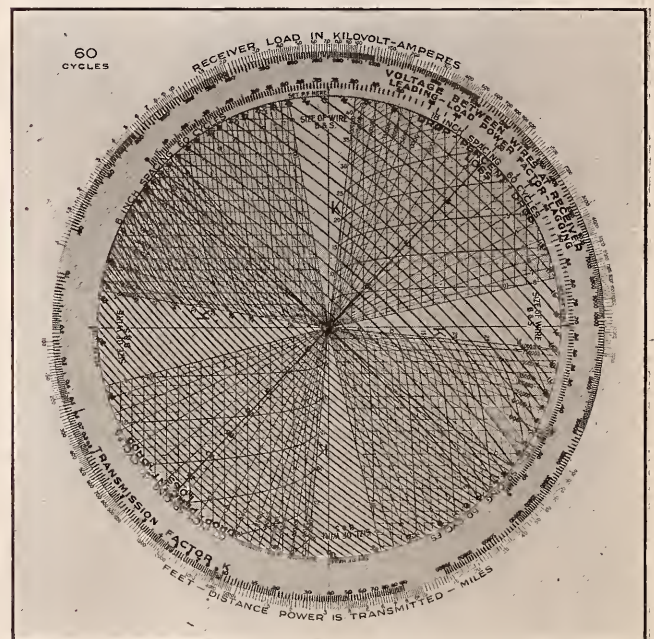
### Brain Saving Line Calculator

Some time ago an alternating current transmission line calculator which was designed for the rapid calculation of

voltage drop in alternating current circuits was placed on the market. This device has now been greatly enlarged so as to cover the whole field of transmission and distributing at moderate voltages.

In its new form the calculator consists of a three fold morocco leather volume of quarto size ( $8\frac{1}{4}$  in. square), containing separate diagrams for 60 and 25 cycle work, each diagram being laid out for four different spacings of conductor, and each being equipped with a revolving transparent disc. The diagrams have been doubled in diameter over the first edition, so that the various scales are more open and therefore more easily read, while at the same time they have been expanded so as to include a much wider variety of operating conditions.

For transmission at ordinary voltages there are provided quadrants for 18, 36 and 60 inch spacing of conductors, which will be found to cover most of the problems presented to the average designing or operating engineer. It is possible, however, by means of the spacing and frequency conversion chart to make accurate determinations for any spacing whatever up to 100 inches; and also for any frequency up to 100 cycles per second. For the benefit of those engaged in mill work, quadrants have also been included for 6 inch spacing, and with this same work in mind the circular scales have been greatly extended so as to include loads as low as one kilovolt-ampere, voltages as low as 100 volts, and distances as small as 100 feet.



A new provision has been made for the calculation of power losses in a circuit, whereby it can be read at a glance along with the voltage drop, the whole process requiring but two minutes and the results being guaranteed accurate within one fifth of one per cent. Other new features are the adaptability of the calculator to current determination, leading power factors, transformer regulation and direct current work, and also a special wire table which gives costs of bare and weatherproof wire as well as the usual information as to weights and ampere capacity.

The directions are so located on the folding leaf as to be readily consulted while the diagrams are being used, and are accompanied by typical examples so that a person having no technical training whatever can learn the method in a few minutes. The ranges of the various scales are as follows:

**Range of the Transmission Line Calculator**

- Systems—1, 2 or 3-phase or direct current.
- Frequency—60 or 25 cycles.
- Load—1 to 20,000, kilovolt-amperes.
- Voltage—100 to 70,000 volts.
- Distance—100 feet to 100 miles.
- Power factor—1 to 100 per cent. lagging or leading.
- Conductor material—Copper, aluminum or copper clad.
- Conductor size—No. 8 B. & S. to 1,000,000 cm.
- Conductor spacing—6, 18, 36 or 60 inches.
- Line drop or loss—0 to 40 per cent.

The device is known as the "Engineer's Edition" of the Transmission Line Calculator and is sold by Robert W. Adams, 181 Taber Ave., Providence, R. I.



**Improved Battery Connector**

Anyone who has ever lost time and patience in working with the refractory ends of short wires for connecting up batteries will appreciate the type of spring clip battery connector lately put on the market by a manufacturer of dry cell batteries.

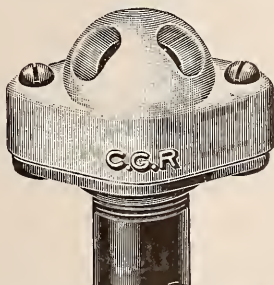


The illustration shows the way it works. It is warranted not to jar loose, as it is self locking. It can be put on or removed without the aid of pliers and insures a good and durable contact. This connector is particularly useful on batteries, coils and spark plugs where the apparatus is subject to constant vibration, as on vehicles, motor boats and in many other places.



**Conduit Fittings**

A new kind of conduit fitting designed by a metropolitan manufacturer, is shown herewith and is meant for use at the ends of exposed iron conduits of BX cable for separating and insulating the wires as they leave the conduit. The device is termed "CGR Pipelet," and is made of glazed porcelain strong enough to prevent cracking or breaking, the base being of gray iron, electrically galvanized. It has the further



advantage of avoiding all twisting of wires, and the manufacturer also points out that it may be utilized for all combination work, motor installations, meter loops or wherever a "condulet" is necessary. The device is being made in three sizes—1/2 in., 3/4 in. and 1 in.—all of which are designed to accommodate three wires.



The Milwaukee office of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is now located at 1527 First National Bank Building.



The American Ever-Ready Works' Chicago address has been changed from 1238 South Michigan avenue to 3711 South Ashland avenue.

**Statement of the Ownership, Management, Circulation, etc., Required by the Act of Congress of August 24, 1912**

of ELECTRICAL AGE, published monthly at New York, N. Y., April 1, 1916.

State of New York }  
County of New York } ss.

Before me, a notary public, in and for the State and county aforesaid, personally appeared Chas. B. Thompson who, having been duly sworn according to law, deposes and says that he is the Editor of the ELECTRICAL AGE and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Name of— Post office address—

Publisher—Technical Journal Co., Inc., 233 Broadway, New York.

Editor—Chas. B. Thompson, 233 Broadway, New York.

Managing Editor—Chas. B. Thompson, 233 Broadway, New York.

Business Manager—William F. Eastman, 233 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock.) Technical Journal Co., Inc., 233 Broadway, New York; Chas. B. Thompson, 233 Broadway, New York; William F. Eastman, 233 Broadway, New York; George H. May, Newton Center, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there none, so state.) None.

That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only.)

CHAS. B. THOMPSON.

Editor

Sworn to and subscribed before me this 23rd day of March, 1916.

(seal.)

SIMON LEVINE.

(My commission expires March 30, 1916)

# TRADE LITERATURE

# Catalogs and Books

## A Review of the Latest Publications

The Ward Leonard Electric Company, Mount Vernon, New York, has issued a new section to be added to their loose leaf catalogue. This is section G-13 which covers their Adaptor (plug and socket) resistance units.

The erection of a locomotive repair shop for the Canadian Pacific Railroad at Calgary, Alberta, Can., is the subject of a folder recently issued by Westinghouse Church Kerr & Co.

Information on the electrically operated equipment of a market at Ninety-fifth Street and Broadway, New York, which is owned by Vincent Astor is contained in an attractively illustrated pamphlet entitled, "The Ninety-Fifth Street Market."

High-tension disconnecting switches of the unit type are described in Leaflet No. 910 of the Delta-Star Electric Co., of Chicago. A number of interesting pictures and diagrams illustrate the use of the company's products.

"The A B C of Automobile Battery Charging" is a booklet prepared by the Westinghouse Electric Mfg. Co. for distribution among owners of electric vehicles. It describes mercury-vapor rectifiers and their accessories for home charging.

Glassware in designs characteristic for various architectural periods is illustrated in a booklet sent out by the Jefferson Glass Company of Follansbee, W. Va. Fittings for various systems are shown and the leaves are perforated for inclusion in a pocket binder.

"Willey" electrically driven tools, for many purposes are described in a folder recently issued by the manufacturers, the James Clark, Jr. Electric Company, of Louisville, Ky. The line includes portable drills and grinders for bench and tool-post use and motor-equipped drill-presses. Full details are given in every case.

The Joseph G. Branch School of Engineering, of Chicago, Ill., have just issued their catalog No. 6, describing their different correspondence courses of study. The need for technically trained men is so great and the prospects of the untrained man so indefinite that it will pay any ambitious electrical worker to investigate. The catalogue may be had for the asking.

The Sprague Electric Works, of the General Electric Co., New York City, have issued three bulletins of interest. No. 48907 describes the company's 500-pound Type I-5 electric hoists for machine shops and other places; No. 48706 shows alternating current motors and controllers for small rotary and flat-bed printing presses; No. 49600 gives information concerning the line of "Greenfield" flexible steel armored conduit and cable, and fittings for use with it.

The C. & C. Electric Co., of Garwood, N. J., have published a bulletin, presenting their well known direct current motor, known as the Old Reliable. The motors are of the four pole, interpole type, built in sizes from 1 to 125 hp. The bulletin illustrates and describes the details of construction of the parts and contains a complete table of adjustable and constant speed ratings, with full dimensions of all frames. A copy of Bulletin 101 will be sent to anyone on request.

Pass & Seymour, Inc., have put out a booklet for distribution to users of sockets under the title "The Gateway of Electric Service." It tells of the importance of sockets to any installation.

An illustrated folder has been issued by W. N. Matthews & Brother, Inc., St. Louis, Mo., which shows their "Serulix" screw anchors equipped with the improved "Thimpuleye" attachment.

Harvey Hubbell, Inc., of Bridgeport, Conn., have recently added three bulletins to their loose-leaf catalogue. Steel reflectors are listed in Bulletin 15-14; locking lamps in Bulletin 15-18, and small attachment plugs and caps in Bulletin 15-19.

The Eclipse Light Company, of 583-85 Broadway, New York City, has issued a two hundred page catalog showing its complete line of lighting fixtures, appliances and gas and electric supplies, "The Leader in Light," and an eighty-two page catalog displaying only Lighting Fixtures of Quality."

"Stentor" Autophones are described in a booklet recently issued by the Stentor Electric Mfg. Co., Inc. These consist of a high-power transmitter and a loud-speaking receiver for use in communicating between passengers and chauffeur in automobiles.

The M. W. Dunton Company, 150 Niagara Street, Providence, R. I., has issued an illustrated brochure, containing helpful suggestions from users of "Nokorode" soldering paste, entitled "Soldering Kink News No. 5." A thirty-two page book entitled "Soldering Kinks" containing information published in previous folders and which sells for a nominal sum, has also been issued by the company.

The Western Electric Company has issued a new catalog of Inter-phones and accessories in which the complete line of Inter-phones, the company's trade name for the intercommunicating telephone manufacturers, is shown at length. The various systems available for intercommunication are fully explained with diagrams showing the service given by each. This is accompanied by complete information as to the amount of wire and cable required as well as the operating battery requirements.

"A-B Transformers for Lighting and Power" is the title of a new folder on Adams-Bagnall transformers for lighting and power service. This folder gives views of some of the classes of single and three-phase transformers, low and high voltage distributing and power transformers, constant current regulating transformers for street lighting work, etc., which are offered by this company.

"The Potentiometer System of Pyrometry" is the title of bulletin No. 875, issued by The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa. The twenty-eight pages of this bulletin contain many illustrations and explain the principles of this system of pyrometry in detail. The bulletin also describes the indicating and recording types of pyrometer sets. A discussion of the adaptability of this method of pyrometry to location of the transformation points in the heat treatment of special steels is given on the last few pages of the bulletin.



**Electrical Fathers—Maxwell**

*(Continued from page 34)*

finally published under the name, "A Treatise on Electricity and Magnetism" in 1871 and the following year was extended as to its scope in "A Theory of Heat." Both of these works took immediate place among the foremost on these subjects and made their author's fame secure.

All this activity of the first order took place in the compass of a short life. He had taught in London only eight years when the state of his health became such as to force his retirement to his country estate in Scotland. Somewhat improved by his residence there, he became professor of experimental physics at Cambridge, in 1871. Only eight years later, he died at the age of forty-eight.

His last years were taken up with the development of the department of science at Cambridge and some work on the kinetic theory of gases. As he felt the end coming on—and from the nature of his disease, he had ample warning—he devoted much thought to spiritual things, giving evidence at all times of the highest type of Christian faith and fortitude.

Maxwell was a handsome and kindly man; always extremely popular with his associates, students and all who were privileged to know him. His powerful mind was ever at the service of his friends and perhaps few men have led better rounded and more useful lives.

At the International Electric Congress, held in Paris in 1900, the memory of Maxwell was honored in giving his name to the unit of flux in a magnetic circuit—the unit corresponding to the ampere in electrical circuits. He was the first Scotchman to be so distinguished.



**Lectures on Illumination**

Immediately following the annual convention of the Illuminating Engineering Society in Philadelphia on September 21 to 28, there will be given a course of lectures on the principles of illumination and various aspects of lighting practice

The new course will include about 20 lectures by men selected on account of their qualification to deal authoritatively with the several phases of the subject.

Associated with the lectures will be an exhibition at the University of the latest developments in illuminating appliances, including lamps, accessories, photometers, etc., together with novel applications of light. This exhibition is expected to be of great educational value. In connection with the course there will be organized an inspection tour which is expected to be of particular interest and value for those who come from a distance. This will be laid out in such a manner as to afford the maximum of educational value with a minimum of time and expense. It will include visits to manufacturing establishments, laboratories, lighting companies and notable lighting installations.

The price of tickets for the lecture course has been fixed at \$25 which includes admission to all lectures and functions associated with the lecture course and reprints of the lectures delivered in this and in a similar course given in 1910.



**Co-operative Meal in Street-Railway Shops**

For the benefit of the office force and foremen of its new Harvard avenue shops, the Cleveland Railway Company has fitted up a kitchen and dining room in the basement of the office building. A charge of \$1.50 per week is made, payable in advance, and any "profits" are divided among the members in proportion to the number of meals they have had, thus putting a premium on regularity of attendance. The average cost per meal is about 22c. One woman devotes all her time to the cooking, etc., while a girl from the office assists her in serving.

**A. I. E. E. Holds National Meeting**

More than five thousand members of the American Institute of Electrical Engineers and their guests attended a meeting held simultaneously in nine cities of the United States. By the courtesy of the American Telephone and Telegraph Company the widely scattered groups were assembled virtually under a single roof, christened by one of the speakers as "Carty's Hall." For every one present there was a telephone receiver, and for the speakers' table a transmitter as well, all of which were linked by the Transcontinental Telephone Line. The roll of cities was called by President John J. Carty, to which the number present at each place was given by the local presiding officer. These were:

Atlanta, 500; San Francisco, 700; Boston, 900; Philadelphia, 850; Chicago, 1,000; New York, 1,100. At Denver and Salt Lake City the small gatherings listened, and sent their greetings to New York over the auxiliary Morse wire.

The election of officers for the ensuing year was announced as follows: officers are: President, H. W. Buck, New York; vice-president, L. T. Robinson, Schenectady, N. Y.; Peter Junkersfeld, Chicago, Ill.; B. A. Behrend, Boston, Mass.; managers, John D. Fiske, Spokane, Wash.; Charles Robbins, Pittsburgh, Pa.; N. A. Carle, Newark, N. J., and Charles S. Ruffner, St. Louis, Mo.; treasurer, George A. Hamilton, St. Louis, Mo. F. L. Hutchinson was re-elected secretary.

Following a brief speech of acceptance by President-Elect Buck, greetings were extended by Dr. Alexander Graham Bell, inventor of the telephone, Theodore N. Vail, president of the American Telephone & Telegraph Company, C. Le Maistre, of London, and Thomas A. Watson, Dr. Bell's assistant in the discovery of the telephone. Each section then held a "local session" at which addresses were delivered by local speakers. The receivers were then reconnected to the line and national melodies were played by phonographs at each city. Greetings from Dr. Mikail I. Pupin, inventor of the loading-coil and from R. W. Pope, honorary secretary of the institute, closed the meeting.



**Rate Reductions in Chicago**

Users of Commonwealth Edison service in Chicago will benefit to the extent of \$1,000,000 per year from rate reductions announced by the company on May 18th. The changes in the schedules are:

- Retail: first 30 kw-hrs. reduced from 10 cents to 9 cents per kw-hr. next 30 kw-hrs. 5 cents per kw-hr.
- All additional, 3 cents per kw-hr.
- Wholesale: first 50 kw-hrs. direct current reduced from \$2.60 to \$2.20 alternating current, from \$2.40 to \$2.00
- next 1000 kw-hr. formerly 5 cents per kw-hr. } now next 5000
- next 4000 kw-hr. formerly 3 cents per kw-hr. } kw-hr. 3 cents per kw-hr.

In his speech of welcome to the N. E. L. A. Convention Mayor Thompson expressed his hearty approval of the Company's policy of voluntary rate reduction:

"Believing that public service corporations should be commended when they do right, as well as condemned when they do wrong, I accept this occasion as most fitting to make public acknowledgment as mayor of Chicago, of the appreciation of our citizens of the voluntary reduction of the charges for electricity recently announced by the Commonwealth Edison Company of this city. This great company, represented in this association by your worthy president, is patronized by nearly 300,000 customers who will benefit by this commendable act."

# Review of the Month

## A Complete Record of Important News Edited for Busy Readers

The Interborough Rapid Transit Company is planning for the construction of a power house on Jerome avenue near Kingsbridge Road to cost about \$40,000. George H. Pegram, 165 Broadway, New York, is chief engineer.

\* \* \*

The City Commissioners of Clarksdale, Mississippi, will shortly install in the new addition to their power-house a 625-kv-a., 3-phase, 60-cycle, 2300-volt turbo-generator with direct-connected exciter, the associated condenser and cooling towers, and a 200-kw. generator direct-connected to a uniflow engine.

\* \* \*

A deal for lighting the railroad yards at Mauch Chunk is reported to have been closed by the Mauch Chunk, Heat, Light & Power Company with the Lehigh Valley Railroad Company. In order to furnish electricity to the Lehigh Valley Electric Light & Power Company, the company is considering extending its transmission lines to Lehigh.

\* \* \*

The Brush Electric Co., of Galveston, Texas, Mr. W. R. Phipps, general manager, has purchased machinery for improvements, the cost of which is \$10,000. They will install a 500-kw., 3-wire rotary converter, 125-250-volts; and a 50 kw., 125-volt, d.c. generator, direct connected to induction motor, 3-phase, 60-cycle, 2300-volt (for exciter unit).

\* \* \*

A novel contest was the feature of a "sociability run" of electric vehicles held on May 19 by the New York Electrical Vehicle Association. The course of 19 miles ending at an attractive country club, had previously been covered by a pilot car—and the woman driver whose running-time most nearly approached 83 minutes and 30 seconds, the time of the pilot, was declared the winner. Forty-two cars were entered, and the expressions of pleasure from all who took part were most decided.

\* \* \*

A plant on Little Red River is under consideration by the Arkansas Hydro-electric Development Co., A. R. Amos, Pres't., 609 State Bank Bldg., Little Rock, Ark. They will construct a dam 150 ft. high, 1,000 ft. on top, 300 at bottom, 150,000 cu. yds. concrete, 80 mi. transmission to Little Rock, cost \$640,000; 160 mi. Little Rock and Memphis, cost \$1,280,000; total development of 54,000 hp. on 2 sites. The entire plant is estimated to cost \$5,000,000; Messrs. Dickinson & Watkins, 610 State Bank Bldg., Little Rock, are the engineers.

\* \* \*

A "Pan-American Joint Engineering Committee was organized this month by the American Society of Civil Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers "in order that the professional engineers of the country make take their part in the great movement which is under way to establish more intimate and sympathetic relations among the various American nations." The object of this organization is to promote the growth of interest in the South American field of enterprise among professional men. The committee is composed of Messrs. B. J. Cresson, Jr.; Chandler Davis, P. W. Henry, Edgar Marburg, Charles T. Plunkett, William H. Bixby, S. W. Stratton, Ambrose Swasey, Carl C. Thomas, Walter H. Altridge, F. K. Copeland, W. H. Leonard, P. N. Moore, Joseph W. Richards, Gano Dunn, John F. Finney, Calvert Townley, Charles W. Stone, Fred. Lavis, secretary, William McClellan, chairman.

The Glenmora Light & Power Co., of Glenmora, La., will spend \$7,500 to construct a plant; 30 kw., and 6 mi. transmission; ultimately 50 hp. development. Mr. F. P. Joseph is the manager and engineer.

\* \* \*

A bonus of \$5 per month has been offered to all men employed for continuous service by the National Carbon Company at Fremont, Ohio. The bonus for the women and girls will be \$3 per month. More than 400 persons are employed by the plant. The offer is made to both time and piece workers.

\* \* \*

The Alaska-Gastineau Mining Company, of Juneau, Alaska, has added an additional 12,000 hp. to its generating plant by driving a tunnel through a mountain and tapping the bottom of Annex Lake. Annex Lake is 1½ miles long, ¼ mile wide and about 200 ft. deep. The additional 12,000 hp. gives the company 18,000 hp. for use at the mines.

\* \* \*

The Western States Gas & Electric Company Eureka (California) division recently started work on a two mile extension to connect a gold dredger in Trinity County. Work has also been started on a pipe line to connect the Company's new water wheel and generator to be installed at its hydro-electric plant.

\* \* \*

More than half of the \$44,000 new 7% preferred stock issued by the San Diego Consolidated Gas and Electric Company has already been sold to residents of the community. Sales during the first two weeks after the stock was offered the public in newspaper advertisements were \$74,200, the shares being bought at par. There were 51 investors, only three of whom availed themselves of the partial payment feature.

\* \* \*

A gain of 78.8% in manufactured products in five years is a record of which the people of Birmingham, Alabama, are justly proud. The Census Bureau's report for 1914 shows \$43,144,000 worth turned out in that year, in spite of the depression in iron, the chief industry of the city. An even larger increase was made in the capital invested in manufacturing. In 1909 this was \$23,718,000, and in 1914, \$55,844,000 a gain of 135%. A census taken at the present prosperous time would make a much better showing.

\* \* \*

Some interesting figures on generation costs are given by the Shanghai, China, Municipal Electric Light Plant in its report for 1915. The total power generated was 62,291,443 kw.-hr. which cost \$469,310, or \$.00753 per kw.-hr. This cost was subdivided as follows:

	Cost	%
Coal .....	\$222,500	47.7
Oil, Water, Waste, Stores .	19,650	3.9
Wages .....	36,720	7.9
Repairs and Maintenance ..	100,700	21.4
Rent and Taxes .....	13,140	2.8
Management Expenses ...	76,600	16.3
	\$469,310	100.0

The plant has a total of over 1200 electric radiators in service, representing a connected load of more than 2400 kw. For this service the rate is 1.32 cents per kw.-hr.

Children of the grade school in Freeport, Ill., are taught to read electric light meters.

\* \* \*

The Capitol building of the State of Pennsylvania at Harrisburg, following the lead of other State capitols, will be illuminated in the near future by flood-lighting. The projectors will be mounted on nearby buildings and other points of advantage.

\* \* \*

The Muncie, Indiana, Electric Light Company and the city officials are negotiating for the installation of an ornamental street-lighting system. The company is considering the construction of a new office building to cost about \$45,000.

\* \* \*

During the coming summer and fall in the eastern part of Washington approximately \$260,000 will be expended for improvements which will include the construction of a concrete sub-station in North Yakima, by the Portland Power & Light Co. which operates in both Oregon and Washington.

\* \* \*

The Royal Theater property at Pearl and Willoughby streets, together with seven frame dwellings standing between the theater and the Edison company's building in Pearl street, have been purchased by the Brooklyn Edison Electric Illuminating Company. The company is planning to expend \$1,000,000 to build an addition to its plant.

\* \* \*

The electrical department of the Frankel Display Fixture Connector Company, Inc., to carry on the manufacture of Frankel Solderless Connectors, Frankel Testing Clips and other electrical specialties.

The office and factory of the company are located at 177-179 Hudson street, New York City.

\* \* \*

It was announced by Mayor Lindsley, of Dallas, Tex., that the traction, electric lighting and power properties of the Stone & Webster Engineering Corporation, of Boston, Mass., were to be taken over by the United Electric Securities Company, a subsidiary of the General Electric Company, in Dallas. New companies will be organized under the law of Texas to operate the properties. Extensions to cost about \$2,000,000 will be made to the traction and lighting systems.

\* \* \*

The Ward Leonard Electric Company, manufacturers of electric controlling devices, has moved into its new building at Mount Vernon, N. Y. The increased demand for floor space and labor operators is the reason for changing. The Ward Leonard Electric Company started manufacturing electric controlling devices in Bridgeport, Conn. in 1892. After two years in Bridgeport, and three years in Hoboken, N. J., they moved to Bronxville, N. Y. and have been manufacturing in Bronxville since 1897. Mount Vernon is nearer New York City than Bronxville—as a matter of fact the new factory is 150 feet from the city limits.

\* \* \*

The Connecticut Company, of New Haven, Connecticut, has awarded a contract to The J. G. White Engineering Corporation of New York, for the engineering and construction of a new steam power plant at New Haven, Connecticut. The plans for this power station are being prepared for an ultimate capacity of 100,000 kilowatts. Construction work on the foundation for this plant will begin this week.

This plant will take the place of the Company's old direct current station at New Haven, and probably two sub-stations will be built in New Haven for local distribution of current to the Connecticut Company's lines. The current generated by this new plant will be in addition to the electrical energy delivered to the Connecticut Company's lines by its other important stations among which are those located at Waterbury, Bridgeport, Hartford, and Berlin, Connecticut.

The Roller-Smith Company has removed from 203 Broadway to 233 Broadway (Woolworth Building), New York, necessitated by the company's requirement for additional space.

\* \* \*

At Cuenca, Ecuador, an electric light plant is under construction, the machinery being furnished by the General Electric Company. A municipal plant is to be erected at Daule, and a water and light plant at Tulean.

\* \* \*

The Ardmore Railway Co., of Ardmore, Oklahoma, is preparing to build fireproof sheds and car-shops for its rolling-stock. The general contractor, I. M. Putnam, of Ardmore, is in the market for street-railway material of all sorts.

\* \* \*

The Minneapolis General Electrical Company has put in effect an electric-cooking rate of 2.5 cents per kilowatt-hour, less 5 per cent for prompt payment. The rate applies to all electric energy used in residences after the first 6 kw.-hr. per room per month, all energy used by the customer measured by the one meter.

\* \* \*

Northern States Power Company Faribault division will construct a high tension line between the Waterford switching station and the sub-station at Northfield, so that the St. Paul and Cannon Falls lines may be controlled locally and prevent possibility of interruption to the service in the Northfield district.

\* \* \*

The erection of a second tower transmission line from the Feather River Power plant to Oakland, Cal., as well as a second power house on the Feather River is under consideration by the Great Western Power Company, of San Francisco. The company proposes further development of its hydroelectric properties in the Feather River Canyon and to erect additional distribution lines.

\* \* \*

An electric-light and ice plant will be erected by the Kusa Ice, Light & Power Co. at Kusa, Okla. Mr. R. C. Clark, of Kansas City, Mo., is president and treasurer; Mr. John F. Goshorn, of Kusa, is the secretary. The company will install two 75-kw. direct-connected units and two 30-ton refrigerating machines with necessary equipment. The work is at present under way on one unit of each.

\* \* \*

Ordinarily a live copper circuit is about as safe from thieves as a red-hot stove. Out in Kansas they must have "rubber-fingered gentry" who are expert with pliers and hack-saws, for they stole a length of 500-volt circuit while it was carrying power. More serious for the power company, however, was the theft of 1500 feet of underground cable, taken in section-lengths from a 6600-volt line serving Cement City. This line was dead at the time, and the trouble was first made known by the tripping of circuit-breakers when next it was put into service. The stolen cable was replaced in thirty-six hours.

\* \* \*

A new office building for the Durham (N. C.) Traction Company, operated by Henry L. Doherty & Company is under advisement. This building will be erected in one end of the business section where a suitable location has been found on a corner plot for an excellent display of interior and exterior lighting, good display windows and salesroom. All cars pass this spot and sufficient space will be provided to take care of all the various departments comfortably.

General Manager R. L. Lindsey plans to equip the top floor for club rooms with reading, writing and bath rooms and a few bed rooms for emergencies. It is planned to have general recreation rooms located centrally for all departments with the idea in mind to encourage a mixing and general get-together of all employees of the company.



Once More We Extend  
**Congratulations**

to the members of the electrical industry and Convention City. The opportunity to do this another year is indeed a privilege. It indicates that the men who have made possible

**The Thirty-ninth Convention of  
The National Electric Light  
Association**

have been working unceasingly in the interest of the electrical industry of America. That individuals and companies throughout the country will benefit by these efforts is the belief of

**The New York Edison Company**  
*At Your Service*

General Offices: Irving Place and 15th Street

New York City

# ELECTRICAL AGE

*The Monthly Authority of the Trade*

Technical Journal Co., Inc.  
233 Broadway, New York

**JUNE, 1916**

Volume 48, No. 6.  
Subscription One Dollar

The "roller-bearing" wireway  
in **DURADUCT** is to the  
wire what roller bearings  
are to your automobile.

**P.S.**

Duraduct is the only  
duct with the "roller-  
bearing" wireway.



# Developing the Biggest Lamp Market

The biggest market for the development of new lamp business is the industrial field.

Every manufacturing establishment needs the best light obtainable, but very few have even fair lighting systems.

The manufacturing industry of the country should be educated in the proper use of lamps and lighting. That is your job and ours.

We show here a few of the Westinghouse Mazda Advertisements which have been read by the managers of textile mills, steel mills, machine shops and other industrial plants during the past year.

Our aggressive publicity will help you increase your business in the biggest undeveloped lamp market that exists.

Let us help you make your plans.

*Guaranteed by the Name*

## Westinghouse Lamp Co.

- |           |            |              |               |
|-----------|------------|--------------|---------------|
| Atlanta   | Cincinnati | Kansas City  | Portland      |
| Baltimore | Cleveland  | Los Angeles  | St. Louis     |
| Boston    | Columbus   | Milwaukee    | Salt Lake     |
| Buffalo   | *Dallas    | New York     | San Francisco |
| Butte     | Denver     | Philadelphia | Seattle       |
| Chicago   | Detroit    | Pittsburgh   | Syracuse      |

\*Westinghouse Lamp Corporation.

Export Sales Department—165 Broadway, N. Y. C.

For Canada—Canadian Westinghouse Company, Limited, Hamilton, Ont.

Member Society for Electrical Development

Do it Electrically.



# USE THESE MOTOR SALES HELPS



MOTOR FOLDERS AND BLOTTERS

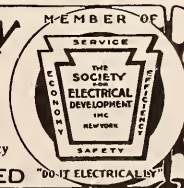
## ASK OUR NEAREST HOUSE FOR YOUR SUPPLY



### Western Electric Company

INCORPORATED

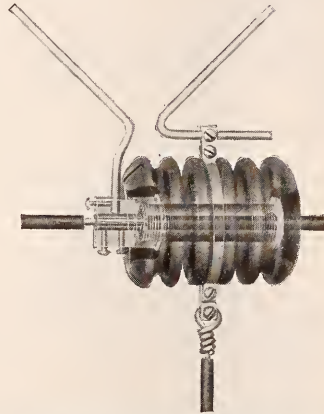
- |              |             |              |               |                |
|--------------|-------------|--------------|---------------|----------------|
| New York     | Atlanta     | Chicago      | Kansas City   | San Francisco  |
| Buffalo      | Richmond    | Milwaukee    | St. Louis     | Oakland        |
| Newark       | Savannah    | Indianapolis | Dallas        | Los Angeles    |
| Philadelphia | New Orleans | Detroit      | Houston       | Seattle        |
| Boston       | Birmingham  | Cleveland    | Oklahoma City | Portland       |
| Pittsburgh   | Cincinnati  | Minneapolis  | St Paul       | Omaha          |
|              |             |              | Denver        | Salt Lake City |



EQUIPMENT FOR EVERY ELECTRICAL NEED "DO-IT-ELECTRICALLY"

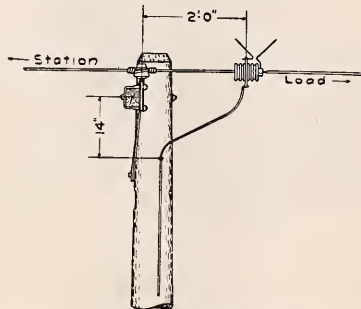
# Peirce Universal Lightning Arrestors

## The Arrestor



Phantom view of Arrestor showing pipe choke coil, line wire and ground wire.

## Its Installation



Method of installing Universal Arrestor.

## Its Results



Universal Arrestor on a single phase lighting circuit.

**Y**OU KNOW from experience in wiring houses in conduit that an iron pipe is a most effective choke coil for one line wire, even at light and power frequencies. Imagine its effect at the high frequencies of lightning discharges! This is why the Universal Arrestor contains a short piece of iron pipe through which your line wire passes, as is shown in the phantom view at the left. The Universal is the only arrestor for distribution lines that has a choke coil. This means that it is the only one that will keep a lightning charge from circulating all over your system until it finds a weak spot, which is usually in a transformer. The lightning *can't* get by the Universal—it simply *has* to jump the horn gap to the ground. And the power arc which follows quickly blows itself out on the horns.

Simplicity is the keynote of the Universal Arrestor. It has no moving parts, housings or supports, and requires no crossarm room. It is clamped directly on a line wire, out of the way of your linemen, and requires no cleaning or inspecting whatever.

What savings Universal Arrestors will make for you can best be judged by what they have made for other companies during the four years they have been in service. In one case a district which should have had 950 arrestors was given 74. Formerly this district had averaged 150 burntout transformers each year. But with only 8 per cent of its proper equipment of Universals the burnouts have been reduced to an average of 40 per year. These burnouts average \$20.00 apiece, and the arrestors cost about \$4.00 apiece installed.

**At this rate, how much money would you save in a year on your system?**

Read Pages 151-5 of your Hubbard Catalogue or write us for your copy of Bulletin 17.

## HUBBARD AND COMPANY - - - Pittsburgh

New York

Chicago

San Francisco



# NATIONAL MAZDA AUTO LAMPS

## Complete For Any Car

The National MAZDA Auto Lamp Kit contains a complete set of six lamps—head, side, rear and instrument lights—for any car. Includes a pair of the new, much-sought-after MAZDA C Headlights!

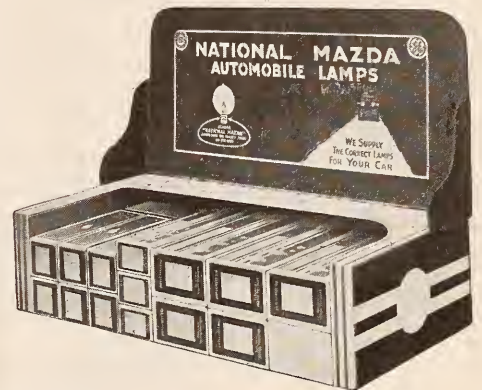
Eight Lamp Kit assortments fill the requirements of nearly all the cars.

The new "National Guide to Proper Lamps" tells every LAMP needed on every American made car for 1916, '15, '14, '13, and the "National Guide to Auto Lamp Kits" shows at a glance which KIT supplies the proper lamps for any car. Either Guide sent free on request.



## The Auto Lamp Cabinet

Here's a Cabinet of 100 National MAZDA Auto Lamps, so selected that they care for the wants of 90% of American made cars! Maximum assortment—minimum stock. The Cabinet itself is a salesman. On counter, in window, it's a persistent auto lamp advertiser. For selling individual lamps as required, and for refilling the kits, you need this 100-lamp Cabinet.



## The Flashlight Lamp Case

Contains 100 lamps for flashlights and electric hand lanterns. Display the case on counter, in window, and get this easy lamp renewal business! It comes without effort and is easy to fill, for a simple index system helps you to produce instantly the proper lamp for any regularly manufactured flashlight or single cell hand lantern.



Nela Park

Cleveland

Member Society for Electrical Development. "Do It Electrically"



# STACK PAINT

Proper protection for smoke stacks demands a paint capable of withstanding the effects of high temperatures.

Such a paint to be efficient and successful must be scientifically made from pigments which embody the necessary qualities to stand up in the service and under the most severe conditions.

## Superior Graphite Paint

For 25 years we have been specializing on paints to meet difficult conditions. One of our most successful products is Superior Graphite Paint for smoke stacks, boiler fronts and all hot surfaces.

Its splendid record in this service is due to the fact that the ore from which Superior Graphite Paint is made is a product of great heat, and when properly ground and mixed with an oil already boiled to a high degree, there is nothing in it that heat will affect.

For Central Station work, our line includes SUPERIOR GRAPHITE PAINT for roofs, structural steel, metal poles, stacks, boiler fronts and hot surfaces; DEGRACO MACHINERY ENAMELS for painting the various pieces of machinery; DEGRACO POLE PAINT for wooden poles; DEGRACO CONCRETE WALL AND FLOOR PAINT for concrete walls, floors, etc.; STA-WHITE, a white enamel finish for interiors; DEGRACO METER ENAMELS for meters, dynamos, generators, etc.

SUPERIOR GRAPHITE PAINT a special stack formula—is protecting the stacks and boiler fronts in a large number of Central Stations and power plants throughout the country. Its great durability and large covering capacity make it a good business investment.

FULL INFORMATION ON REQUEST

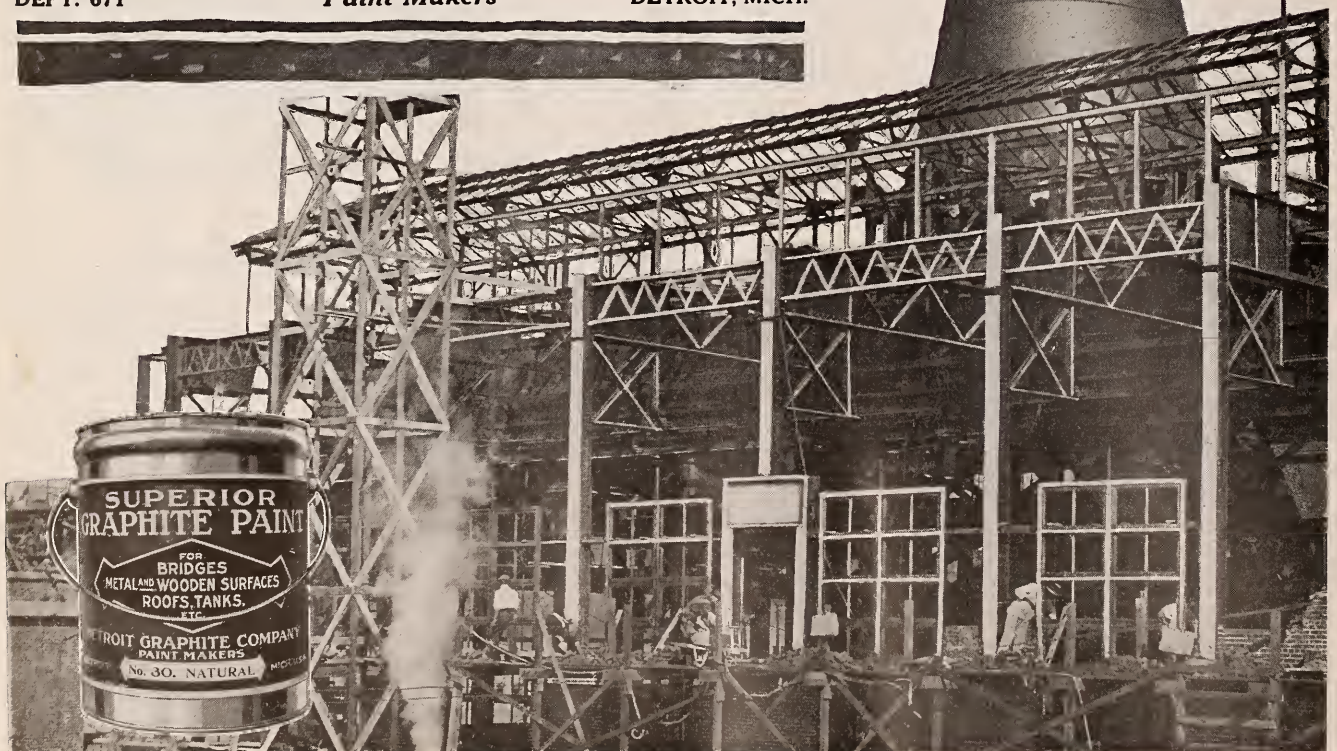
## DETROIT GRAPHITE COMPANY

DEPT. 671

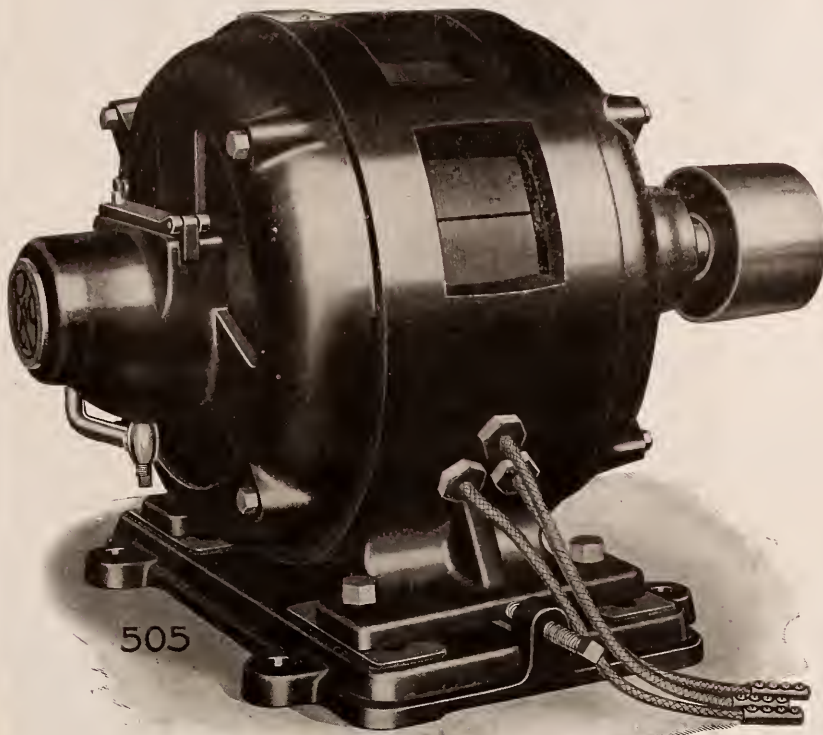
Paint Makers

DETROIT, MICH.

200 ft. Stack of the Omaha Power & Light Co., painted with Superior Graphite Paint.



# *Examine the Bearings When You Buy Induction Motors*



The bearings of an induction motor are about the only parts which are subject to wear. You can measure the service a motor will give by the strength and durability of the bearings.

Unusual strength and durability are conspicuously apparent in the bearings of the Robbins & Myers Type "K" Motor. So great is the factor of safety in their design that one end head and bearing can be removed, allowing the weight of the rotor to be carried on

one bearing alone, and the motor will operate without vibration or heating in the remaining bearing. This test has been made time and again with Type "K." We invite you to make the test on any Type "K" motor.

In addition to their great strength and durability, Type "K" bearings are dust proof. They will give years of service in localities where dust and grit fill the air, as in cement mills, mines, etc.

The Type "K" bearing insures long, reliable service for the user and good will for the dealer or contractor who sells the motor.

Bulletin No. 123 gives complete specifications of this motor in sizes from 1-4 to 25 horse-power. Copy on request.

## **THE ROBBINS & MYERS COMPANY**

**SPRINGFIELD, OHIO**

New York

Boston

Philadelphia

Rochester

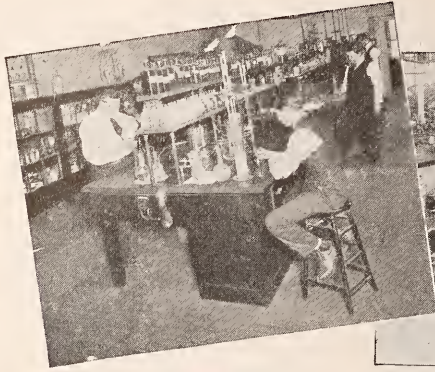
Cleveland

Cincinnati

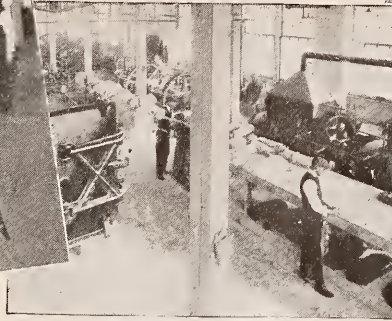
Chicago

St. Louis

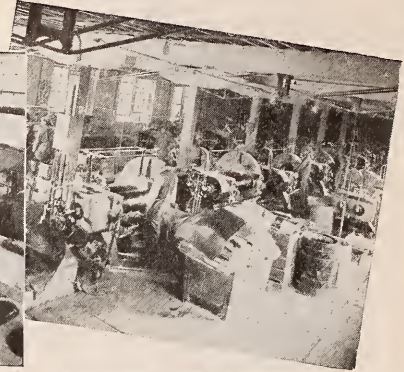
San Francisco



LABORATORY



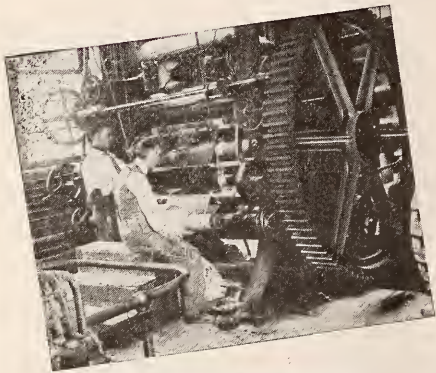
WASHING THE GUM



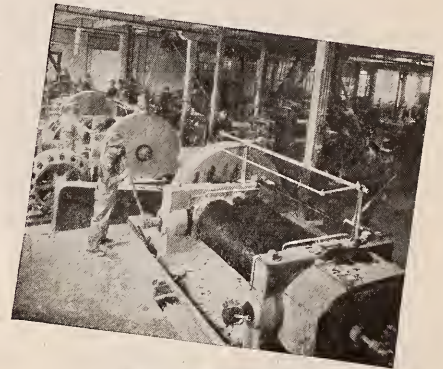
MILLING THE STOCK

Some of the Various Stages  
In the Manufacture of the  
**DEPENDABLE BRANDS**

OF  
**TAPE**



CALENDERING THE STOCK



MIXING THE STOCK

MADE BY

**THE MECHANICAL RUBBER CO.**

CLEVELAND



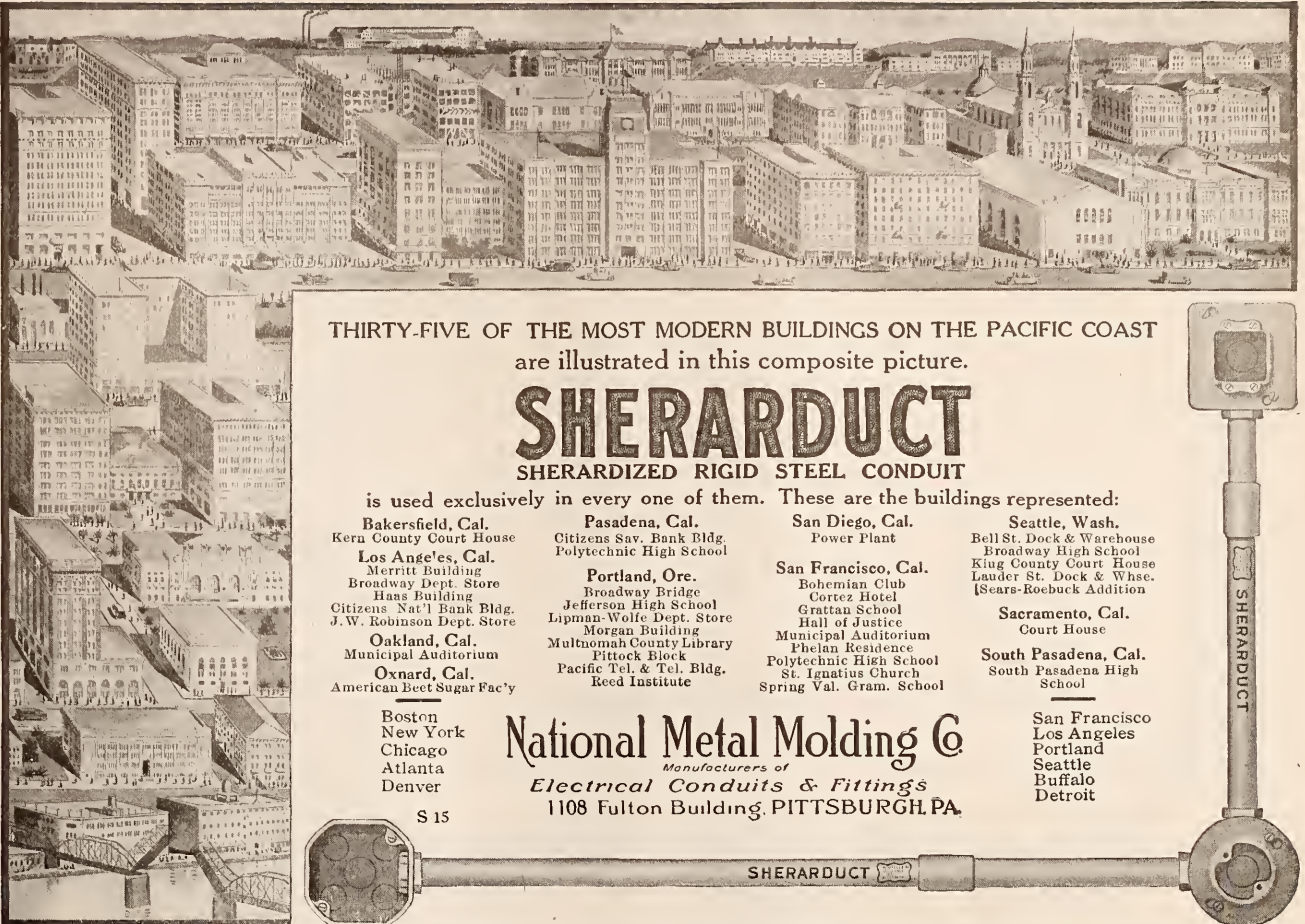
ROLLING THE TAPE



PACKING THE TAPE



MAKING BOXES AND CARTONS



THIRTY-FIVE OF THE MOST MODERN BUILDINGS ON THE PACIFIC COAST are illustrated in this composite picture.

# SHERARDUCT


SHERARDED RIGID STEEL CONDUIT

is used exclusively in every one of them. These are the buildings represented:

Bakersfield, Cal. Kern County Court House	Pasadena, Cal. Citizens Sav. Bank Bldg. Polytechnic High School	San Diego, Cal. Power Plant	Seattle, Wash. Bell St. Dock & Warehouse Broadway High School King County Court House Lauder St. Dock & Whse. [Sears-Roebuck Addition]
Los Angeles, Cal. Sterritt Building Broadway Dept. Store Haas Building Citizens Nat'l Bank Bldg. J. W. Robinson Dept. Store	Portland, Ore. Broadway Bridge Jefferson High School Lipman-Wolfe Dept. Store Morgan Building Multnomah County Library	San Francisco, Cal. Bohemian Club Cortez Hotel Grattan School Hall of Justice Municipal Auditorium Phelan Residence Polytechnic High School St. Ignatius Church Spring Val. Gram. School	Sacramento, Cal. Court House
Oakland, Cal. Municipal Auditorium	Oxnard, Cal. American Beet Sugar Fac'y		South Pasadena, Cal. South Pasadena High School
Boston New York Chicago Atlanta Denver			San Francisco Los Angeles Portland Seattle Buffalo Detroit

**National Metal Molding Co**  
Manufacturers of  
*Electrical Conduits & Fittings*  
1108 Fulton Building, PITTSBURGH, PA.

S 15







# We Make 'em all!

## Chattanooga Armature Works

Chattanooga, Tennessee

## "From Coal to Customer"

requires many connections in your power and substations. The current surge that may burn out soldered connections will be safely carried if those connections are made secure and reliable with

### Dossert Connectors and Terminals

Time and labor saving as well as affording easy connection or disconnection, whether for temporary use or that ever-present central station consideration—obsolescence.

Tighten them up—leave them alone and the connections are permanent; not only that, but in the event of trouble DOSSERT CONNECTORS will carry overloads great enough to melt the conductor to which they are attached.

Made in every necessary size and form for all conceivable connections from No. 14 to 2,500,000 C. M. conductors.

If you are not using DOSSERT CONNECTORS you are missing the advantages secured to our old customers who are using more of them every year.

Efficiency, Safety and Economy in  
Installation, Service and Maintenance

Ask for our Tenth Year Catalogue

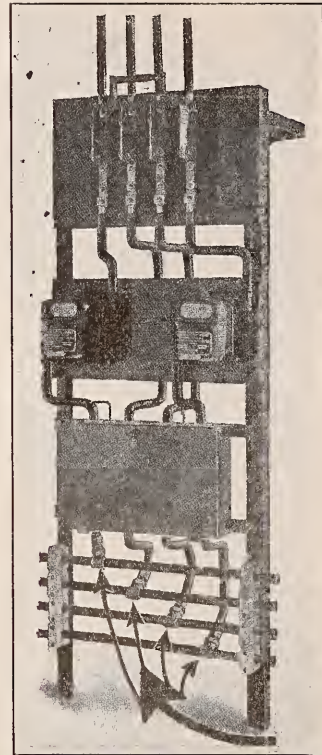
## Dossert & Company

H. B. LOGAN, Pres.

242 W. 41st Street

New York City

Illustration shows Typical Installation of Dossert Cable Taps Tapping  
from Solid to Stranded Conductors



## These Jobbers are Always Waiting for Your Orders on

### LIST OF OSHKOSH JOBBERS

AMARILLO, TEXAS  
Nunn Elec. Co.  
BALTIMORE  
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BOSTON  
Pettingell-Andrews Co.  
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BUFFALO, N. Y.  
Robertson-Cataract Elec. Co.  
BUTTE, MONT.  
Montana Elec. Co.  
CEDAR RAPIDS, IA.  
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F. D. Lawrence Elec. Co.  
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Lockwood-Luetkemeyer-Henry Co.  
DALLAS, TEXAS  
Southwest General Elec. Co.  
Electric Appliance Co.  
DENVER, COLO.  
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INDIANAPOLIS, IND.  
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JACKSONVILLE, FLA.  
Florida Elec. Co.  
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MILWAUKEE, WIS.  
Julius Andrae & Sons

## OSHKOSH TOOLS

The fact that these reputable jobbers and supply houses whom you will recognize as occupying an important place in the electrical industry, carry OSHKOSH CONSTRUCTION TOOLS—"speaks well for the tools." Jobbers prefer to handle "good sellers"—; they like to sell what the public demands and the telephone public prefers OSHKOSH TOOLS. If you haven't a copy of the OSHKOSH CATALOGUE, ask your jobber or write us and remember that your jobber is anxious to receive your OSHKOSH ORDER.

And The WESTERN ELECTRIC  
COMPANY at all its branches

Oshkosh Manufacturing  
Company

Oshkosh — Wisconsin

AGENTS

H. B. SQUIRES COMPANY  
San Francisco

F. K. SIMONS ELECTRIC CO.  
Widener Bldg., Philadelphia

### LIST OF OSHKOSH JOBBERS

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Electric Appliance Co.  
Interstate Elec. Co.  
NEW YORK  
Northwestern Elec. Equip't Co.  
NORFOLK, VA.  
Woodhouse Elec. Co.  
OMAHA, NEB.  
McGraw Elec. Co.  
Mid-West Elec. Co.  
PHILADELPHIA  
H. C. Roberts Elec. Co.  
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Powell, Clouds & Co.  
PITTSBURGH  
Union Elec. Co.  
PORTLAND, ORE.  
Pacific States Elec. Co.  
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SALT LAKE CITY, UTAH  
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SAN FRANCISCO  
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SEATTLE, WASH.  
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Washington Elec. Supply Co.  
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St. Paul Elec. Co.  
SYRACUSE  
Mohawk Elec. Supply Co.  
H. C. Roberts Elec. Co.  
WACO, TEXAS  
Waco Elec. Co.  
WASHINGTON, D. C.  
National Elec. Supply Co.  
WICHITA, KANS.  
United Elec. Co.

This border is engraved from a photograph of REALFLEX Armored Conductor wound around BUCKEYE Conduit.

*The latter was bent cold.*

The REALFLEX is our "14-2" and the conduit is 1 1/4 inch BUCKEYE Black Enameled.

Are they easy-working? See for yourself.

**The Western Conduit Company**  
(Subsidiary to The Youngstown Sheet & Tube Co.)  
**Youngstown, Ohio**

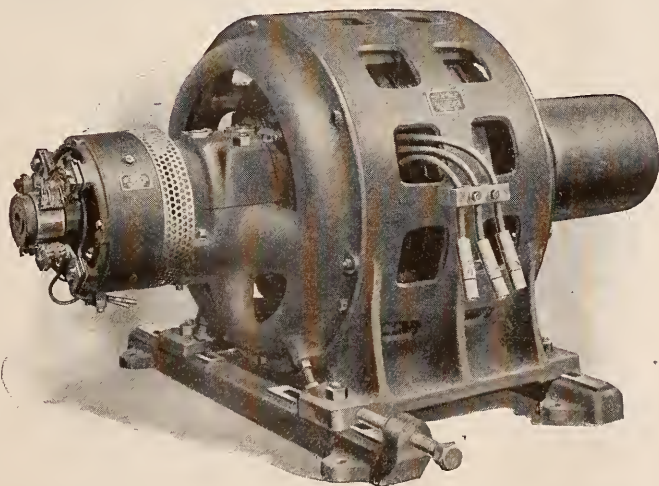
DISTRICT SALES OFFICES:

80 Church Street	New York, N.Y.	902 Third National Bank Bldg.	St. Louis, Mo.
604 Mission Street	San Francisco, Cal.	575 Central Bldg.	Seattle, Wash.
1563 McCormick Bldg.	Chicago, Ill.	1514 Healey Bldg.	Atlanta, Ga.
1826 Oliver Bldg.	Pittsburgh, Pa.	1518 Widener Bldg.	Philadelphia, Pa.
775 First National Bank Bldg.	Denver, Col.	120 Franklin Street	Boston, Mass.
915 Busch Bldg.	Dallas, Texas		

REPRESENTED BY

The W. A. Bonnell Co.	132 Church Street	New York, N.Y.
E. R. Bryant	81 High Street	Boston, Mass.
Walker Bros. & Haviland	1532 Sansom Street	Philadelphia, Pa.
Electric Agencies Co.	247 Minna Street	San Francisco, Cal.
Electric Agencies Co.	Central Bldg.	Los Angeles, Cal.
McNair Electric Sales Co.	27 Woodward Ave.	Detroit, Mich.

# Improve Your Power Factor



## Allis-Chalmers Synchronous Motors and Synchronous Condensers

Meet Every Requirement  
for Power Factor Correction

Synchronous Motors - Built in all types—for belted, coupled or direct connected service.

They are self starting.

One of these modern machines on your power circuit may be used for power purposes as well as corrective effect, or it may be used for power factor correction only

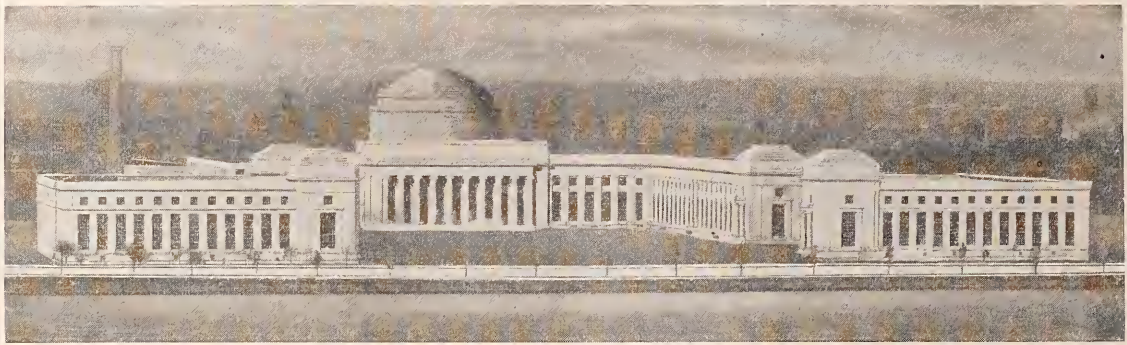
Let us help solve your power problems

**Allis-Chalmers Manufacturing Company**

**Milwaukee, Wis.**

Offices in All Principal Cities

Canadian Representatives: Canadian Allis-Chalmers, Ltd., Toronto, Ont.



The new buildings of the Massachusetts Institute of Technology—Cambridge, Mass.  
W. W. Bosworth, Architect—14 Buildings completed—750,000 sq. ft.

### Hygrade Lamps Win At Tech.

The new \$6,000,000 Massachusetts Institute of Technology, the newest product of the ablest and keenest engineering and constructive minds of the country, will be lighted by Hygrade Lamps. The initial order placed by the builders, the Stone & Webster Engineering Corp., was for 2680 Hygrade Gas-filled and 2905 Hygrade Tungsten Lamps.

If Tech. uses Hygrade, why don't you?

## HYGRADE LAMP CO.

GENERAL OFFICE  
AND FACTORY



SALEM MASS

**OKONITE**

TRADE MARK Registered U. S. Pat. Office

**INSULATED  
WIRES & CABLES**

*The STANDARD for  
RUBBER INSULATION*

THE leading electrical engineers all over the world know that OKONITE Insulated Wires and Cables never disappoint. Their knowledge can be made your gain.

When you get the habit of using OKONITE Insulated Wires and Cables, you have met success more than half way.

**THE OKONITE COMPANY**  
253 Broadway  
NEW YORK

## Constant Service

the important factor in brush selection is guaranteed to you in

### “NO-SPARK” CARBON BRUSHES

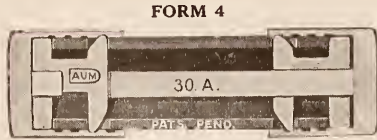
They allow the motor to run free of sparking, heating and cutting—reducing the wear on the commutator and eliminating annoying and costly delays.

There are many more vital points proving the superiority of No-Spark Carbon Brushes. We shall gladly send you a set on thirty days free trial so you may see them for yourself.

**CALEBAUGH SELF-LUBRICATING CARBON COMPANY**  
1503 Columbia Ave. Philadelphia, Pa.

Sales Agents: { N. Y., N. Y.—George W. Letts, 2 East 23rd St.  
Birmingham, Ala.—Robertson Sales Co.  
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Chicago, Ill.—John B. Swift, Jr., 704 Fisher Bldg.  
Phone Harrison, 6557



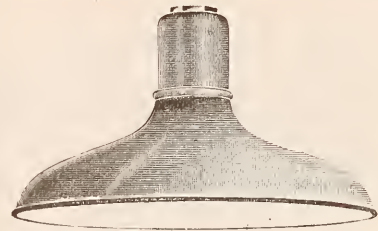


3-60 Am. 250-600 V.

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Caps removed by the twist of your wrist, no tools whatever are required. The fusible element comes in rolls of ¼-lb. to the roll, averages 500 renewals to the roll. Send for Bulletin J-22 and sample free.

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Represent the highest grade  
at the lowest price

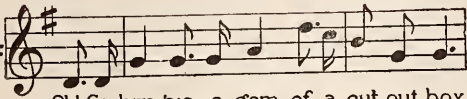
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We specialize in

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Decorative Carbon Lamps  
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**C. D. Wood Electric Co., Inc.**  
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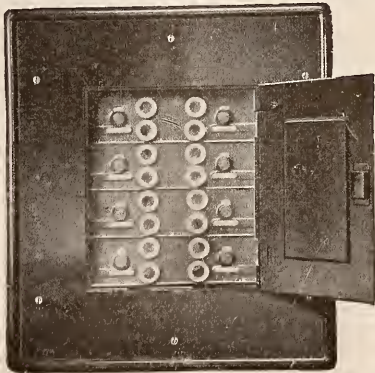
Makers of *The Monocoil Motor*  
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Oh! Co-lum-bia, a gem of a cut-out box.

## COLUMBIA-QUALITY TYPE E GUTTERED CABINETS

For Regular Plug and Panel Cutouts and  
Dead Front Perkins Panel Cutouts



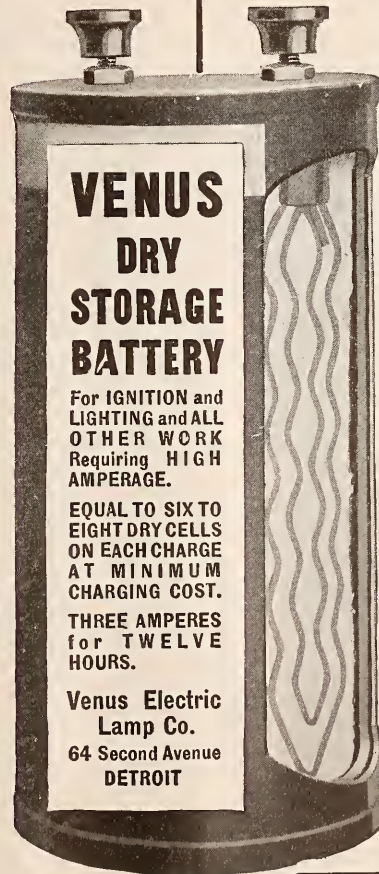
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Six times the efficiency of a standard dry cell and an indefinite recharging capacity.

Approximately the same size as a standard dry cell, with a six times higher efficiency. Discharging rate is exceptionally high for so small a battery, being 2½ amperes for twelve hours. This makes the Venus the ideal battery for ignition, lighting and other heavy duty purposes. The charging rate is correspondingly high, 3½ amperes, fully charging in about 8 hours.

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You have been waiting for this battery, test it yourself. Send for a sample.

Special Sample Offer: \$2.00  
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## Try Us on Quick Deliveries

We carry a stock of standard lighting transformers for immediate shipment. We can always ship standard voltage transformers in three to five days if necessary.

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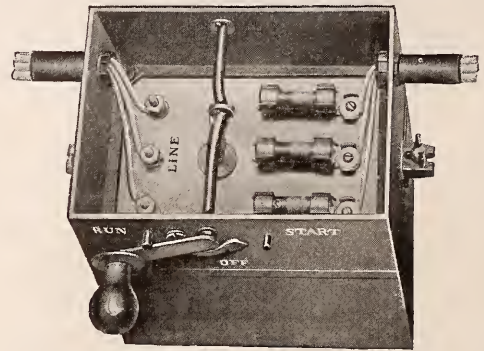
"Transformers of all kinds for all purposes"

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can be reduced by using

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## Type I Oil Starters



Type I 250 Volt Oil Starter with cover removed.

### Because:

They absolutely prevent properly fused polyphase motors from running singlephase with the resulting expensive burnouts.

They permit fusing the motor for proper overload protection without blowing the fuses in starting the motor.

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STURDY LITTLE MOTORS THAT WITHSTAND THE LAYMAN'S ABUSE

**PITTSBURGH**  
**THREAD PROTECTED**  
**ENAMELED CONDUIT**  
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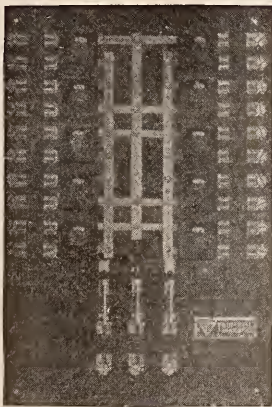
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Standard Panelboards



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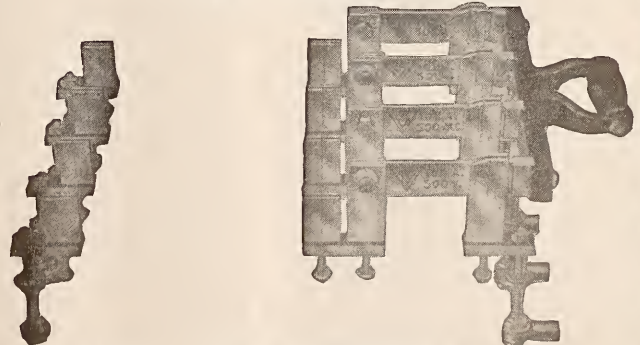
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**The Trumbull-Vanderpoel Electric Mfg. Company,**  
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**GREENFIELD  
SINGLE STRIP CONDUIT**

Designed for fire-proof or non-fire-proof construction

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Also  
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Steel Boxes and Covers—Floor Boxes—Fittings—Tools.

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Designed for non-fire-proof work



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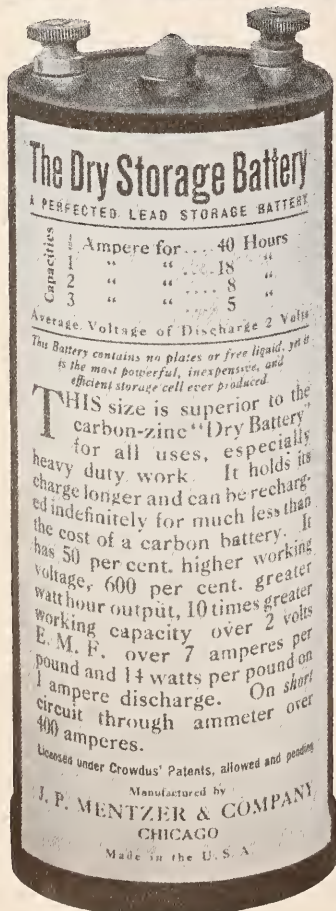
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**The Dry Storage Battery**  
A PERFECTED LEAD STORAGE BATTERY

Capacities	Ampere for ...	40 Hours
1	"	18 "
2	"	8 "
3	"	5 "

Average Voltage of Discharge 2 Volts

*This Battery contains no plates or free liquid, yet it is the most powerful, inexpensive, and efficient storage cell ever produced.*

**THIS** size is superior to the carbon-zinc "Dry Battery" for all uses, especially heavy duty work. It holds its charge longer and can be recharged indefinitely for much less than the cost of a carbon battery. It has 50 per cent. higher working voltage, 600 per cent. greater watt hour output, 10 times greater working capacity over 2 volts E. M. F. over 7 amperes per pound and 14 watts per pound on 1 ampere discharge. On short circuit through ammeter over 400 amperes.

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Made in the U. S. A.

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than seven No. 6 Dry Cells is rendered by

**The Mentzer  
Dry Storage Battery**

Yet the initial cost is only \$2.50, forty cents more than the seven old style batteries. To get this given amount of service from dry cells would cost \$630, whereas the Mentzer Dry Storage Battery performs this work for \$17.50, including recharging.

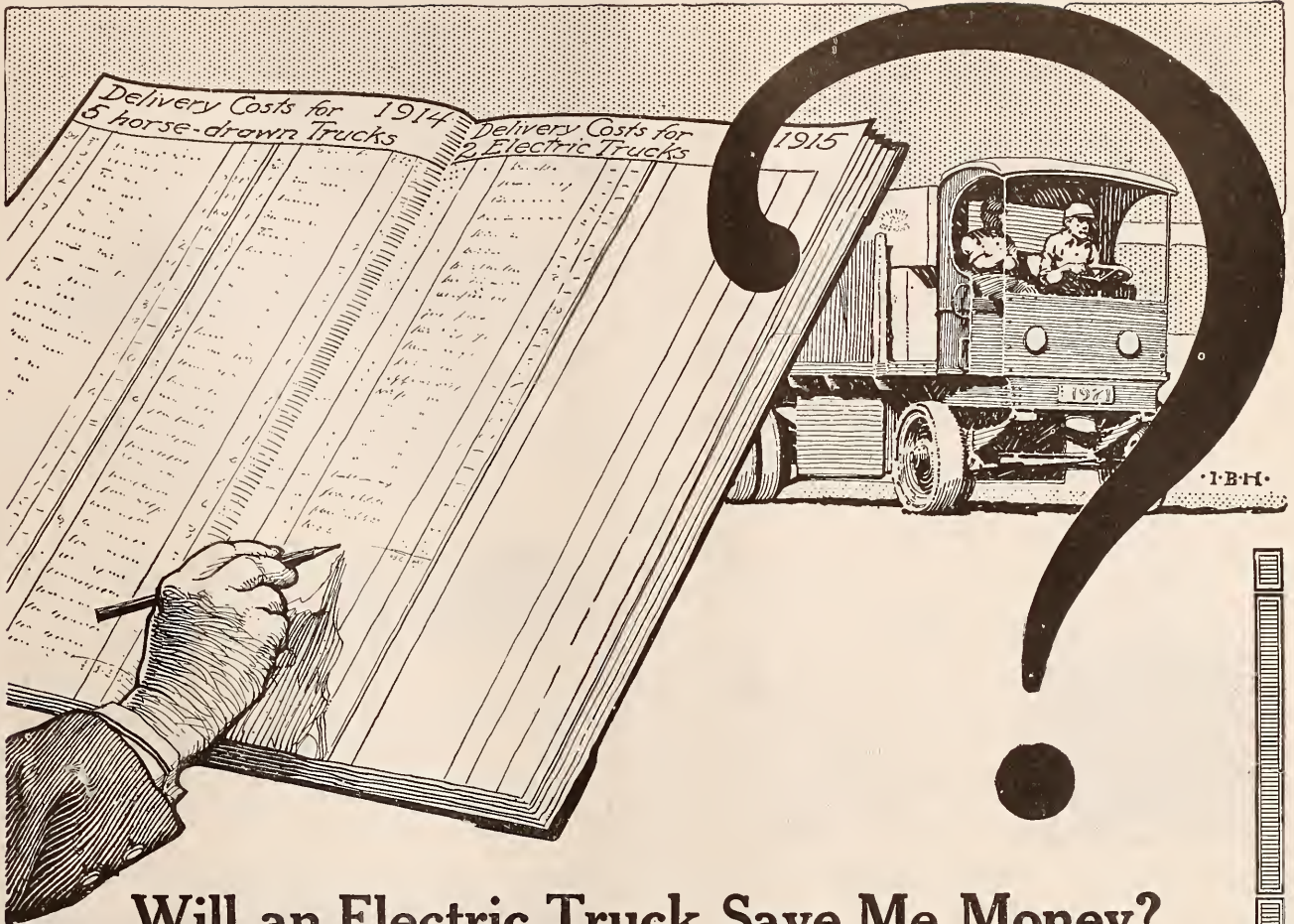
This important feature makes the Mentzer Dry Storage Battery

**A Big Seller**

It is the logical battery for heavy duty work, Ignition, Lighting, Telephone and Telegraph service, etc.

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You can estimate accurately beforehand just what a certain trucking cost will be with G. V.'s.

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Have you done *your* part to secure the benefit of this advertising for *your* "off peak"? Do you set the truckers of *your* city the example of using electric trucks; or are you wasting money and opportunity by using gas vehicles?

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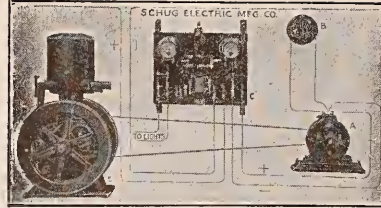
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For Country Homes  
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Solid braided cotton, waterproofed. Will outwear metallic devices or twisted rope, and will not transmit shocks.  
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EVERY coil examined and labeled under the direction of the underwriters laboratories. Ignition wire for autos, motor boats and aeroplanes.

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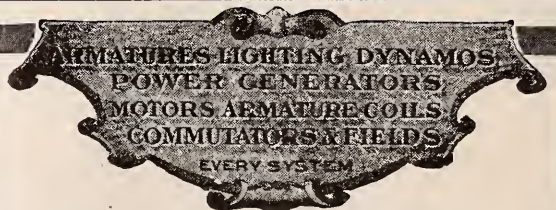
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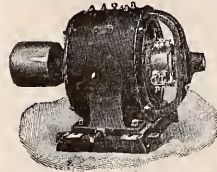
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We build switchboards fully equipped to execute any class of electric work on short notice.



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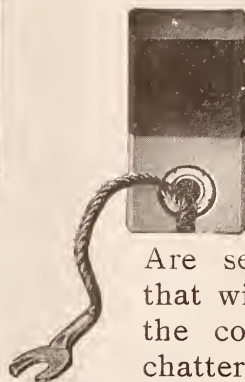
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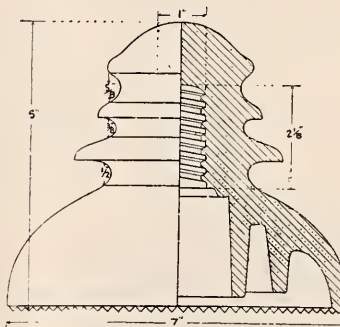
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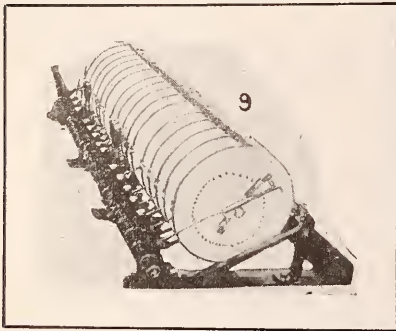
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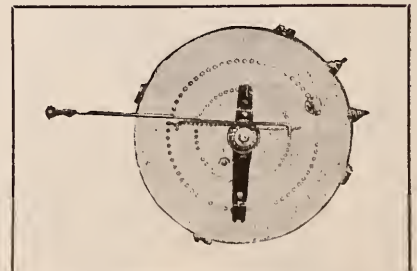
that each RD plate has 110 steps. This means that these dimmers will give 20% finer regulation than if they had 90 steps, 35% finer regulation than if they only had 80 steps, and 100% finer regulation than if they had 55 steps.



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Only Theatre Dimmer  
Made With  
110 Steps of Control  
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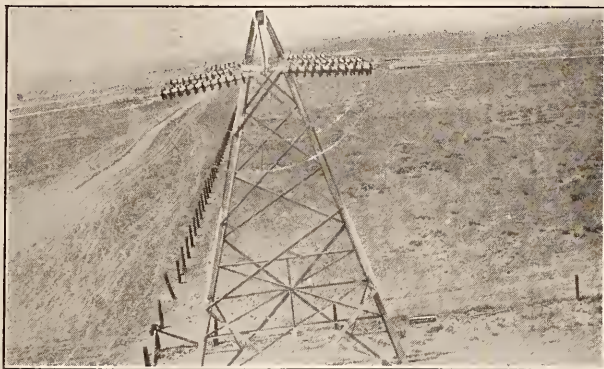
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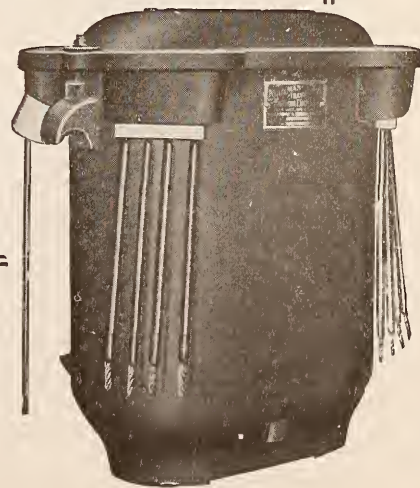
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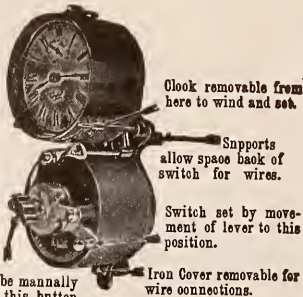
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Switch set by movement of lever to this position.

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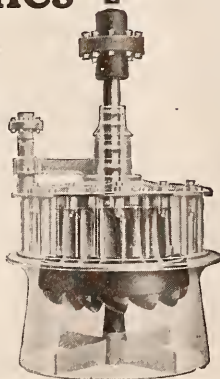
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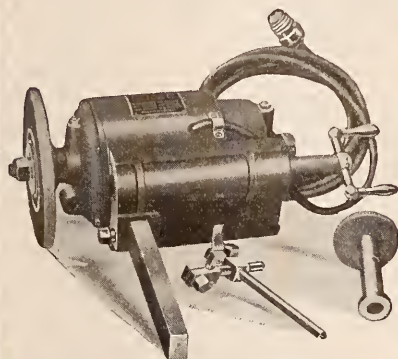
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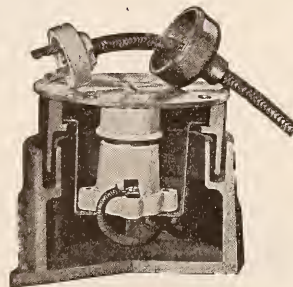


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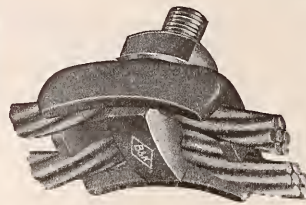
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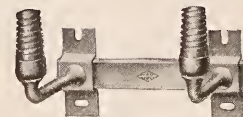
No. 2160 Guy Clamp



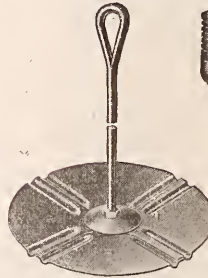
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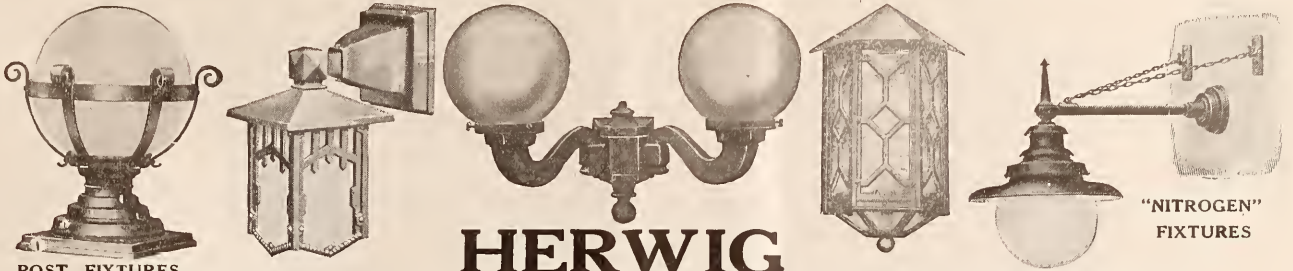
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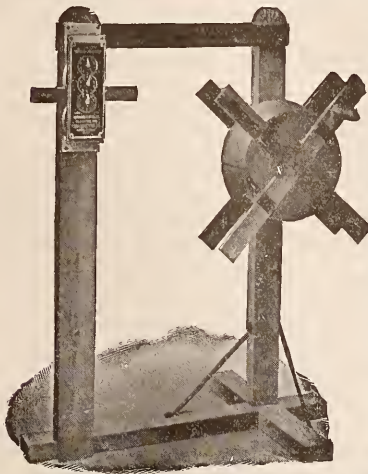
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- Dynamoes and Motors (Second-Hand.)**  
Atlanta Electric Machine Co.  
Chattanooga Armature Works.  
Oliver Electric & Machine Co.
- Electrical Repairing.**  
Chattanooga Armature Works
- Electric Fixtures.**  
Adam Electric Co., Frank  
Illuminating Engineering Co.  
Southern Electric Co.
- Electric Light Plants—Small.**  
Schug Elec. Mfg. Co.
- Electric Signs—(See Signs).**
- Electric Sign Flashers—(See Flashers—Electric Sign).**
- Electric Vehicles.**  
General Vehicle Co.
- Engines—Gas and Gasoline.**  
Allis-Chalmers Mfg. Co.  
General Electric Co.  
Westinghouse Mach. Co.
- Engines—Steam.**  
Allis-Chalmers Mfg. Co.  
Westinghouse Mach. Co.
- Engineers—Consulting.**  
Arnold Co., The  
Byllesby, H. M. & Co.  
Cooper, Hugh L. & Co.  
Dixon-Smith Engineering Co.  
Jackson, D. C. and Wm. B.  
Pillsbury, Chas. L.  
Sanderson & Porter.  
Scofield Engineering Co.  
Spiker, William C.  
Stone & Webster Engineering Corporation.  
White & Co., J. G.
- Fans—Exhaust.**  
Lindstrom, Smith Co.  
Menominee Electric Mfg. Co.  
Peerless Electric Co.  
Robbins & Meyers Co.  
Southern Electric Co.  
Star Fan & Motor Works.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Fan Motors.**  
Clark, Jas. Jr., Elec. Co., Inc.  
General Electric Co.  
Hunter Fan & Motor Co.  
Lindstrom, Smith Co.  
Matthews Elec. Co.  
Menominee Electric Mfg. Co.  
Peerless Electric Co.  
Robbins & Meyers Co.  
Southern Electric Co.  
Star Fan & Motor Works.  
Western Electric Co.  
Westinghouse Electric & Mfg. Co.
- Fibres.**  
Continental Fibre Co.  
Standard Underground Cable Co.
- Financial.**  
Electric Bond & Share Co.
- Fixtures—Lighting.**  
Adam Electric Co., Frank  
Cutter Co., George  
Herwig Art Shade & Lamp Co.  
Shapiro & Aronson.  
Southern Electric Co.  
Wallace Novelty Co.
- Friction Tape and Cloths.**  
Okonite Co., The  
Walpole Tire and Rubber Co.
- Fuses—Electric.**  
Daum Co., A. F.  
Delta Star Elec. Co.  
Economy Fuse & Mfg. Co.  
General Electric Co.  
Monarch Refillable Fuse Co.  
Multi Refillable Fuse Co.  
Railway & Industrial Engineering Co.  
Western Electric Co.

# BUYERS CLASSIFIED INDEX (Con'd)

- Fuses—Refillable.**  
Economy Fuse & Mfg. Co.  
Monarch Refillable Fuse Co.  
Multi Refillable Fuse Co.
- Fuse Boxes.**  
(See Boxes—Fuse.)
- Gas Engines.**  
Allis-Chalmers Mfg. Co.
- Gauges—Recording.**  
Bristol Co.  
Uehling Instrument Co
- Generator Brushes—(See Brushes—Motor and Generator.)**
- Generators and Motors.**  
Allis-Chalmers Mfg. Co.  
Crocker-Wheeler Co.  
General Electric Co.  
Menominee Electric Mfg. Co.  
Peerless Electric Co.  
Robbins & Myers Co.  
Southern Electric Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Globes, Shades, etc.**  
General Electric Co.
- Graphite.**  
Calebough-Block Self Lubricating Carbon Co., Inc.  
Joseph Dixon Crucible Co.
- Graphite Paint.**  
Detroit Graphite Co.
- Hand Lamps—Electric.**  
Southern Electric Co.
- Hangers—Cable.**  
Hubbard & Co.  
Standard Underground Cable Co.
- Heating Apparatus—Electrical.**  
General Elect. Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Helists—Electric and Steam.**  
Allis-Chalmers Mfg. Co.
- Hydraulic Machinery.**  
Allis-Chalmers Mfg. Co.
- Injectors.**  
Bristol Co.  
Duncan Electric Co.  
General Electric Co.  
Westinghouse Elec. & Mfg. Co.  
Weston Elec. Inst. Co.
- Instruments—Electrical.**  
Bristol Co.  
Duncan Elec. Mfg. Co.  
General Electric Co.  
Norton Electrical Inst. Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.  
Weston Electrical Instrument Co.
- Instruments—Recording.**  
Bristol Co.  
Uehling Instrument Co.
- Insulators.**  
Brookfield Glass Co.  
General Electric Co.  
Hemingray Glass Co.  
High Tension Elec. Specialty Co.  
Johns-Manville Co., H. W.  
Locke Insulator Mfg. Co.  
Pittsburgh High Voltage Insulator Co.  
R. Thomas & Sons Co.
- Insulating Material.**  
American Electrical Works.  
Brookfield Glass Co.  
Chicago Mica Co.  
Continental Fibre Co.  
Dickinson Mfg. Co.  
General Electric Co.  
Locke Insulator Mfg. Co.  
Moore, Alfred F.  
Okonite Co., The
- Pittsburgh High Voltage Insulator Co.**  
Standard Underground Cable Co.  
Thomas & Sons Co., R.  
Ward Leonard Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Insulators—Wood.**  
Barnes & Kobert Mfg. Co.
- Insulator Pins.**  
Hubbard & Co.  
Southern Exchange Co., The  
Thomas & Sons, R.
- Irons—(Electrical).**  
Southern Elec. Co.  
Westinghouse Electric & Mfg. Co.
- Lamp Cord.**  
Moore, Alfred F.  
Sampson Cordage Works  
Standard Underground Cable Co.
- Lamp Shades.**  
A.-A. Electric Co.  
Herwig Art Shade & Lamp Co.
- Lamps—Carbon Arc.**  
General Electric Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Lamps—Flaming Arc.**  
General Electric Co.  
Western Electric Co.  
Westinghouse Elect. & Mfg. Co.
- Lamps—Incandescent.**  
Boston Economy Lamp Div.  
Clark, Jas. Jr., Elec. Co., Inc.  
Douth & Co.  
Edison Lamp Works.  
General Electric Co.  
Hygrade Lamp Co.  
Lux Mfg. Co.  
National Lamp Works.  
Southern Electric Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.  
Westinghouse Lamp Co.
- Lamps—Miniature.**  
General Electric Co.  
Southern Electric Co.
- Lanterns—Electric.**  
Southern Electric Co.
- Lead-Covered Wires.**  
Okonite Co., The
- Lighting Fixtures.**  
Eclipse Light Co.
- Lighting Systems.**  
Schug Elec. Mfg. Co.  
Ward Leonard Electric Co.
- Lightning Arresters.**  
Delta-Star Elec. Co.  
General Electric Co.  
Hubbard & Co.  
Westinghouse Elect. & Mfg. Co.
- Line Material.**  
Barnes & Kobert Mfg. Co.  
Electrical Eng'rs Equip. Co.  
General Electric Co.  
Hubbard & Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Lubricants.**  
Calebough-Block Self Lubricating Carbon Co., Inc.  
Dixon Crucible Co., Jos.  
Galena Signal Oil Co.
- Lubricants—No-Spark Commutator Brush.**  
Calebough-Block Self Lubricating Carbon Co., Inc.
- Machinery Guards—Perforated.**  
Erdle Perforating Co.

# “DECO”

Some Users of “DECO” Lamps

Equitable Bldg.  
Adams Express Building  
The Vincent Astor Estates  
Hamburg - American Line Bldg.  
McAlpin Hotel  
Hotel Astor  
St. Regis Hotel  
Sherry's  
Delmonico's  
Lord & Taylor Dept. Store  
Gimbel Bros. Dept. Store  
Abraham & Strauss Dept. Store  
A. I. Namm & Sons Dept. Store  
Oppenheim Collins & Co., Dept. Store



Some Users of “DECO” Lamps

Young Men's Christian Assn., New York City  
New York Public Library  
Department of Education, City of New York  
Department of Docks and Ferries, City of New York  
Thompson Starrett Co.  
Hercules Powder Co.  
American Car & Foundry Co.  
Atlantic City Steel Pier Co.  
Central Coal & Iron Co.

# A R G O N

## 40, 60 and 75 Watt Gas-Filled Lamps

### “DECO”

40-60 and 75 Watt Gas Filled Lamps were the first of their kind on the market.

### “DECO”

40-60 and 75 Watt Gas Filled Lamps were the first to be accepted by consumers as practicable and successful.

We are now the first to reduce the list price on “DECO” 40-60 and 75 Watt Gas Filled Lamps.

## “DECO” Always Ahead!

*New List Prices in effect May 15th:*

40 Watt Gas Filled Lamps, each.....	\$0.60
60 Watt Gas Filled Lamps, each.....	.60
75 Watt Gas Filled Lamps, each.....	.65

### AGENTS WANTED

Special Discounts on Nitrogen, Tungsten and Carbon Lamps

# DEUTH & CO., Inc.

Equitable Bldg. 120 Broadway  
NEW YORK CITY

Chicago Agent: Peerless Light Co.

# BUYERS CLASSIFIED INDEX (Con'd)

- Magnet Wire.**  
American Steel & Wire Co.  
Hazard Mfg. Co.  
Alfred F. Moore  
Standard Underground Cable Co.  
Western Electric Co.
- Mechanical Stokers.**  
Baker & Co., Inc.  
Westinghouse Machine Co.
- Metal—Perforated.**  
Erdle Perforating Co.
- Metal Polish.**  
Ever-Ready Mfg. Co.
- Metal Punching.**  
Erdle Perforating Co.
- Metals.**  
American Platinum Works.
- Meters.**  
Duncan Electric Mfg. Co.  
Westinghouse Electric & Mfg. Co.  
Weston Elec. Instrument Co.
- Meter Testers.**  
States Co.
- Mica—Insulating Material.**  
Chicago Mica Co.
- Mining Machinery.**  
Allis-Chalmers Mfg. Co.  
General Elect. Co.
- Molding—Metal.**  
National Metal Molding Co.
- Motors—(See Generators and Motors)**
- Oils—(See Lubricants).**
- Oils—Illuminating.**  
Galena Signal Oil Co.
- Oil Starters.**  
Conduit Elec. Mfg. Co.
- Ozonizers.**  
General Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Paints—Graphite.**  
Detroit Graphite Co.
- Paints—Insulating.**  
Standard Underground Cable Co.
- Panelboards.**  
Adam Electric Co., Frank  
General Electric Co.  
Trumbull-Vanderpoel Electric Mfg. Co.  
Western Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Patent Attorneys.**  
Howe, Thomas
- Perforated Metals.**  
Erdle Perforating Co.
- Photometer Standards.**  
Electrical Testing Laboratories.
- Pins—Iron.**  
Southern Exchange Co., The
- Platinum.**  
American Platinum Works.  
Baker & Co.
- Plugs—Flush and Receptacles.**  
National Metal Molding Co.
- Pole Line Material.**  
Barnes & Kobert Mfg. Co.
- Poles—Ornamental Street.**  
Brady Elec. & Mfg. Co.  
Meyer Mfg. Co., Fred J.
- Poles—Brackets—Pins, Etc.**  
Brady Elec. & Mfg. Co.  
Brookfield Glass Co.  
Reeves Co., The  
Southern Exchange Co., The  
Thomas & Co., R.  
Western Elec. Co.
- Porcelain.**  
R. Thomas & Sons Co.
- Pot-Heads.**  
Brady Elec. & Mfg. Co.  
Electrical Engineers' Equip Co.  
Okonite Co., The  
Standard Underground Cable Co.
- Producers—Gas.**  
Westinghouse Machine Co.
- Public Service Reports.**  
Law Publishing Co.
- Pumps.**  
Allis-Chalmers Mfg. Co.
- Rail Bonds.**  
American Steel & Wire Co.  
General Electric Co.  
Roebbling's Sons Co., J. A.
- Receptacles—(See Sockets).**
- Recording Instruments.**  
Bristol Co.  
Uehling Instrument Co.
- Rectifiers.**  
General Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Reels.**  
Minn. Elec. & Cons. Co.
- Reflectors.**  
Erdle Perforating Co.  
General Electric Co.  
Pittsburg Reflector & Illum. Co.  
Westinghouse Elec. & Mfg. Co.
- Resistance Rods.**  
Dixon Crucible Co., Joseph
- Resistance Units.**  
General Electric Co.  
Ward Leonard Electric Co.
- Resistance Wire—(See Wires).**
- Rheostats.**  
Erdle Perforating Co.  
General Electric Co.  
Simplex Electric Heating Co.  
Ward Leonard Electric Co.  
Westinghouse Elec. & Mfg. Co.
- Rosettes.**  
National Metal Molding Co.
- Schools.**  
Branch School of Engineering
- Screens and Sieves—Perforated.**  
Erdle Perforating Co.
- Segment Cement.**  
Acme Compound & Mfg. Co.
- Searchlights.**  
General Electric Co.
- Sewing Machine Motors.**  
Westinghouse Elec. & Mfg. Co.
- Shade Holders.**  
A.-A. Electric Co.
- Shafts—Flexible.**  
Stow Mfg. Co.
- Sockets and Receptacles.**  
General Electric Co.  
Johns-Manville Co., H. W.  
National Metal Molding Co.
- Sockets—Turndown.**  
General Electric Co.
- Soldering Irons.**  
Westinghouse Elec. & Mfg. Co.
- Soldering Material.**  
Alex R. Benson Co.
- Solenoids.**  
General Electric Co.
- Stage Lighting Apparatus.**  
General Electric Co.  
Ward Leonard Electric Co.

## THE HOOVER SUCTION SWEEPER

**One dealer sold 24 Hoovers  
in a single day**



This record was made during a special selling drive on Hoovers during the month of March. The 1915 business of this same dealer was over \$30,000. Would the same selling effort back of any other cleaner accomplish the same result? No! Because The Hoover *does* what other machines *claim* to do. It has been proved 98.5% efficient. It cleans *thoroughly* because it's the only electric carpet sweeper and vacuum cleaner combined.

**ASK HOW**

the selling records mentioned above, were made on The Hoover—ask also for full information on our proposition to dealers.

**The Hoover Suction  
Sweeper Co.**  
E. Maple Ave.  
New Berlin,  
Ohio



## Catalogs That Sell Goods

☛ When the ECLIPSE LIGHT COMPANY contemplated printing its latest catalogs, we considered the fact that a great many electrical dealers do not carry stock.

☛ And so in issuing our No. 42 and No. 43 we brought out catalogs containing cuts that are more than mere illustrations of the merchandise—They are photographic reproductions of Lighting Fixtures, Fixture Parts, and Lamps that have a real selling value, arranged and indexed to appeal to your customers as well as to you.

☛ A request on your business letterhead brings you either the "Leader in Light," our complete catalog of fixtures, appliances and supplies or "Lighting Fixtures of Quality" just fixtures and lamps shown at their very best. Which do you prefer?

**ECLIPSE LIGHT COMPANY**  
New Address  
583-85-87 Broadway New York, N. Y.

## BUYERS CLASSIFIED INDEX (Con'd)

**Staples—Insulating**  
American Steel & Wire Co.

**Starters and Controllers—Motor.**  
General Electric Co.  
Ward Leonard Electric Co.  
Westinghouse Elec. & Mfg. Co.

**Steel Armored Wire.**  
Okonite Co., The  
Standard Underground Cable Co.

**Stocks and Bonds.**  
Electric Bond & Share Co.

**Stoves—Electric—(See Heating Apparatus—Electrical).**

**Strainers—Perforated.**  
Erdle Perforating Co.

**Substations—Outdoor.**  
General Electric Co.

**Supplies—Electrical.**  
Clark, Jas. Jr., Elec. Co., Inc.  
Delta-Star Elec. Co.  
General Electric Co.  
National Elect. Supply Co.  
National Metal Molding Co.  
Western Elec. Co.  
Westinghouse Elec. & Mfg. Co.  
Weston Elec. Instrument Co.

**Supplies—Telephone.**  
Johns-Manville Co., H. W.  
Southern Electric Co.  
Western Elec. Co.

**Surfacing—Steel and Tin.**  
Erdle Perforating Co.

**Switchboard Supplies.**  
General Electric Co.

**Switchboards—Light and Power.**

Frank Adam Electric Co.  
Allis-Chalmers Mfg. Co.  
General Electric Co.  
Minerallac-Electric Co.  
Western Elec. Co.  
Westinghouse Elec. & Mfg. Co.

**Switchboards—Telephone—(See Telephone Equipment).**

**Switches—Automatic amp.**

**Switches—Flush and Snap.**  
National Metal Molding Co.  
Newark Electric Supply Co.  
Southern Electric Co.  
Westinghouse Elec. & Mfg. Co.

**Switches—Fuse.**  
General Electric Co.

**Switches—Knife.**  
Adam Elec. Co., Frank.  
General Electric Co.  
Trumbull-Vanderpoel Electric Mfg. Co.  
Westinghouse Elec. & Mfg. Co.

**Switches—Oil.**  
General Electric Co.  
High Tension Elec. Spec. Co.  
Westinghouse Elec. & Mfg. Co.

**Switches—Pole Top.**  
Delta-Star Elec. Co.  
General Electric Co.

**Switches—Remote Control.**  
General Electric Co.

**Switches—Time.**  
Campbell Elec. Co.  
Reliance Automatic Lighting Co.

**Tape.**  
American Electrical Works.  
Mechanical Rubber Co.  
Newark Electric Supply Co.  
Okonite Co., The  
Standard Underground Cable Co.

**Telephones—Intercommunicating—(See Telephone Equipment).**

**Telephone Equipment.**  
Western Elec. Co.

**Terminals—Cable.**  
Dossert & Co.  
Standard Underground Cable Co.

**Test Clips.**  
Mueller, R. S. & Co.

**Testing Apparatus.**  
Bristol Co.  
Silberberg, M. J.  
Thompson Levering Co.

**Testing—Electrical.**  
Electrical Testing Laboratories.  
National Elec. Laboratories.

**Theater Dimmers.**  
General Electric Co.  
Ward Leonard Electric Co.

**Time Study Watch.**  
Silberberg, M. J.

**Tools—Linemen's.**  
Oshkosh Mfg. Co.  
Western Elec. Co.

**Transformers.**  
Allis-Chalmers Mfg. Co.  
Columbia Metal Box Co.  
Duncan Electric Mfg. Co.  
Enterprise Electric Co.  
General Electric Co.  
Kuhlman Electric Co.  
Moloney Electric Co.  
Western Elec. Co.  
Westinghouse Elec. & Mfg. Co.  
Weston Elec. Inst. Co.

**Transformers—Bell Ringing.**  
Southern Electric Co.  
Westinghouse Elec. & Mfg. Co.

**Turbines—Steam.**  
Allis-Chalmers Mfg. Co.  
General Electric Co.  
Lefel & Co., James.  
Western Elec. Co.  
Westinghouse Elec. & Mfg. Co.

**Vacuum Cleaners.**  
Hoover Suction Sweeper Co.  
Western Elec. Co.

**Ventilators.**  
Erdle Perforating Co.

**Washing Machines—Electric.**  
Western Elec. Co.

**Washers—Iron, Steel and Misc.**  
Chicago Mica Co.  
Erdle Perforating Co.

**Water Wheels and Turbines.**  
Allis-Chalmers Mfg. Co.  
Lefel & Co., James.

**Wattmeters—(See Instruments—Electrical).**

**Wires & Cables.**  
American Electrical Works  
American Platinum Works  
American Steel & Wire Co.  
Detroit Insulated Wire Co.  
General Electric Co.  
Hazard Mfg. Co.  
Indiana Rubber & Insulated Wire Co.  
Lowell Ins. Wire Co.  
Moore, Alfred F.  
Okonite Co., The  
Roebling's Sons Co., John A  
Phillips Insulated Wire Co  
Rome Wire Co.  
Southern Electric Co.  
Simplex Wire & Cable Co.  
Standard Underground Cable Co.  
Western Elec. Co.

# Weston

## Alternating Current Switchboard Instruments

possess to a marked degree those qualities of originality and excellence of mechanical and electrical design and construction that distinguish WESTON products from all others, and we claim for them a perfection with respect to accuracy, reliability, serviceability and durability that is unapproached.

These Instruments are the perfected product of many years of specialization. The modern art of commercial electrical measurement was created by the founder of this Company. Our immense plant is devoted exclusively to the manufacture of the world's highest grade Electrical Instruments of precision.

Write for Catalog 16

Complete groups of Weston Switchboard Instrument Transformers are described in Bulletin 1501.

**Weston Electrical Instrument Co.**

51 Weston Ave., Newark, N. J.

New York	Chicago
Boston	Detroit
Philadelphia	Denver
Buffalo	San Francisco
Richmond	Toronto
Pittsburgh	Montreal
Cincinnati	Winnipeg
Cleveland	Vancouver
St. Louis	



## The Name Guarantees Satisfaction

“WILLEY” Electric Drills have behind them 15 years of successful manufacture. Thorough experiment was the rule before placing new designs on the market. The result—every customer a satisfied one. When you buy an electric drill insist on one bearing the name

# “WILLEY”

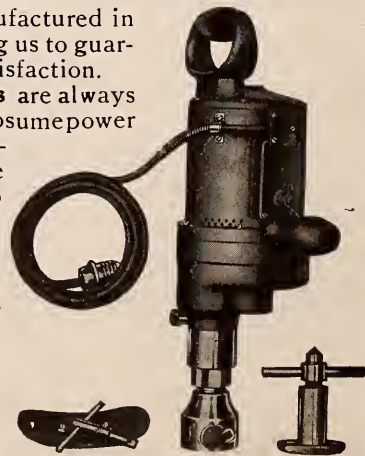
Every part is manufactured in our shops, enabling us to guarantee absolute satisfaction.

“WILLEY” Drills are always ready for use and consume power only when in operation. As there are no belts to slip they save time and trouble.

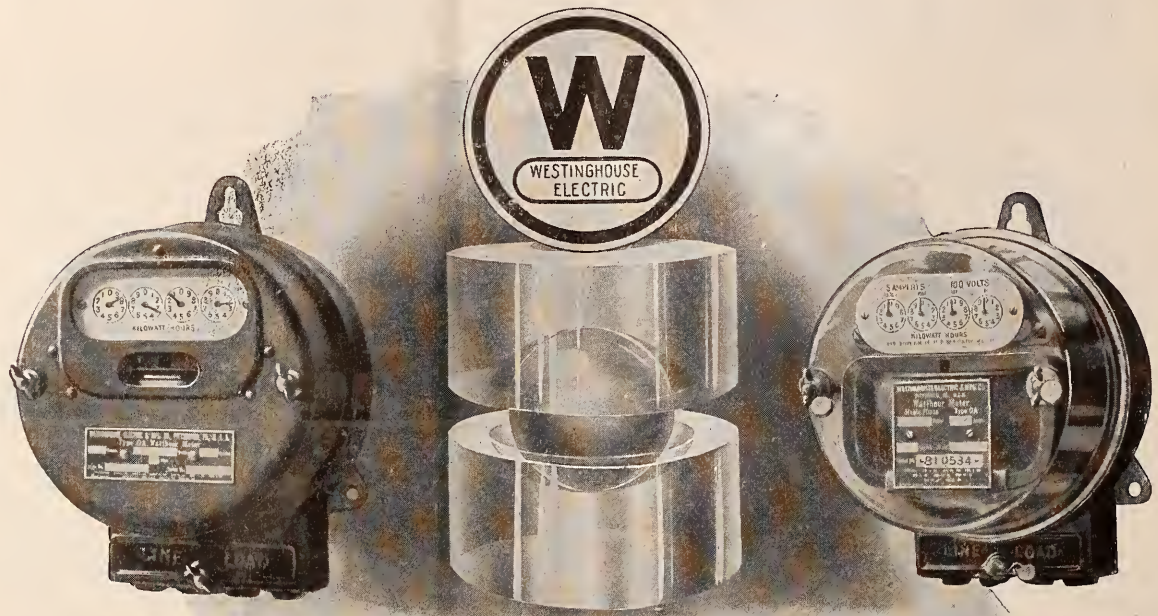
*If you want drill-satisfaction, get a “WILLEY.” We would like to send you our catalog*

**James Clark, Jr.,  
Electric Co., Inc.**

518 W. Main St.  
Louisville, Ky.







The reputation of Westinghouse Watt-hour Meters for unequalled sustained accuracy rests upon the ball bearing which supports the main shaft.

**Westinghouse Electric & Manufacturing Company**  
**East Pittsburgh, Pa.**

Atlanta, Ga.  
 Baltimore, Md.  
 Birmingham, Ala.  
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 Boston, Mass.  
 Buffalo, N. Y.  
 Butte, Mont.

Charleston, W. Va.  
 Charlotte, N. C.  
 Chicago, Ill.  
 Cincinnati, O.  
 Cleveland, O.  
 Columbus, O.  
 \*Dallas, Texas

Dayton, O.  
 Denver, Colo.  
 Detroit, Mich.  
 \*El Paso, Texas  
 \*Houston, Texas  
 Indianapolis, Ind.  
 Joplin, Mo.



Kansas City, Mo.  
 Louisville, Ky.  
 Los Angeles, Cal.  
 Memphis, Tenn.  
 Milwaukee, Wis.  
 Minneapolis, Minn.  
 New Orleans, La.

New York, N. Y.  
 Omaha, Neb.  
 Philadelphia, Pa.  
 Pittsburgh, Pa.  
 Portland, Ore.  
 Rochester, N. Y.  
 St. Louis, Mo.

Salt Lake City, Utah  
 San Francisco, Cal.  
 Seattle, Wash.  
 Syracuse, N. Y.  
 Toledo, O.  
 Washington, D.C.  
 \*W. E. & M. Co.,  
 of Texas





# TRANSFORMERS

*Manufactured for all electrical purposes  
in any size, frequency or voltage.*

**Lighting and Power Transformers  
High Transmission Transformers  
Single and 3-Phase Transformers**

*To secure prices give us K. W. capacity  
voltage, cycles, transformers required.*

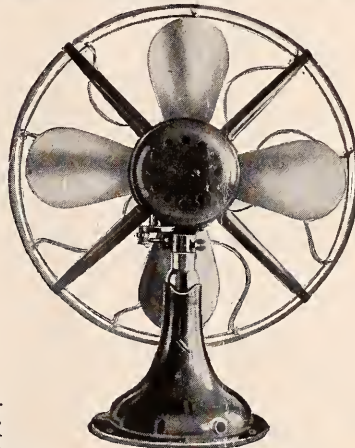
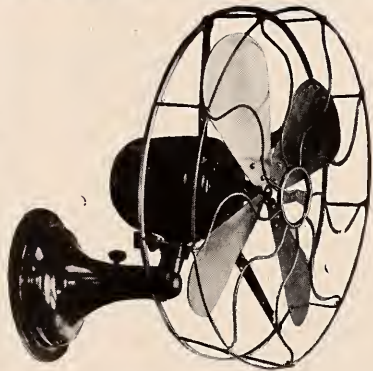
## MOLONEY ELECTRIC CO.

**St. Louis, Mo.**

**Windsor, Canada**

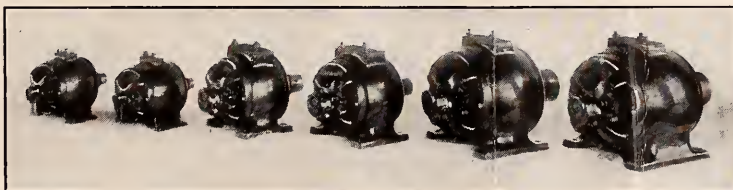
**District Offices: New York - Chicago - San Francisco.**

**Whenever placed on actual test the STAR FAN shines above the rest**



Star Fans are made of drawn steel and highest quality of electrical materials. These fans are made in two most efficient sizes, 12 and 16 inch direct current all voltages oscillating and stationary types. Note particularly the ball and socket joint which allows these fans to be used as either a desk or bracket fan by

merely turning the thumb screw. The mechanical features of these fans, make them absolutely fool proof. This applies particularly to the oscillating type.



The above motors range from 1-32 to 1 H. P. all voltages, direct current. They are the most compact and rugged small motors on the market.  
**ALL OUR PRODUCTS ARE GUARANTEED.**

**STAR FAN and MOTOR WORKS 245-247 N. J. R. Ave., Newark, N. J.**

**HIGHEST POSSIBLE AWARD  
FOR BRISTOL'S RECORDING INSTRUMENTS**

**At The Panama-Pacific Exposition**

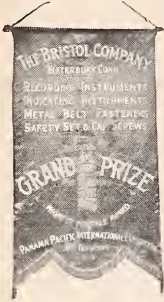
Bristol Recording Instruments were awarded the Grand Prize which is the highest possible award. The merits of Bristol Recorders, combined with the marked progress which has been made in their manufacture, is the reason for their superiority.

WRITE FOR BULLETIN 200-R

**THE BRISTOL COMPANY**

**Waterbury, Conn.**

Branch Offices: Boston New York Chicago Pittsburg San Francisco



**MULTI REFILLABLE FUSES**

will cut your fuse maintenance on motor circuits in two. They are doing so for others, why not for you? Accurate in rating, dependable under all conditions of service. Easily and quickly refilled.

Write for samples, catalogue and discounts.

Multi Refillable Fuse Co., 723 Fulton St., Chicago



**RUBBER COVERED WIRE  
ROME WIRE CO.**

ROME

NEW YORK



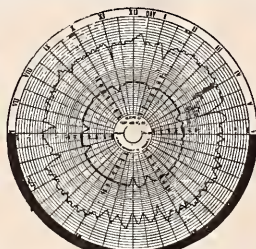
**UEHLING  
CO<sub>2</sub> RECORDERS**

To know the amount of fuel wasted up the chimney is the first step toward Higher Boiler Efficiency.

Write for particulars

**Uehling  
Instrument Co.**

2005 Empire Bldg.,  
New York City



Recorder of CO<sub>2</sub> and Stack Temperature On One Chart.

Uehling Combined CO<sub>2</sub> and Stack Temperature Recorder.

**Galvanite**

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